Equivalence in Scientific and Technical Translation
A Text-in-Context-based Study

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The central problem of translation practice is that of finding TL translation equivalents. A central task of translation theory is that of defining the nature and conditions of translation equivalence.

(Catford 1965:21)

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Declaration of already published sections

A brief overview of the methodology applied (sections 2.2.1 and 2.2.2) and summarizing overviews of section 3.2.1.1.1 and of the results for 4.3.2.1 to 4.3.2.6 have been given in Krein-Kühle 1999 and 2001. A summarizing overview of 5.2.1.1 has been published in Krein-Kühle 2002.

List of abbreviations and acronyms

AcI	Accusativus cum infinitivo
AE	American English
ASTM	American Society for Testing Materials
BE	British English
CAT	Computer-aided/assisted translation
CL	Contrastive linguistics
CTS	Corpus-based translation studies
DIN	Deutsches Institut für Normung (German institute for standardization)
DTP	Desktop publishing
DTS	Descriptive translation studies
i.a.	inter alia
LGP	Language for general purposes
LSP	Language for special purposes
MT	Machine translation
NcI	Nominativus cum infinitivo
R&D	Research and development
SL	Source language
ST	Source text
STT	Scientific and technical translation
TL	Target language
TT	Target text
UN-ECE	United Nations Economic Commission for Europe (standards development)

Abstract

Scientific and technical translation has always played a pivotal role in disseminating knowledge. Today, the domain of science and technology is the main area of translation work. Nevertheless, there is still a discrepancy between the growing need for high-quality technical translations and the short supply of competent technical translators to produce them, a situation which may be due in part to the recent neglect of the equivalence concept in the theoretical/descriptive and applied branches of translation studies (TS).

This thesis sets out to redefine, reassess, and reinstate equivalence as a useful concept in TS by adopting an approach based on the English-German language pair and on one specific text genre and type. The investigation of equivalence as a qualitative complete-text-in-context-based concept is embedded in an equivalence-relevant methodology based on two methodological pillars, the first being a theoretically sound translation comparison and the second a highly refined translation corpus. Within this methodological framework, equivalence-relevant features are investigated and described at the syntactic, lexical-semantic, terminological-phraseological and overall textual levels. These levels are hierarchically interrelated in descending and ascending order and may be conditioned by pragmatic aspects, viz., domain knowledge and register considerations. The comparison is made using a high-quality corpus selected on the basis of a threefold set of selection criteria, with a special emphasis on the qualitative criteria. This helps us generate well-underpinned intersubjectifiable regularities in the form of potential equivalents established in the TT for ST equivalence-relevant features and enables us to obtain meaningful generalizations.

Both regularities and generalizations should be capable of implementation in the applied branches of TS and, at the same time, help dynamize and intersubjectify the complex concept of equivalence. So, hopefully, this thesis will also contribute toward creating a link between the methodological, theoretical/descriptive and applied branches of TS to their mutual benefit.

Introduction

> Die Klärung der *Übersetzungsbeziehung* (*Äquivalenzrelation*), das heißt der für die Übersetzung *konstitutiven Beziehung* zum Ausgangstext ist nach meiner Auffassung von fundamentaler Bedeutung für die Übersetzungstheorie. Übersetzungspraxis heißt - um es auf diese (allzu) einfache Formel zu bringen - Herstellung von Äquivalenz; die Übersetzungstheorie hat die vorrangige Aufgabe, sich mit deren Voraussetzungen, Bedingungen, Faktoren, Möglichkeiten und Grenzen zu beschäftigen.
>
> (Koller [4]1992:9)

> Trotz der Übersetzerschwemme klagen Industrie und Übersetzerdienste über einen Mangel an qualifizierten Fachübersetzern. (Schmitt 1985:37)

> Das Stichwort für die zukünftige Übersetzungswissenschaft heißt Praxisbezug [...]
> (Wilss 1995:104)

The impetus for an examination of the concept of equivalence in scientific and technical translation (STT) is both theoretically and practically motivated, since these two aspects are closely interrelated. The theoretical aspect addresses the low status of equivalence as a concept in translation studies (TS) today (e.g., Baker 1993; Munday 2001), while the practical aspect involves the discrepancy between the growing need for high-quality technical translations and the short supply of competent technical translators to produce them (Schmitt 1985:37, Schmitt 1998a, BDÜ[1] Memorandum 1987[2]), a situation which may itself be due in part to the recent neglect of the equivalence concept in the theoretical/descriptive and applied branches of TS.

While some translation theorists have tried to (re)define the equivalence concept and do consider it an integral part of the discipline, even if they understand it in different ways (e.g., Jakobson [1959]1992; Nida 1964; Catford 1965; Kade 1968, 1973, 1977; Koller 1978, 1981, [4]1992, 1995, 2000; Newmark [1982]1988, 1988; Neubert 1970, 1984, 1985, 1988, 1994; Neubert and Shreve 1992; Pinchuck 1977; House 1977, 1997; Horn-Helf 1999; Sager 1993; Wilss 1977, 1982, 1996; Pym 1992, 1995; Toury 1980, 1995; Halverson 1997; Wotjak 1997), others question its universal usefulness

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[1]   *Bundesverband der Dolmetscher und Übersetzer* (*German National Association of Interpreters and Translators*, my translation).

[2]   According to Wilss (1998:149), the recommendations of the above Memorandum, which were designed to bring about an improvement in translator quality, were either rejected on financial grounds or simply ignored by the universities concerned and what are now called in Germany universities of applied sciences, i.e., former polytechnics (*Fachhochschulen*), with the exception of Germersheim.

(e.g., Hatim and Mason 1990; Nord [2]1991; Reiß and Vermeer [2]1991; Stolze 1994) or even reject it outright (e.g., Holz-Mänttäri 1984; Hönig and Kußmaul 1982; Kußmaul 1986; Ladmiral 1981; Vermeer 1984; Schmitt 1986; Snell-Hornby 1986, [1988]1995). Certainly, the concept of equivalence has been a fundamental though controversial issue ever since the early days of writing on translation, and its indeterminacy and ambiguity have led to very different interpretations and definitions which have tended to cloud the issue rather than clarify it. However, as Wilss (1996:16-17) rightly claims, the solution cannot be simply to dispense with the concept altogether, although this option has become very popular in Germany, in particular, in the wake of a preoccupation with culture-specific, 'translatorial action'-based (*Translatorisches Handeln*), functional and/or *skopos*-oriented approaches to translation,[3] in which the actual language transfer plays only a subordinate role or is, at most, an upstream activity in the overall translation process (Snell-Hornby et al. 1998 fairly accurately mirrors this trend) and 'equivalence' is either degraded to a special form of 'adequacy'[4] (Reiß and Vermeer [2]1991:139-140) or completely abandoned (Holz-Mänttäri 1984; Kußmaul 1986; Vermeer 1984). An even more rigorous attempt to dispense with the concept can be found in some recent corpus-based approaches to translated texts which claim that "the move away from source texts and equivalence is instrumental in preparing the ground for corpus work" (Baker 1993:237) (see 2.1).

In much the same vein, the above approaches have shifted the emphasis in STT away from translational issues to a preoccupation with 'culture-specific'[5] and terminographical aspects (Schmitt 1989), considerations of layout and typography (Schopp 1998) and electronic tools (Schmitt 1998b), creating the impression that successful STT may be merely a matter of being equipped with the latest technology,[6]

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[3] As for example represented by Holz-Mänttäri (1984), Nord ([2]1991), Reiß and Vermeer ([2]1991); see Schäffner (1998a) and Dizdar (1998) for overviews of *skopos* theory, and Schäffner (1998b) and Risku (1998) for overviews of the theory of 'translatorial action', see Witte (1998) for aspects of cultural specificity. For a very critical account of *skopos*, culture-specific and 'translatorial action'-based approaches to translation see Kelletat (1987).

[4] For different interpretations of 'adequacy' see Chapter 1, f.n. 10.

[5] The notion of 'cultural specificity' in STT (Schmitt 1986, 1989) is often used as a renamer for old problems, such as lexical and terminological issues, or to refer to aspects of localization or adaptation which are not strictly translational.

[6] This view is obviously also held by the European Commission which claims in its report on the European Translation Platform that "the typical translator of the future will be like a

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such as DTP, CAT, translation memory, voice type dictating machines, or having access to large term banks and electronic hypertexts in the Internet (Stolze 1996:2-3, 2002:72). While the practical usefulness of these tools and the importance of these aspects cannot be denied, the fact should not be ignored that they remain tools and that preoccupation with such aspects begs the central question of how to achieve equivalence which - it is argued here - is at the heart of successful STT and is still unfinished business. Instead of dealing with this unfinished business, the focus of STT has shifted to aspects of software localization (Gerhardt 1998) and technical writing (Schmitt 1998c, 1999; Göpferich 1998), in Germany, at least. Even if such topics, too, should be considered within the larger framework of TS, they do not belong to our central object of study and are not typical of the multi-faceted standard range of scientific and technical translation work. The central object of TS is the description and explanation of the specificity of its subject matter, viz., translation (for a definition see 1.4.1), and the existential legitimation of translation studies as a discipline in its own right lies precisely in the fact that - as Kade (1977:39) has pointed out - no other discipline explains the specificity inherent in this particular subject matter.

While the majority of translation scholars - even those who question the usefulness of the equivalence concept - nonetheless admit the relevance of the equivalence criterion in STT (e.g., Reiß and Vermeer [2]1991:137), only few writers (Jumpelt 1961; Pinchuck 1977; Sager 1993; Horn-Helf 1999) deal with the critical question of how to determine and define equivalence in this field. This may be due to the fallacious and widely held opinion that successful STT is mostly a matter of using the 'correct terminology' (as still reflected, e.g., in Wilss 1999a:81-98) and that equivalence in the sense of one-to-one correspondences at terminological level can be taken for granted. This view, rightly criticized by Schmitt (1986:252), may be one reason for the poor quality of so much STT (for examples see Schmitt 1999:15 ff.), an issue much discussed in Germany.

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synthesiser, manipulating various tools as appropriate to the job in hand. The training of translators, it is suggested, should move towards the tool-aided processing of volumes of text, and away from sentence-by-sentence hand-crafting [sic!]." (Europäische Kommission, Generaldirektion XIII 1996:163).

Thus, the general underestimation of the difficulties involved in STT, in tandem with culture-specific and functional/*skopos* orientations in approaches to translation, giving rise to an *ad infinitum* extension of the concept of translation which, as a result, "risks losing its practicability for the scientific study of texts" (Schreiber 1993:2, my translation), to a 'degradation' of the source text (ST) to a mere 'offer of information' (*Informationsangebot*) (Reiß and Vermeer [2]1991) and to overemphasis of the above extra-translational aspects - as reflected in the current training of scientific and technical translators at university and college levels (Snell-Hornby et al. 1998: 341 ff.; Schmitt 1987a; Kelletat 1996) - may be held responsible for the present low status of the equivalence concept, a fact which - in our view - directly correlates with the above poor translation quality. Today, the concept is obviously denied its theoretical and practical status even in its 'traditionally legitimate' field of application, i.e., scientific and technical translation, in Germany, at least.[7] However, the above aspects - in our view - are merely symptoms of a deeper fundamental misunderstanding that perceives equivalence as a 'narrow linguistic' concept that is concerned with sameness, identity or even symmetry (Snell-Hornby [1988]1995:22). Such a view may be rooted in the concept's first emergence in writings on translation, i.e., in the development of machine translation (MT)[8] (Zenner 1971:2-4) involving a mathematical and logical background. However, as early as 1978, van den Broeck (op. cit.:32-33) pointed out that the precise definition of equivalence in mathematics "forms the main obstacle to its use in translation theory", since "the properties of a strict equivalence relationship (symmetry, transitivity, reflexivity) do not apply to the translation relationship." And Pym (1995:164) has rightly pointed out in his criticism of Snell-Hornby, that concepts such as Nida's 'dynamic equivalence' "presuppose substantial linguistic *asymmetry*." In 1969, Wandruszka (op. cit.:528) concluded from his multi-lateral translation comparison that languages are characterised by and to be admired for their non-systematic availability (*asystematische Disponibilität*), a circumstance that may involve

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[7]   The very few instances of the terms *Äquivalenz* or *äquivalent* in Schmitt (1999) betray
       the basic misunderstanding as regards equivalence and correspondence (op. cit.:344) (see
       our discussion in 1.4.2) and confine the use of these notions to the terminological context.
       Schmitt's book is more about technical writing than about translation and at one point
       (op.cit.:33) he even equates specialized (i.e., technical translation) with "interlingual
       Technical Writing".

[8]   For introductions to MT see Hutchins and Somers (1992) and Arnold et al. (1994).

considerable asymmetries in translation at various textual levels, as the present research will show (see Chapters 3 to 6).

A look at the etymology of the term alone (1.4.2) would have pointed the way to a potentially more useful understanding of the concept in the translation context. Moreover, early German research into equivalence, which is often criticized for having adopted such a narrowly defined notion of equivalence (as mentioned, e.g., in Halverson 1997:211), would not have yielded its meaningful insights (see, e.g., the contributions in Spitzbardt 1972, Wilss 1977, 1982, and the contributions of the 'Leipzig school', e.g., Kade, for one, or the work by House) if it had set its sights on something such as identity or symmetry. Also, a view that dismisses the concept on the grounds of its having an allegedly 'narrowly linguistic' slant and disregarding the contextual-situational dimension points to a misunderstanding that arises when correspondence as a concept of *langue* is equated with equivalence as a concept of *parole* (Koller 1978) as regards actually occurring source text-target text (ST-TT) pairs in context (1.4.2). Neubert (1994:414) has aptly summarized the problem:

> The narrow and hence mistaken interpretation of translational equivalence in terms of linguistic correspondence is in our opinion one of the main reasons that the very concept of equivalence has fallen into disrepute among many translation scholars. But, I think, it is a typical case of throwing the baby out with the bath water. Equivalence can never rest entirely on linguistic pillars.

In this context it should be pointed out that linguistics is at the heart of TS (cf. also Malmkjær 1998a:535) and that translation scholars have benefited much from linguistic theories and insights, such as those of contrastive linguistics (Kühlwein and Wilss 1981), functionalist linguistics (e.g., Firth [4]1974, Halliday et al. 1964, Halliday 1978), e.g., in the area of register analysis, and text linguistics (de Beaugrande and Dressler 1981), e.g., aspects of cohesion and coherence as translation-relevant standards of textuality (see, e.g., the work by Hatim and Mason 1990, 1997).

Is it possible that this fundamental misconception has been more a problem for translation scholars and teachers than for competent professional translators who have always set their sights on equivalence in translation, perhaps without naming it as such, but speaking rather of high-quality translation achievable only on the basis of extra-linguistic context-*cum*-language knowledge?

It is almost a truism that a meaningful notion of equivalence must involve an extra-linguistic dimension, and this wider framework has in fact been employed already by those scholars who work successfully with the concept (such as House 1997). Also, as Pym (1995) reminds us, equivalence has scored well in counteracting "theories of untranslatability", has contributed to the "institutional legitimation" of TS, and has helped distinguish translation from non-translation. The latter is an important aspect at a time when the boundaries of translation are being stretched beyond a meaningful use of the concept. However, it does involve a problem of definitional circularity, which we try to overcome by moving away from equating translation with equivalence, a step which we deem necessary if our investigation is to yield meaningful insights.

With the ultimate aim of reinstating equivalence as a useful concept in the theoretical/descriptive and applied branches of TS, this doctoral thesis sets out to redefine, reassess and investigate the concept of equivalence in STT by adopting an approach based on one language pair (English and German) and on one specific text genre, i.e., the research report, and type, i.e., what Reiß (1971:31-37) calls the 'content-centred' and later 'informative' text type (Reiß and Vermeer [2]1991:206 ff.). The object is to demonstrate that equivalence - when understood as defined in this thesis - can be a valuable theoretical concept which helps us achieve the much-sought-after improvement in the quality of scientific and technical translation on the basis of the regularities or patterns in translation solutions which are established in this research (Chapters 3 to 6) and can be used as input in the applied branches of the discipline. At the same time, the theory itself (2.2.1) in whose terms our research is performed will be tested out (Toury 1995:1), and it is hoped that this test will contribute to the much-needed clarification, dynamization[9] and objectivization of the complex concept of equivalence.

A detailed examination and description of the concept of equivalence that goes beyond the investigations carried out so far - which were more or less confined

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[9]   Wilss (1996:16-17) points to the need to dynamize ("dynamisieren") the equivalence
      concept, i.e., to make it operational for specific situations and texts. In this thesis, the
      dynamization of the equivalence concept involves not only making it operational for a
      specific text genre and type and mode of translation, but also treating it as both a
      prospective and a retrospective concept, an aspect which is discussed in greater detail in
      1.4.2.

to the grammatical, word or, at most, sentence levels within the realm of applied linguistics (Jumpelt 1961; Pinchuck 1977) - is the main object of this thesis. Such an examination is an indispensable prerequisite for achieving equivalence at the text-in-context level and for doing justice to this highly complex concept. Hence, this thesis investigates and describes equivalence-relevant features that have different degrees of structural-semantic complexity at the syntactic (Chapter 3), lexical-semantic (Chapter 4), terminological-phraseological (Chapter 5) and overall textual levels (Chapter 6), and establishes their potential equivalents in the TT. Since all of these levels are hierarchically interrelated and may be conditioned and modified by pragmatic considerations, i.e., the highly important aspects of knowledge of domain(s), register and genre, it is necessary to examine the underlying pragmatics as well. Consideration of all levels is crucial for achieving equivalence at the text-in-context level, which is not merely the sum of these levels but the cohesive and coherent final result of all the relations operating between them.

Although it is generally accepted today that a text-based notion of equivalence is the most promising basis (Hatim 2001; Koller 1995; Neubert 1988; Neubert and Shreve 1992) for obtaining meaningful equivalence-relevant insights, we ourselves consider it to be necessary to stress the text-in-context-based approach employed here. The text as "an integral part of the context" - or as is often the case in STT - of several contexts (intersecting domains) - "is observed in relation to the other parts regarded as relevant in the statement of the context" (Firth [4]1974:7). Context as used in this thesis is defined as the extra-textual surrounding in which the text is embedded and which has a decisive influence on the language used (cf. Hatim and Mason 1990, 1997). In STT, in particular, the context refers predominantly to the domain(s) underlying the text and reflected in it. Contextual knowledge, therefore, involves knowledge of the domain(s) in question, but also includes the wider aspect of encyclopaedic/'real word' knowledge and knowledge of appropriate registers (see 2.2.1). Our notion of context of situation refers to situational aspects, such as receptor-related aspects, which involve knowledge of the communicative effect of the translations on the receptors, and which are to be considered in the selection of our object of study (2.2.2.1 ff.). The co-text is defined here as the immediate and overall textual surrounding of a linguistic feature (cf. Hatim and Mason 1990).

Since - as Kade (1973:161) rightly claims - an exact account of interlingual equivalence relations between STs and TTs for practical applications remains one of the predominant tasks in translation theory, it is hoped that the findings of this thesis, from a theoretical point of view, will contribute toward dynamizing and objectifying the equivalence concept and, from an applied point of view, will be useful in professional translation work, translation teaching and criticism and, in this way, help close the unfortunate gaps in the quality of STT. Hence, this thesis also aims at providing a link between the theoretical/descriptive and applied branches of translation studies (cf. Holmes's basic 'map' of the discipline as illustrated in Toury 1995:10) which must be complementary, since each can benefit from the results of the other. Such a link, in turn, may contribute toward defusing the unproductive confrontational tension (see the harsh criticism of German TS by Berglund 1990) between the two, in order to achieve a more productive dialectic tension.[10]

This thesis is organized in 7 chapters. Chapter 1 gives a brief overview of scientific and technical translation from both a diachronic and a synchronic standpoint and reviews the concept of equivalence as it is perceived in STT and in more recent approaches within TS in general. The concepts of translation and equivalence are then redefined for the purpose of our investigation with a definition of the equivalence-relevant features that are to be analysed. Chapter 1 ends with a description of the research report genre, which is examined here as a translation/equivalence-relevant text genre. Chapter 2 looks at the methodological issue in TS and gives an overview of existing approaches, in particular, descriptive and corpus-based approaches to translation, and propounds our own equivalence-relevant methodology, which is based on a theoretically well-founded translation comparison and a highly refined translation corpus. As regards the first point, both theoretical and comparative aspects involving the establishment of comparative parameters are discussed in greater detail; as regards the second point, an extensive threefold set of criteria for the selection of our corpus is presented. The following

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[10] See, e.g., Lambert and van Gorp (1985:42) who claim that "the links between the different branches of translation studies still have to be established more firmly." Cf. also Hewson and Martin (1991:6) who rightly claim that "theory and practice are the two complementary aspects of the same reality." And Ladmiral (²1994:189-190) describes the theory of translation as "praxéologie (*Handlungswissenschaft*)".

Chapters (3 to 6) investigate equivalence on a text-in-context basis. Chapter 3 describes how equivalence relations operate at the syntactic level by categorizing and analyzing the non-finite verb forms and by establishing trends in their TT counterparts. Chapter 4 describes equivalence relations at the lexical-semantic level by categorizing and analyzing equivalence-relevant lexical-semantic features, viz., *have* and *be* used as main verbs, modal auxiliaries and instances of 'secondary subjectification', and by establishing trends in translation solutions for these features in the TT. Chapter 5 looks at how equivalence operates at the terminological-phraseological level by analyzing compounding as an equivalence-relevant feature at this particular level. The emphasis here is on a categorization and analysis of 2-element compounds in their various structural-semantic patterns and their potential equivalents in the TT. Chapter 6 investigates equivalence at the overall textual level on the basis of one aspect of cohesion and coherence - as translation-relevant standards of textuality - viz., demonstrative reference, and discusses the potential equivalents established. This chapter is less comprehensive than the other 'analytic' chapters. This is not because the topic is deemed less relevant from an equivalence point of view - on the contrary, equivalence-relevant aspects of cohesion and coherence would themselves deserve a thesis in their own right - but because we feel that, in view of the lack of text-in-context based translational research into scientific and technical discourse, it would be sensible - in a first step - to concentrate on the basic levels of syntax, semantics, and terminology-phraseology, to lay a foundation for further research. Although much research is being carried out in the terminological field itself as the allegedly key issue of STT, the findings - though certainly useful - often cannot be applied to the translational context, since such research cannot account for the conditions under which terms and phrases occur and behave in ST-TT pairs, i.e., actual texts-in-contexts as *parole* events. Hence, our own investigation looks at terminology from a translational point of view, an approach which may yield findings of a different quality. Chapter 7, the conclusion of this thesis, summarizes the main findings of this research and highlights their relevance for both the theoretical/descriptive and the applied branches of TS. It contains some suggestions for further research in the equivalence context and underlines the strong 'corrective' and language developing force of translation work.

1 The concept of equivalence in scientific and technical translation

In this chapter, scientific and technical translation (STT) will be briefly reviewed from a diachronic and a synchronic point of view (1.1). This will be followed by an overview of the concept of equivalence as it is perceived in STT (1.2) and in more recent approaches to translation studies (TS) in general (1.3) before our own attempt to define the concept (1.4 ff.) is discussed.

1.1 A brief overview of scientific and technical translation (STT) from both a diachronic and a synchronic point of view

> Technical and scientific translation, more than any other mode of translation perhaps, is an instrument of cross-fertilization, transformation and progress. Without translation, the modern phenomenon of "technology transfer" would not exist.
>
> (Salama-Carr et al. 1995:101)

As research into the history of translation has shown (Salama-Carr 1990, Salama-Carr et al. 1995:101-127; Montgomery 2000; see also the various traditions in Baker 1998), scientific and technical translation has always played an instrumental role in imparting knowledge down the ages, and - ever since the invention of writing - has been "the great multiplier" (Montgomery 2000:293-294) and "the great pollinator" (Fischbach 1992) of science and technology.[1] In some major cultures (e.g., China, Japan), in fact, modern science is closely linked to translation or, indeed, started as translation (Montgomery 2000:272). The transfer of scientific and technical knowledge across linguistic-cultural borders had considerable linguistic and epistemological consequences, such as

> the creation of new vocabularies; the deletion and addition of epistemological matter; alterations in logic and organization; major shifts in the rhetoric of persuasion; even such deep-seated philosophical differences as the declaration of "facts" vs. the suggestion of factual possibilities. (Montgomery 2000:269)

Science and technology find their expression in language. This does not mean that there is one monolithic scientific and technical language, but rather a plethora of special languages and sub-languages manifesting themselves through various discourse genres and types, and these special languages reflect various technical

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[1] For a discussion of the relation between science and translation from a philosophical point of view see Sarukkai (2002).

domains/sub-domains which may be intersecting and overlapping. Despite its diversity, scientific and technical discourse in general exhibits certain common features or universals such as "das Streben nach Klarheit, Effizienz, Formalisierung, Standardisierung, Widerspruchsfreiheit, Vollständigkeit, Objektivität, Unpersönlichkeit, expressiver und emotionaler Neutralität und Ausschaltung von Redundanz" (Beier 1980:84), although these parameters may vary with specific text genres and types. Certainly, scientific and technical languages are not always 'clear', 'standardized', 'objective', 'non-redundant' or 'unequivocal' (e.g., English multiple compound nouns, see Chapter 5). From the point of view of translation, it can be said that the higher the degrees of specialization and abstraction, the lesser the clarity for the translator. The main point is, however, that each language realizes specific common features or universals in a different way and that in order to overcome these differences in translation - as Rülker (1972) rightly points out - the translator has to know the equivalence relations operating at both the grammatical-semantic and the pragmatic levels:

> [Es gibt] eine Vielzahl von Unterschieden zwischen der Art und Weise, wie ein Fachtext in zwei verschiedenen Sprachen abgefaßt, wie eine bestimmte Intention des Autors in zwei verschiedenen Sprachen realisiert wird. Wenn sich die Übersetzung wie ein Original lesen soll, müssen auch diese Unterschiede vom Übersetzer überwunden werden. Dazu muß dieser neben den Äquivalenzbeziehungen auf der grammatisch-semantischen Ebene auch die auf der pragmatischen Ebene kennen.
>
> (Rülker 1972:56)

The above aspects, together with the fact that scientific and technical language cannot be perceived as one "universal *lingua scientia*" (Montgomery 2000:271) due to the highly diverse content of scientific and technical work, should in themselves be a sufficient argument to defy any attempt to relegate STT to an inferior rank relative to other modes of translation.[2] In their long history, scientific and technical translators have not been 'just' translators, but often scientists as well. Sound linguistic-translational knowledge, together with sound domain knowledge, has always been of prime importance to felicitous scientific and technical translation. Also, translators have acted as "popularizers" and teachers by explaining the specialist works they translated to a non-specialist readership (Salama-Carr et al.

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[2]   As Wilss (1999a:79) mentions: "Literary translators tend to regard themselves as an elite (as do conference interpreters) and to dismiss specialist translators as a professional underclass."

1995:103), which shows that the boundaries between translations and adaptations have always been as fluid as they are today.

Since the end of World War II, LSP translation has spread considerably in the German-speaking countries (Wilss 1998, 1999a:83, 1999b), and Wilss (1996:viii) estimates that specialist or LSP translation (*Fachtextübersetzungen*) accounts for ca. 90% of the total volume of translation. Today, the domain of science and technology itself accounts for the lion's share of total translation work. According to Schmitt (1998a:9), 76% of the translators/interpreters in Germany work in technical fields, although only 43% had specialized in scientific and technical translation during their university education.[3] This situation is certainly similar to that in other countries and merits greater consideration in curriculum planning. The main working language in Germany is English (Schmitt 1990, 1998a), which as *lingua franca* has outdistanced German in the course of the last 80 years and especially after 1945, particularly in the domain of the sciences (Hoberg 1995:3). Today, English is the dominant language of science (see the various contributions in Ammon 2001) and its predominant status is reflected in the volume of publications in the scientific and technical arena. In 1996 - according to Ammon (1998:152) - English accounted for 90.7% of the publications in the hard sciences[4], whereas Russian accounted for 2.1%, Japanese for 1.7%, French for 1.3% and German for a mere 1.2%. Although these figures may suggest that there is a very great demand for translations from English, the situation on the German translation market shows that translations from German into English and from English into German almost hold the balance in quantity terms with a slightly stronger demand for translations from German into English (Schmitt 1998a:8). As regards the English-German translation direction, many Germans working in the domain of science and technology have a reasonable command of English and therefore 'may not need' translations, a circumstance which may lead to an impoverishment of German scientific and technical register (Trabant 2000, see Chapter 7), especially in the English-language oriented cutting-edge research domain.

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[3]   Schmitt's figures are based mainly on two surveys conducted in Germany (the former West German federal states) between 1989 and 1992 (Schmitt 1998:5). Though his figures are somewhat dated, we may still safely assume that any changes will have led to an increase rather than a decrease in the above 76%.

[4]   These include the fields of biology, chemistry, physics, medicine and mathematics (Ammon 1998:137-162).

This situation is made even more critical by the fact that German scientists today are more or less forced to publish in English if they want to make their contributions known in the international scientific community (Ammon 1998). Such publications by non-native English speakers are, however, not without problems from a qualitative point of view (Ammon 2001:354).[5]

The rise in the general demand for English, in particular, but also other language translations due to the "Anglophone globalization of markets" (Stoll 2000:53)[6] and the situation in Germany described above - which may be similar to that in other countries - are not only a challenge to translation studies in both its theoretical/descriptive and applied branches, but also point to the enormous potential of translation both as a 'corrective' force (see, e.g., 4.3) and language/register-developing force (see Chapter 7).

Scientific and technical translation (STT) plays a pivotal role in imparting knowledge internationally and at all levels, i.e., all the way from research and development to industrial application. The growth in the exchange of information and in the transfer of knowledge due to the internationalization of science and technology, the globalization and diversification of business and commerce, and the greater sophistication of industrial products has also led to a growth in translation needs. Hence, translation has come to be viewed against this industrial background, and a broader definition of translation has been provided to include, for instance, the production of autonomous documents from SL drafts, excerpts, abstracts, or 'gist' translations (Sager 1993). Though these 'special cases of translation' ("Sonderfälle der Translation", Wotjak 1997:141), which also include software localization (for an overview see, e.g., Gerhardt 1998), should certainly be given due consideration within the larger framework of translation studies (TS), any investigation of equivalence requires a refocussing on TS's central object of study, viz., translation *per se*, which has to be demarcated from all other forms of text (re)production

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[5] Ammon (2001:354) has pointed out that texts in English published by Germans in the field of sociolinguistics have been criticized for their linguistic (grammatical and stylistic) defectiveness. This observation is certainly not restricted to the sociolinguistic field.

[6] According to Crystal (1997:12), "there has never been such a strain placed on the conventional resources of translating and interpreting." Schmitt (1998:5) mentions that the annual demand for translation amounts to 30 million standard pages per year in Germany (West). In 1987 *Logos Computer Integrated Translation GmbH* mentioned a volume of 200 million pages world wide with a rate of increase of 15% p.a. (Schmitt 1998:5).

(1.4.1). This is because the brief of scientific and technical translation still has a focus on the production of functionally equivalent high-quality TL texts and is geared to disseminating information and enabling communication to take place between specialists from different linguistic-cultural communities in order to advance scientific and technological progress. In an industrial environment with increasingly stringent customer/supplier quality audits, "high quality documentation implicitly communicates an overall, company-wide commitment to high quality products, user-friendly operation and responsive customer support" (Wright 1993:70; cf. also Schmitt 1999:15). In this context, however, there is a striking discrepancy between the growing demand for STT, on the one hand, and the short supply of qualified and competent translators, on the other, which is reflected in the poor quality of so many translations (cf., e.g., Schmitt 1985). This is the moment when the concept of equivalence comes into play, since equivalence - when understood as defined here - is a valuable theoretical text-in-context-based concept (1.4.2) that is able to help achieve the much-sought-after improvement in the quality of STT and also serve as a basis for translator training in the field (Krein-Kühle 1995a:104-110).

This brief diachronic and synchronic overview makes us realize that what we now call LSP translation has always played an instrumental role in the dissemination of knowledge down the ages, so that it would deserve to be the object of more intensive research. Such research, however, must crucially hinge on three fundamental questions: first, how is the object of our inquiry, viz., translation, defined (Woodsworth 1998:101; Koller 2000:17[7]), second, how can we make sure that the data under analysis is qualitatively acceptable and, third, what methods and theoretical models can best be applied in the investigation. Finding answers to these questions is all the more important in an equivalence-related investigation, since equivalence is indivisibly connected to translation quality (House 1997:31) and its investigation presupposes a definition of the concept of translation. Before the concept of translation is discussed in greater detail (1.4.1), an overview of the concept of equivalence in STT (1.2) and a cursory overview of more recent

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[7]   According to Koller (2000:17) diachronic research into translation will have to work with a
        wider concept of translation that goes beyond the criterion of equivalence, in order to
        include the various adaptation types which are all the more interesting to the translation
        historian, the more clearly they differ from their originals. (Koller 1995, 2000 referring to
        Stackelberg 1984).

approaches to the concept in TS in general (1.3) will be given in the following sections.

1.2   The concept of equivalence in STT as it is perceived in the literature

While the majority of translation scholars admit the relevance of the equivalence criterion in STT (see, e.g., Jumpelt 1961; Pinchuck 1977; Reiß and Vermeer [2]1991:137; Koller 1981:276; Fluck [2]1997:259 ff.), only few writers deal with the critical question of how to determine and define equivalence in this field. This may be due to the fallacious opinion that successful STT is mostly a matter of 'correct terminology' and that equivalence in the sense of one-to-one correspondences at the terminological level can be taken for granted. As Schmitt (1986:252) critically points out:

> Ein gewisses Maß an Äquivalenzproblemen gesteht man allenfalls den
> Fachübersetzungen auf den Gebieten Recht, Wirtschaft und Sozialwissenschaft zu [...]
> Die überwältigende Mehrheit der Sprachwissenschaftler, literarischen Übersetzer und
> nicht-technischen Fachübersetzer scheint sich indessen einig darin zu sein, daß man,
> wenn überhaupt irgendwo, dann in der Technik von Äquivalenz im Sinne einer 1:1-
> Entsprechung zwischen den Begriffen verschiedener Sprachen ausgehen könne [...]

This view rightly criticized by Schmitt may contribute to an underestimation of the complexity of STT which, in turn, may be one of the main reasons for the poor quality of so many translations. Unfortunately, this view - despite the findings of very early research into STT (Jumpelt 1961; Spitzbardt 1972) and more recent accounts of STT (Montgomery 2000) - seems to persist, as is shown in current works on translation. Wilss (1999a:81-98), for example, still tends to reduce 'specialist translation' to terminology involving the relatively straightforward establishment of even "one-to-one equivalents" (op. cit.:94) and describes special language as using "conventionalized, more or less pre-structured lexical resources" and involving a "restricted mode of expression" (op. cit.:81). Such remarks can only be regarded as very general statements, and more specific descriptions may be necessary when dealing with particular text genres/types and domains. Although Wilss (1999a:83) is basically right in claiming that "the relative consistency and regularity of special-language repertoires means that it is possible to objectify and generalize translation procedures", the adjective 'relative' is of importance here, since the consistency and regularity of specific linguistic features may vary with specific text genres/types and domain(s)-related contexts owing to the wide diversity and high complexity of

scientific and technical discourse. In order to objectify and dynamize (Wilss 1996:16-17) the concept of equivalence and establish patterns in translation solutions, one specific text genre, type and domain has been selected (2.2.2.1 ff.) to furnish more specific results as regards regularities and generalization. Since the equivalence-relevant features established here (see 1.4.2 and Chapters 3 to 6) may also occur in other scientific and technical discourse genres and types, the present research may furnish insights that go beyond the ST-TT pair examined here (see 2.2.1, f.n. 50 and 3.2.4).

Among those scholars who take a more detailed look at the concept are Jumpelt (1961), Pinchuck (1977), Sager (1993) (cf. also Krein-Kühle 1995a:39-48) and more recently Horn-Helf (1999). Their concepts of equivalence will be briefly presented and discussed in the following:

1.2.1 Jumpelt: *Gleichwertigkeit*

> Nach den moderneren Auffassungen werden Übersetzungen nicht nach der textlichen Übereinstimmung, sondern nach der G l e i c h w e r t i g k e i t (*Äquivalenz*) der Aussagegehalte gewertet. Vollständige Gleichwertigkeit [...] bedeutet bei FEDOROV [...] äußerste Genauigkeit in der Wiedergabe des semantischen Gehaltes der Vorlage und vollständige gleichwertige Übereinstimmung (mit dem Originaltext) *in funktioneller und stilistischer Hinsicht.* Bekanntlich sind selten alle Forderungen gleichzeitig erfüllbar.
>
> (Jumpelt 1961:45)

Jumpelt (1961), who introduced the term *Gleichwertigkeit* in the German literature on translation, distinguishes between *Entsprechung* (*correspondence*) and *Gleichwertigkeit* (*equivalence*). For Jumpelt (1961:45), *Gleichwertigkeit* implies equal value in propositional content, whereas *Entsprechung* (*correspondence*) refers to the "state of congruence achieved between units of sense[8] in two languages and their semantic functions in similar contexts and situations and with similar communicative intentions" (my translation, f.n. added). Jumpelt assumes that there is a certain relationship between the *Sinneinheiten* (*units of sense*) of two languages and distinguishes between three types of correspondence, viz., one-to-one, one-to-many, and many-to-one correspondence (op. cit.:44).

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[8] The *Sinneinheit* (*unit of sense*) is defined as "the smallest segment of interconnected phonetic forms in the utterance which must not be translated separately" (op. cit.:53, my translation).

For Jumpelt (op. cit.:46), *Gleichwertigkeit* (*equivalence*) is merely a result-oriented auxiliary concept (*Hilfsbegriff*) which we use to examine elements to be considered equivalent in their dependence on situation, context, text typology and text use. In STT these are mainly content-related elements.

Still, in a given translation, correspondences are additionally governed by his equivalence conditions, which have to be fulfilled in order to achieve full correspondence between ST and TT units of sense (op. cit:46-49), viz.:

1. *Statistische Gleichwertigkeit* (*statistical equivalence*)

Frequency and relative frequency are important factors in achieving equivalence. Jumpelt (op. cit.:46-47) quotes the example of the English SL unit *aircraft*. Although the apparent German correspondence is *Luftfahrzeug*, the term is translated in most cases by *Flugzeug*, first, because *aircraft* in English is used both as the generic term and the subordinate term and, second, because German, in this instance, prefers the more concrete designation.

2. *Zeitliche Gleichwertigkeit* (*temporal equivalence*)

This equivalence type means checking correspondences for their temporal validity, such as "airship, aeroplane, aircraft" (op. cit.:47, f.n. 169). To achieve equivalence in a text on the history of telecommunications, for example, the translator may also need to have recourse to older terminology.

3. *Konventionelle Gleichwertigkeit* (*conventional equivalence*)

Unlike the international standardization of terminology, industrial concerns and international organizations produce their own 'correspondences' which are semantically and genetically often not 'equivalent'. For instance, although the German term *Kohlenartenmischung* (*blended coal*) is a DIN-registered term (DIN 22005), the term used in the German brown coal industry is *Mischkohlen* (Krein-Kühle 1995b). In this case, equivalence is merely based on habitual use, which nonetheless has to be respected, since it reflects the conventions of a limited language community.

4. *Institutionelle Gleichwertigkeit* (*Institutional equivalence*)

Terms and expressions designating legal entities, public and private institutions are strongly related to the SL culture. They may be translated in informal texts, if the institution is casually mentioned, e.g., *Deutsche Forschungsgemeinschaft - National Research Council* (Jumpelt 1961:48). If the institution is the subject of the

text, however, the original title should be retained and an explanation given in parentheses, e.g., the legal form *GmbH* should be explained as *private limited company under German law.*

Equivalence of units of sense considered separately is, however, not sufficient to achieve equivalence of the content conveyed in the translation as a whole. The weighting of the individual units of sense can vary. Hence, the term *Gleichwertigkeit* (*equivalence*) refers to "sequences of statements rather than to individual units" (op. cit:46, my translation). In other words, equivalence of individual units of sense says nothing about the equivalence of the text as a whole.

Although this important aspect clearly points the way towards a text-related approach to equivalence, Jumpelt does not pursue this aspect any further, so that his approach to equivalence, which is rooted within the framework of linguistics, remains restricted to the grammatical and lexical levels. However, his demonstration of how correspondences (in his sense) are governed by certain equivalence conditions (see above) may be considered a helpful tool in achieving equivalence at the lexical and terminological levels.

1.2.2   Pinchuck: Equivalence of grammatical units vs. equivalence of effect

> Translation may be defined as a process of finding a TL equivalent for an SL utterance.
> (Pinchuck 1977:38)

In order to pin down the "elusive notion" of equivalence in translation, Pinchuck suggests that we seek "the smallest identifiable unit that can be matched in two languages." This means "testing the smallest units available and working upwards until we arrive at our 'atom' or 'molecule' of translation, if there is such a thing" (1977:38). He sets out to investigate the smallest unit of grammatical analysis, i.e., the morpheme. He takes the German term *Geräuschempfindlichkeit* as an example, breaks it down into its elements *Ge-räusch-emp-find-lich-keit* and tries to match these elements with TL elements. The TL term arrived at, however, would be nonsensical, and even if the compound is taken as two words, the resulting TL term, viz., *noise sensitivity*, is not the equivalent accepted by the experts for every field, which may be *noisiness*. Thus the only equivalence at morphemic level is that between -*keit* and -*ness*. From this he concludes that there is a certain hierarchy in the

forms examined and that the word always takes priority over the morpheme. Although the morpheme is "a clue to meaning" (op. cit.:42), it cannot be used as a basic unit of equivalence.

This statement is also true of the word, as is demonstrated in the following example: *die Anschlußleitung - service pipe lines* (op. cit.:42), which shows an expansion of the TL structure relative to the ST term. The weakness of an examination based on grammatical rank and function lies not only in the size of the unit but in the static approach as such. Since translation is part of the communication process, which is dynamic, "the equivalence that matters, then, is one of effect. This can be described in terms of the sender achieving the same effect on the reader with the TL text as would be achieved if the reader were able to read the SL text. In technical translation, the emphasis will be placed on the effect on the reader" (op. cit.:43-44).

Although he claims that "the larger the unit of translation, the more accurate the equivalence" (op. cit.:44), he concludes on the basis of his examples that "the sentence is probably the typical unit of translation equivalence" (op. cit.:46), providing, however, that due account is taken of the subject field. Hence, where specialized knowledge is necessary, the "equivalent unit will lie on the conceptual plane" (op. cit.:47). He concludes, therefore, that in the hierarchy of translation equivalents, the concept ranks first, "followed by the lexical and syntactic equivalents on the level of the sentence, and then the smaller units - phrase, word, morpheme" (op. cit.:48).

Pinchuck (op. cit.:49) distinguishes four types of equivalence, first, *structural similarity + meaning similarity* (e.g., *she is - sie ist*), second, *structural similarity + dissimilarity in meaning* (typical examples are *faux amis*), third, *structural dissimilarity + similarity in meaning* (e.g., *Geräuschempfindlichkeit - noisiness*), and, forth, *structural dissimilarity + dissimilarity in meaning* (involving incorrect translations or untranslatable utterances). Since the ideal case of equivalence (type 1) is rare, the best we can expect in practical conditions is the third type. Pinchuck (op. cit.:50-51) also suggests making a scale of levels of equivalence "in ascending order from the substitution of the simplest linguistic signs to more elaborate groupings."[9]

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[9]   1. Substitution of printed letter for printed letter (e.g. transliteration).

Pinchuck's approach to equivalence perceives the concept as being above all related to analyzable grammatical and lexical units. This is due to the fact that he - like Jumpelt (1961) (1.2.1) - regards translation as a branch of applied linguistics. Although he claims that the sentence governs phrasal meaning, the complete text the sentential meaning and the situation the textual meaning (op. cit.:41) and although he stresses the importance of equivalence of effect - though without telling us how recipient response may be established and assessed - and of contextual and situational aspects, including extra-linguistic data, his investigation into equivalence remains restricted to the word or, at most, the sentence level.

He uses the concept of adequacy to describe the aim of the translation process and argues that "the technical translator sets his sights on adequacy, not on perfection" (1977:206). Adequacy is said to be determined by three factors, viz., accuracy, intelligibility and speed. Adequacy, however, implies that the purpose or *skopos* (e.g., Vermeer 1984; Reiß and Vermeer [2]1991) of the translation becomes the determinant of every translation. This being so, the concept of adequacy, which involves functional variance, should be confined to special forms of translation and should not be applied to translation in its proper sense.[10]

1.2.3   Sager: Equivalences

Units of translation and the search for equivalents for these units lie at the heart of any theoretical or practical discussion about translation. But, just as units of translation are flexible and a matter of cognitive and linguistic factors, there are many types of equivalence [...] the choice of which is determined by cognitive, pragmatic as well as purely linguistic factors.

(Sager 1993:222)

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2. Substitution of morpheme for morpheme.
3. Substitution of word for word.
4. Substitution of phrase for phrase.
5. Substitution of sentence for sentence.
6. Substitution of a context larger than a sentence for a similar one.
7. Substitution on the rank of situation, i.e. having recourse to extra-linguistic data.

[10] It should be noted in this context that the concept of 'adequacy' is interpreted very differently in the translational context. Unlike Reiß and Vermeer ([2]1991), Toury (1995:56-57) defines 'adequacy' as an ST-related concept, i.e., "adherence to source norms determines a translation's adequacy as compared to the source text". For the problems involved in the use of his term 'adequate translation' both as counterpart to acceptability and as methodological concept see Appendix II, f.n. 2.

In his industrially oriented approach to translation, Sager revisits the concept of equivalence and claims that it is a recognized fact that the ST-TT relationship "is one of cognitive, pragmatic and linguistic equivalences" (Sager 1993:142). However, how these equivalences are implemented and how they work is "far from clear" and there is "diversity in the evaluation of what is considered successful equivalence" (op. cit.:142). He concludes that equivalence is a relative notion, "because all decisions on equivalence are based on the alternative perceptions of adequacy and correspondence, which, however, themselves presuppose some form of norm against which we can measure equivalence" (op. cit.:144). However, for Sager (op. cit.:145) a "concept of equivalence or correspondence" is still necessary to evaluate the translation product at the micro-levels.

In Sager's "dynamic 'process' view" of translation, the criteria for determining equivalence are "moderated by the specifications which decide the status of the target language document [...] and with it the importance of one type of equivalence or another" (op. cit.:222). For instance, summarizing or abstracting translations require shifts from the specific to the generic which override linguistic equivalence. In search of equivalents, translators are confronted with three main difficulties, i.e., comprehension, cultural interference and maintaining the balance "between the effect the text has on them as recipients and readers of a SL document and their intention as producers of TL messages" (op. cit.:223). According to Sager (op. cit.:224), this balance is the prerequisite for the creation of the three general types of equivalence, viz., pragmatic equivalence, cognitive equivalence and linguistic equivalence. The establishment of pragmatic equivalence requires text typological knowledge and "the correct interpretation of the specifications". The establishment of cognitive equivalence requires domain knowledge. Since this domain knowledge is implemented via linguistic expression, it can only be evaluated "as part of linguistic equivalence". The latter can be deemed to have been achieved, "when equivalents are interchangeable in a given situation", or, when there is "an approximation between two messages", or, by the application of normative criteria, i.e., "by establishing conditions of equivalence prior to actual translation and to measure achievement against such predetermined values of equivalence".

In order to establish equivalence at the word or expression level, Sager (op. cit.: 225-229) suggests using the techniques introduced by Vinay and Darbelnet [1958](1977), i.e., borrowing, loan translation or calque, literal translation, transposition, modulation, equivalence [sic!], adaptation, explanation, and allusion. The search for equivalents is confirmed by matching an SL unit with an appropriate TL unit. Obligatory matching is expected for lexical units, syntactic matching for sentence units. The units identified as matches at one level may have to meet the requirements of a higher level. Sager therefore concludes that "matching at the rhetorical and pragmatic levels takes precedence over matching at the lexical and syntagmatic levels" (op. cit.:230). However, this important approach, which is related to Neubert's (1970) syntactic-semantic-pragmatic equivalence complex (2.2.1), is one that he does not investigate any further.

The main problem with Sager's somewhat unstructured approach to equivalence lies in his attempt to apply the concept - which he has split up into three types of equivalence - to his extended definition of translation, which is to include so-called "functional types of translation", such as the production of autonomous documents from SL drafts, "selective document translation", i.e., excerpts, "reduced document translation", i.e., abstracts and 'gist' translations (op. cit.:179-182), so that his approach to equivalence does not mark it off from the concepts of adequacy and correspondence. Moreover, at one point in his argumentation he equates equivalence with correspondence (op. cit.:145); at another point he defines it as an "approximation between two messages" (op. cit.:224). And by taking Vinay's and Darbelnet's [1958](1977) translation technique of 'équivalence' as one possibility of achieving equivalence at the word or expression level, he would end up defining equivalence by equivalence.

The terminological confusion arising from Sager's (1993) approach highlights the necessity of delimiting translation in its proper sense in order to create a basis for the applicability of the concept of equivalence (1.4.1 and 1.4.2). In the case of translation proper, ST sense and/or ST author intention take priority over the intentions of translators "as producers of TL messages" (op. cit.:223).

1.2.4 Horn-Helf: An ST-defectiveness-based approach to *Äquivalenz*

Horn-Helf (1999) is an example of a more recent approach to bridge the gap between the theory and the practice of technical translation and to revitalize the equivalence concept and adapt it to serve as a theoretical basis for this translation mode (op. cit.:101-142).[11] According to this author, existing theoretical approaches are of very limited use to technical translation, because they proceed from flawless STs, although there is no such thing as a flawless technical text (op. cit.:40). On the basis of a framework of certain types of equivalence, the author attempts to lay the theoretical basis for technical translation. Within this framework, reference (to the extra-linguistic subject matter) and terminology are the relevant text-external factors for which invariance can be demanded, so that referential equivalence and terminological equivalence are discussed as the chief equivalence types (op. cit.:109-125) alongside pragmatic equivalence - under which heading she discusses explication vs. implication, paratexts (such as footnotes) and adaptation in the *stylistique comparée*-based sense - and text-normative equivalence involving 'text aesthetics' ('well-writtenness'), theme-rheme aspects and text genre conventions (op. cit.:125-139). The requirement of formal equivalence is confined to TT layout, and denotative equivalence is dismissed as an inadmissible requirement because of the frequent defectiveness of technical source texts (op. cit.:360). In fact, defectiveness of source texts is the author's main concern, and rectification via translation is discussed on the basis of German/English/Russian examples.

Even if ST production-related defectiveness must be considered both from an applied and a theoretical point of view, e.g., in the definition of our object of study, viz., translation (1.4.1), defectiveness as such can hardly be a key area in our object of study or serve as a basis for a sound translation theory. By applying *a priori* established equivalence types to isolated aspects and to defect-related ST problems, in particular, the impression is created that technical STs consist almost entirely of defects, which simply is not the case. Moreover, in her typology of defects, some of the characteristic and systematic features of German scientific and technical discourse, e.g., prefixation (op. cit.:181) (see 5.2.1.1), appear under the heading of "defects", a view that leads to a misrepresentation of these features and to their

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[11]   For a review of Horn-Helf's (1999) book see Krein-Kühle (2001a).

oversimplification in translation. On the other hand, though, ST defects have been elevated to the status of translational features/aspects (op. cit.:262 ff.).

Although Horn-Helf (1999) must be given credit for having submitted a quite comprehensive typology of defects that may occur in technical STs, this may prove more useful for technical writers and engineering students than for translation scholars or translators, first, since certain ST defects, e.g., certain orthographic errors, are not translation-relevant, as the author herself concedes (op. cit.:234) and, second, because it may hardly be possible to systematize or generalize on anything so unpredictable and erratic as defects.

The basic problem with Horn-Helf's approach is the attempt to reconcile the theoretical concept of equivalence with aspects that go beyond translation proper, such as her claim to give the translation agency a "theoretical" [sic!] slot in the translation process (op. cit.:96) and the client priority over the ST (op. cit.:295). Not surprisingly, therefore, a definition of translation and its delimitation from other forms of text production - as a basis for any investigation into equivalence - is missing, and equivalence is equated with translation by being defined as the translational relation between two texts or text segments (op. cit.:45).[12] The additional splitting of equivalence leads to yet another proliferation of equivalence types rather than to a clarification of the concept itself. If equivalence is to be a useful concept in the technical translation context, then it should be regarded as a complete-text-in-context-related concept (1.4.2), which involves, but, at the same time, goes far beyond the rectification of isolated ST defects.

1.3   An overview of more recent views of equivalence in translation studies

Although it would go beyond the scope of this thesis to give a detailed account of the equivalence concept as it is perceived within translation studies in general (for an overview see Krein-Kühle 1995a:8-34; Pym 1995[13]), we will briefly comment on the current status of the equivalence concept. Although the concept still appears in recent introductions to translation studies (Munday 2001:35-54; Hatim 2001:26-42), its

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[12]   "Äquivalenz ist die Relation "Übersetzung von" zwischen zwei Texten oder Textsegmenten." (Horn-Helf 1999:45)

[13]   Pym (1995) is an overview of the concept from a 'sociological' perspective and reviews, in particular, Koller's, Toury's, Vermeer's and Snell-Hornby's approaches to the concept.

usefulness is seen as being restricted to the practical side of translation, and is considered "marginalized" in a theoretical context (Munday 2001:50). Such a standpoint, which ignores the interdependence of the applied and theoretical/descriptive areas of TS, amounts to relegating equivalence to the realm of mere subjectivity or speculation. In fact, equivalence is also under attack for requiring a "subjective judgement from the translator or analyst" (Munday 2001:43). However, such an approach ignores the attempts to objectivize the concept that have already been made by German-speaking scholars in the field, in particular (such as Wilss 1977, 1982; Koller [4]1992, 1995, 2000, or the scholars of the 'Leipzig school', see Wotjak 2000[14] for an overview), and does not absolve such critical scholars from a duty to make their own attempts at objectivization. As the present research will show, an evaluative analysis of equivalence may be much less subjective than some scholars may think, owing to the highly constrained nature of translational decisions (Chapters 3 to 6). Hatim (2001) is less dismissive of the concept and admits its usefulness in a text-based approach (op. cit.:31 ff.). Kenny (1998:77) points to views that criticize the "circularity" of the definitions of equivalence: "equivalence is supposed to define translation, and translation, in turn, defines equivalence." Such circular definitions, however, only exist because many scholars shun any judgements about the quality of translation as a direct indicator of achieved equivalence. It is only by moving away from the basic misunderstanding which equates translation with equivalence that the concept of equivalence can be reinstalled, explained, dynamized and made operative as a valuable theoretical, both process and product-related concept in TS (1.4.1, 1.4.2.). Halverson (1997, 1999) links perceptions of the equivalence concept to the concept of scientific knowledge studied within the philosophy of science and - drawing on the latter - points to the philosophical problems underlying the concepts of equivalence and translation, one of the main issues being "the comparability (and 'sameness') of theories, descriptions, texts or translations" (Halverson 1997:225) as a prerequisite for generalizations and scientific progress. She considers the problems of utilizing the concept in TS to lie "in establishing relevant units of comparison, specifying a definition of sameness, and enumerating relevant qualities" (op. cit.:210). However, from the point of view of etymology - (see 1.4.2 below) and as has been mentioned already in early works on

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[14] It need come as no surprise that the name of Albrecht Neubert, one of the main proponents of the 'Leipzig school', is seriously misspelled as "Albert Neuber" in Munday (2001:46).

translation (e.g., Reiß 1971:11-12, f.n. 6) - equivalence is not about sameness or identity, but of 'being of equal value', which may raise different questions, such as those about what has to be kept invariant in translation in order to achieve what kind of equality of what value by what TL linguistic means. Sameness and equality of value are not the same. According to Halverson (1997:211), it has been argued that a narrowly defined equivalence concept based on mathematical and/or logical definitions was adopted by German translation scholars as a result of their search for objectivity and a 'scientific' approach. However, the insightful findings of early research into STT (such as the contributions in Spitzbardt 1972) would not have been possible at all if such research had involved a narrowly defined (often also equated with 'linguistic') concept of equivalence based on mathematical prerequisites such as symmetry. Although Halverson convincingly pinpoints some fundamental problems in TS, such as the incommensurability of concepts, theories, descriptions, etc., we cannot wait until scholars have agreed on the vividly discussed 'common ground' (see the *Forum* discussions in *TARGET*) before getting further research done. A first step towards the operationalization of the equivalence concept then is to try to define our object of study, viz., translation (1.4.1). Halverson's (1999) prototypological approach to translation, which involves a broadening of our object of study or field of concern, may dilute the concept of translation even more, thus rendering inoperable the concept of equivalence, which depends on defining translation and demarcating it from other forms of text (re)production.

Among German-speaking scholars it is Koller ([4]1992, 1995, 2000) and Wotjak (1997, 2000) who still believe in the usefulness of the equivalence concept, though in a relativized way (Koller 1995). According to Koller (2000:24), the theoretical concept of equivalence postulates that there is a translational relation between a TT and an ST. Equivalence says nothing about the nature of this relation which has to be specified by defining relational frameworks (Koller 1995:197). Koller (1978, [4]1992:216 ff., 2000:24) views these in terms of five equivalence frameworks, viz. (1) denotative equivalence (*denotative Äquivalenz*) which refers to the extra-linguistic subject matter of a text, otherwise referred to as 'invariance at the content level', (2) connotative equivalence (*konnotative Äquivalenz*) which refers to the connotations present in the text and conveyed by a specific type of verbalization as regards stylistic

peculiarities, sociolectal and geographical dimensions, frequency, etc., otherwise termed 'stylistic equivalence', (3) text-normative equivalence (*textnormative Äquivalenz*) which refers to the norms of usage (*Gebrauchsnormen*) valid for specific texts, also often called 'stylistic equivalence', (4) pragmatic equivalence (*pragmatische Äquivalenz*) which refers to the receptor of a translation and implies that the translation has been geared to specific receptor requirements in order to fulfil its communicative function, otherwise known as 'communicative equivalence', and (5) formal-aesthetic equivalence (*formal-ästhetische Äquivalenz*) which refers to aesthetic, formal and individual stylistic properties of the ST, otherwise termed 'expressive equivalence'. For Koller, equivalence involves a framework of requirements to be met and he suggests that the term equivalence should often be replaced by equivalence requirements (*Äquivalenzforderungen*) (Koller [4]1992:94). For Albrecht (1990:75), equivalence depends on what has to be kept invariant in translation. In this context, he points out that specifying an equivalence requirement simply implies the decision *that* a translation is to be carried out, whereas specifying an invariance requirement implies *how* a translation is to be carried out. Apart from the familiar problem of definitional circularity, the problem we see in Koller's approach is the splitting of the concept into various isolated equivalence types, since in the complex processes of translation and descriptive analysis, denotative, connotative, text-normative, pragmatic and formal aspects may all come into play simultaneously in the search for and analysis of equivalence. What we need to know is *which* aspect takes precedence over the other and, above all, *how* and *why* this is so with a specific translational feature at a specific textual level in a specific text-in-context.

Wotjak (1997) suggests a multi-level model (*Mehrebenenmodell*) to describe equivalence and the complex phenomena of translation. It would go beyond the scope of this thesis to discuss his highly complex model[15] (see Appendix I for a summarizing diagram) in greater detail, but, put briefly, it consists of four levels. Level I involves the systemic-semantic correspondence between SL and TL meanings; level II refers to the informational content of the text and involves "preliminary stages of semantic equivalence at the content level" (op. cit:166); level III refers to communicative macrostructures including the communicative potential

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[15]   Unfortunately, Wotjak's (1997) extremely dense and scientific style makes his proposals difficult to digest even for native German scholars in the field.

(i.e., aspects of diasystematic marking) and involves the establishment of communicative textual equivalence; level IV deals with discursive-illocutionary macrostructures involving knowledge of recipient-related and situational requirements and refers to the establishment of translational equivalence. Although Wotjak (1997:139) clearly demarcates equivalence (*Äquivalenz*) as depending on functional constancy from other translationally relevant concepts, such as acceptability (*Akzeptanz/Akzeptabilität*), appropriateness (*Angemessenheit*) and adequacy (*Adäquatheit*), he does not tell us under which circumstances which specific levels take priority over other levels. Also, there may be translation problems which are difficult to allocate to a specific level (op. cit.:165). Moreover, we feel that equivalence instead of correspondence (1.4.2) should be the aim also at his level I, since syntagmatic-semantic structures may be highly constrained by pragmatic aspects which influence the selection of potential equivalents. As Wotjak (1997:164) himself concedes, his multi-level model of equivalence has yet to be applied to actual STs and their translations to prove its usefulness.

Despite the various theoretical models of and approaches to equivalence which have been critically reviewed above (1.2 and 1.3), no attempts have been made so far to develop an objectivized and dynamized theoretical concept of equivalence, the validity of which could be tested by applying it to an actual ST-TT pair in context. Such an attempt, which is urgently needed if we want to know how equivalence works under what specific circumstances in a specific text-in-context, is discussed in greater detail in the following sections.

1.4 Towards a redefinition of equivalence in scientific and technical translation

> To simply discard the concept of equivalence - as has become fashionable in some quarters - cannot be the solution. It seems more reasonable for translation studies to retain the equivalence concept in translation theory and practice and in translator training, but [...] to dynamize and, at the same time, relativize it to deal with specific situations and texts, allowing for an adequate tolerance range [...]"
>
> (Wilss 1996:16-17, my translation).

As the above discussions have shown, any definition of equivalence crucially hinges on a definition of our object of study, viz., translation, which is discussed in greater

detail in the following sections (1.4.1), before our own approach towards a redefinition of the equivalence concept is presented (1.4.2).

1.4.1   Delimitation and definition of the subject matter of 'translation'

Although a clear-cut delimitation of the subject matter of 'translation' is certainly not always feasible owing to the complexity of the translation concept and to its being investigated on the basis of different theoretical approaches (Koller 1995), a discussion of the concept of equivalence calls for a distinction between translation in its proper sense and 'special cases of translation' ("Sonderfälle der Translation", Wotjak 1997:141). As Koller ([4]1992:205) rightly argues, this delimitation is necessary to allow description of syntactic, semantic, 'stylistic' and pragmatic regularities in the relationship between STs and TTs and to work out the conditions which govern the selection from among potential equivalents at the various textual levels. The notion of 'translation in its proper sense' views a translation as having the same function as the original, i.e., it serves the same intended purpose. Functional constancy, therefore, is the prerequisite for the presence of translation (Albrecht 1990:79) and, by extension, for the presence of equivalence (Wotjak 1997:139). Function is understood here to refer to text function as defined by House (1997: 36): "I define the function of a text very simply as the application or use which the text has in the particular context of a situation."

For the purpose of this thesis, a translation is defined as the interlingual transposition of a source text into a target text based on the invariance requirement of ST sense/intended sense or 'das Gemeinte' (2.2.1) and involving an interpretation of the ST against the background of factual knowledge (e.g., domain knowledge, encyclopaedic/world knowledge, etc.) underlying the ST. Since scientific and technical STs may be defective (Schmitt 1987b; Horn-Helf 1999), scientific and technical translation may therefore be understood as to include corrections, e.g., to remedy ST factual inaccuracies, or well-motivated minor revisions, omissions or additions (such as a translator's footnote), but to exclude any revisions, omissions or additions that go beyond the level of sense/intended sense or 'Gemeinte'. It is the sense/intended sense or 'Gemeinte' that is common to both ST and TT and has to be replicated and kept invariant in translation and will function as the *tertium*

comparationis in our translation comparison (2.2.1). This intended sense has a double nature, being simultaneously a text-internal and a text-external invariant, since, e.g., in the case of defective STs, the sense has to be established by the translator via replication of author intentions against the background of factual domain knowledge and encyclopaedic or world knowledge underlying a specific text.

Excluded from our object of study are adaptations in Schreiber's (1993)[16] terminology and translations with revisional elements that modify the intended sense or revisions with translated elements in Koller's (1995:206 ff.) sense.

1.4.2 Redefinition of equivalence and the establishment of equivalence-relevant features

As Wotjak (1997:137) rightly criticizes, equivalence is often understood in different ways and used without prior clarification of the intension and extension of the concept (cf. also Albrecht 1990:71) and without taking due account of the more recent research results in the areas of semantics and pragmatics. Snell-Hornby (1986:14), for example, points out in this context that German *Äquivalenz* and English *equivalence* are not semantically identical owing to differences in the historical development of the two terms. The problem, however, is not so much due to the terms *equivalence* or *Äquivalenz* themselves, but to the indeterminacy of the concepts they stand for. Concepts, however, have to be described, clarified and defined before terms can be assigned to them. In trying to define this concept for use within the terminology of TS, the etymology of the word equivalence provides a valuable first insight (cf. also Albrecht 1990:72). Proceeding from its Latin origin, we can break down the adjective equivalent into *æquus* (*æqui*) (*equal*) and *valere* (*be worth*) to obtain *of equal value* (*The Oxford Dictionary of English Etymology* 1979). On the basis of its Latin origin, and as previous research into the origin, meaning and use of the term has shown (Krein-Kühle 1995a:1-4), equivalence is not about sameness, but about like use, function, size or value, or having an equal effect. In the

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16   Schreiber's (1993) definitions of translation (*Übersetzung*) and adaptation (*Bearbeitung*)
      run as follows: "A translation is an interlingual text transformation based on hierarchized
      invariance demands and always involving an interpretation of the ST [source text]" (op. cit.
      43). "An adaptation is a media-independent text transformation which retains at least one
      complex, individual textual feature and which is otherwise based on variance demands"
      (op. cit.:105, my translations). Schreiber's (1993) has been the only in-depth attempt to
      delimit the concept of 'translation' (*Übersetzung*) from the concept of 'adaptation' (in the
      broader sense of the term, *Bearbeitung*). For reviews of his book in English see House
      (1996) and Krein-Kühle (1998).

translation context, the question then is "equivalent in what respect?" (Albrecht 1990:73, my translation). To answer this question, we have to define the factor (or factors) to be kept invariant in translation, i.e., the *tertium comparationis*, in relation to which equivalence is aimed at (Albrecht 1990:74). Thus, equivalence is achieved when certain invariance demands have been met to the highest possible degree.

For the purpose of this thesis, equivalence is defined as a qualitative complete-text-in-context-related concept. It refers to a translational relation between a complete source text and a complete target text, both of which are embedded in a specific domain-related context, and implies the preservation of ST sense/intended sense or 'das Gemeinte' (the invariant) (2.2.1) in the TT using TL linguistic means, the best possible selection of which must have been achieved at the syntactic, lexical-semantic, terminological-phraseological, and textual levels. These levels are hierarchically interrelated and subject to pragmatic aspects (2.2.1). In this way, the TT fulfils the same or - in the case of ST defect correction - an improved informative-communicative function among specialists in the TL culture, i.e., equality or even improvement of 'communicative value' (*kommunikativer Wert*) (Kade 1977:35-36) may be deemed to have been achieved.[17]

Equivalence, therefore, is a hierarchized syntactic, lexical-semantic, terminological-phraseological, and textual complex which is determined and constrained by pragmatic aspects. Equivalence in the present research will be investigated on the basis of equivalence-relevant features - which are allocated to the above levels (Chapters 3 to 6) - to establish patterns in translation solutions, i.e., potential equivalents, in order to allow insights into the conditions which govern selections from among potential equivalents at the various textual levels and into the way equivalence relations operate between STs and TTs. Equivalence, therefore, is regarded as a dynamic rather than a static concept, since the establishment of potential equivalents requires the unearthing of the equivalence relations extant in a specific ST-TT pair and the replication of the translation process and the evaluation of translators' decisions. The dynamism of equivalence lies in the fact that it is both a

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[17]   So we could talk of the TT's exchange value. To my knowledge this term goes back to
         Neubert (1970:453) who talks of the TT's "Tauschwert" and not to Pym as mentioned in
         Kenny (1998:78).

prospective and a retrospective concept. Prospectively, it is negotiated in the process of translation via translator's decisions which are constrained by, e.g., syntactic, semantic and pragmatic aspects of equivalence. Retrospectively, it is used to replicate the process as well as the translational decisions and their constraints in the analysis of the product.

In this research a distinction will be made between correspondences as belonging to the realm of *langue* and potential equivalents as belonging to the realm of *parole* (cf. Koller 1978, [4]1992:204[18], 2000:21-23). Correspondences for syntactic, semantic or terminological units may be found in grammars and bilingual dictionaries or terminology lists. Among these correspondences, potential equivalents in the form of patterns in translation solutions may only be established on the basis of a translated text-in-context, as this research will show (Chapters 3 to 6). This, certainly, does not preclude that specific correspondences may become potential equivalents under certain co-textual and contextual circumstances.

Within the scope of this thesis, the equivalence-relevant features in question are defined as those linguistic features in a given ST that pose equivalence-relevant problems at the various textual levels on various translational grounds, such as grammatical-syntactic, semantic, terminological-phraseological or pragmatic grounds, e.g., register and domain-related aspects. It must be admitted that the allocation of specific features to specific textual levels is not always unequivocal, since the analysis of certain complex structures (e.g., instances of 'secondary subjectification' in 4.3) may require a combined consideration of several specific dimensions, such as the syntactic and semantic dimensions. However, only the allocation of specific features to specific levels will enable us to show how equivalence relations operate at the various hierarchically interrelated textual levels and how they are influenced by pragmatic aspects (Chapters 3 to 6).

The selection of equivalence-relevant features is governed, first, by their relevance to our analysis (see above), second, by their frequency of occurrence in the

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[18]   Koller ([4]1992:204) argues in this context that not all possible TL correspondences of an SL expression which perform their communicative function under specific circumstances can be considered "potential equivalents". Only those correspondences and relations between ST and TT which fulfil certain equivalence requirements may be objectivized and described on a scientific basis.

ST, and, third, by their typicality in scientific and technical discourse and in the genre under analysis, in particular. On the basis of research into LSP (e.g., Gerbert 1970; Sager et al. 1980; Beier 1980; Göpferich 1995a), we know that certain features, e.g., the non-finite verb forms in English (Chapter 3), are more common than others and/or have a different distribution in scientific and technical discourse. The frequency of occurrence of these equivalence-relevant features is established by simply counting them in the ST under investigation. The features investigated will then be categorized and/or sub-categorized on equivalence grounds (see above) either in compliance with grammatical categorizations/sub-categorizations (Quirk et al. [13]1995), LSP-based categorizations or source text-related categorizations which arise out of the text under investigation (such as the category of compounds occurring in the production of texts in Chapter 5). By analogy, we draw on the German standard grammar (Duden vol. 4, [5]1995, Duden vol. 9, [4]1997), LSP-based or target text-related categories for classifying the potential equivalents established in the TT.

It is hoped that in this way it will be possible to achieve a high degree of replicability and intersubjectivity in the findings of our analysis, the validity of which - due to the typicality of the features examined - may go beyond the genre - and occasionally even beyond the language pair (3.2.4) - investigated.

Due to the indivisible connection between equivalence and translation quality (House 1997:31) and our perception that the ST-TT relationship is first and foremost a translational relationship which does not say anything about the quality of this relationship, any investigation of equivalence must be based on what Kade (1964a) calls "druckreife Übersetzungen" (*publishable translations*), implying the highest possible quality level. For the publishable translation Kade (1964a:257) demands "an optimum selection of the TL means used within the scope of the objectively given equivalence relations between SL and TL". To ensure this high-quality requirement, specific criteria have been established for the selection of the objects of our study (2.2.2.1 ff.).

1.4.3 The research report as an equivalence-relevant genre

Although the genre of the research report is not only relevant to the field of STT, but also a typical representative of scientific and technical discourse (Schmitt 1993:3-10; 2.2.2.1.1), to our knowledge, no research has been carried out so far into this genre. As early as 1972, research reports (or *Forschungsberichte*) were mentioned by Gräf[19] as a particularly fruitful source for translation-relevant research. Gräf points out that this type of scientific and technical discourse is characterized by an unusual host of tenses (since it operates on three tense levels, i.e., review, overview, outlook), copious terminology covering intersecting subject fields, phraseological/idiomatic specificity and more demanding grammatical structures (Gräf 1972:289-291), such as modality (4.2 ff.). As our analysis will show, this discourse genre exhibits a highly dense and complex textual structure due to a very advanced or even novel subject-specific conceptual reality which is reflected in this structure and also underlies it. It is not rare for the textual density and complexity of these reports to be further increased by the scientific writer's recourse to ellipsis and redundancy (involving problems of cohesion and coherence in translation, see Chapter 6), since the writer may rightly presuppose a sound and very advanced domain knowledge in the specialist recipient. Since researchers are often in a hurry to present their findings, and since their results may be considered more important than the language describing them, a somewhat 'careless style' may occasionally result. Understandably, these circumstances do not facilitate the task of the translator/analyst in her/his search for equivalence, a search which may require expert advice. The research report was selected as our object of study, first, owing to its general relevance in the STT context, second, because no translational/equivalence-relevant research has been carried out so far into this genre and, last but not least, owing to its relevance in the translational/equivalence-relevant context on the grounds of the above described linguistic and domain-related conceptual complexity. Although - again due to its relevance in the STT context - this genre should be dealt with both in the theoretical/descriptive and applied branches of TS, the problem here is that such reports are hard to come by owing to their confidential status. This was precisely the problem with the corpus in question, so that some alterations and omissions have had to be made in exemplification (e.g., proper names are replaced by letters X, Y, Z,

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[19]   Gräf (1972:289) calls the research report *Fortschrittsbericht* or *state-of-the-art report*.

omissions are indicated by three dots), though these do not impair the general argument.

For more information on the research report selected see 2.2.2.1.1, e) register considerations and f) genre considerations and Appendix III.

In this context a word should be said about the notion of 'style'. The unqualified term 'style' should be avoided in STT, since 'style' may imply an unlimited subjective-facultative choice, a width of choice that the technical translator does not have. Since STT is highly TL-oriented, the translator has to comply with TL norms, such as *usage norms* (*Gebrauchsnormen*) (Wilss 1982:169), and conventions to ensure that "a given linguistic utterance is appropriate to a certain use" (Hatim and Mason 1990:46). The notion of style is therefore replaced here by the notion of register which is defined (2.2.1) and made operative in the analysis of the corpus (2.2.2.1.1, e)). The notion of 'style' is used only to refer to stylistic defects in the ST brought about by a certain carelessness or idiosyncrasies on the part of the ST author.

1.5   Summary of this chapter

A brief diachronic and synchronic overview of scientific and technical translation has shown that this mode of translation has always played a pivotal role in disseminating knowledge throughout the ages down to the present time. Today, specialist or LSP translation (*Fachtextübersetzungen*) is estimated to account for ca. 90% of the total volume of translation (Wilss 1996:viii), with the domain of science and technology being the most common arena for translation work. In Germany, 76% of the translators/interpreters work in technical fields (Schmitt 1998a:9), a situation which is certainly similar to that in other countries and merits greater consideration in the theoretical/descriptive and applied branches of TS. Growth in the exchange of information and in the transfer of knowledge due to the internationalization of science and technology, the globalization and diversification of business and commerce, and the greater sophistication of industrial products has also led to a growing demand for high-quality translation (Wright 1993). The "Anglophone globalization of markets" (Stoll 2000:53) has not only given rise to a further increase in translation needs, but has also led to a situation in which German or other non-English native speaking

scholars and scientists publish their research results directly in English rather than waiting for them to be translated. This situation, however, is not unproblematic, first, because it may lead to an impoverishment of national scientific and technical registers (for German see Trabant 2000) and, second, because the articles published in English by non-native speakers may not be fully accepted by English native speakers due to a lack of linguistic-stylistic quality (Ammon 2001:354, see f.n. 5). The demand for high-quality translation and the situation described above not only challenge translation studies in both its theoretical/descriptive and applied branches, but also point to the enormous potential of translation as both a 'corrective' (see, e.g., 4.3) and a register developing force (see Chapter 7).

This is the moment when the concept of equivalence comes into play, since equivalence - when understood as defined, dynamized and objectivized here - can prove to be a valuable theoretical text-in-context-based concept (1.4 ff.) capable of helping achieve the much-sought-after improvement in the quality of STT on the basis of the establishment of patterns in translation solutions for specific equivalence-relevant features (1.4.2 and Chapters 3 to 6). An overview of the concept as it is perceived in the literature of STT has shown that very early approaches to equivalence (Jumpelt 1961, see 1.2.1, Pinchuk 1977, see 1.2.2) remain restricted to the grammatical, lexical or, at most, syntactic levels. This is not surprising, since, at the time, translation was considered to be a branch of applied linguistics, and theoretical/descriptive frameworks to account for the complex phenomenon of translation had not yet been developed. Nonetheless, these very early approaches must be given credit for detailed and clear-sighted analyses (here, in particular Jumpelt's (1961) analysis based on the application of the procedures of modulation and transposition) and for already pointing out the need to consider, e.g., text-typological aspects, domain-related context, situation and reader orientation as prerequisites for successful scientific and technical translation. More recent approaches to the concept (Sager 1993, Horn-Helf 1999) involve a splitting of equivalence into various types, which may, however, be viewed as yet another contribution to the proliferation of equivalence types rather than a help in clarifying the concept itself. Apart from the terminological confusion arising from Sager's (1993) (1.2.3) discussion, the main problem with his somewhat unstructured approach to equivalence lies in his attempt to apply the concept to his extended

definition of translation, which implies a lack of delimitation of the concept of translation from other forms of text (re)production as a prerequisite for dealing with equivalence. Such a demarcation is also missing in Horn-Helf's (1999) (1.2.4) ST-defectiveness-based reconsideration of the concept. The unsystematic and erratic defectiveness of STs cannot be regarded as a legitimate basis for a clarification of the equivalence concept. The basic problem with Horn-Helf's approach is the attempt to reconcile the theoretical concept of equivalence with aspects that go beyond translation proper, such as her claim to give the translation agency a "theoretical" [sic!] slot in the translation process (op. cit.:96) and the client priority over the ST (op. cit.:295).

Despite more recent attempts to revitalize the concept of equivalence in TS in general, such as Halverson's (1997, 1999) philosophical approach, Koller's ([4]1992, 1995, 2000) frameworks of equivalence and Wotjak's (1997) multi-level model, which have been critically reviewed in 1.3, no attempts have been made so far to develop an objectivized and dynamized theoretical concept of equivalence, the validity of which can be proved by applying it to an actual ST-TT pair in context. Such an attempt is urgently needed, if we are to know how equivalence operates under what specific circumstances in a specific text-in-context.

Any investigation into equivalence crucially hinges on a delimitation and definition of the subject matter of translation. Following Albrecht (1990:79), we posit functional constancy as being the *conditio sine qua non* for the presence of translation, and, by extension, for the presence of equivalence (Wotjak 1997:139). For the purpose of our investigation, a translation is defined as the interlingual transposition of a source text into a target text based on the invariance requirement of ST sense/intended sense or 'das Gemeinte' (2.2.1) and involving an interpretation of the ST against the background of the factual knowledge (e.g., domain knowledge, encyclopaedic/world knowledge, etc.) underlying the ST. This definition is understood to include corrections, e.g., to remedy ST factual inaccuracies, or well-motivated minor revisions, omissions or additions (such as a translator's footnote), but to exclude any revisions, omissions or additions that go beyond the level of sense/intended sense or 'Gemeinte'.

As the etymology of the term has shown, equivalence is not about sameness or identity but about being *of equal value*. In the translation context, this implies that

we have to define the factor (or factors) to be kept invariant in translation, i.e., the *tertium comparationis*, in relation to which equivalence is aimed at.

In our view, the translational relation between an ST and a TT does not say anything about the quality of this relation. Translation quality, however, is the direct indicator of achieved equivalence. Therefore, equivalence is regarded here as a qualitative complete-text-in-context-based concept. It refers to the translational relation between a complete source text and a complete target text, both of which are embedded in a specific domain-related context, and implies the preservation of ST sense/intended sense or 'das Gemeinte' (the invariant) (2.2.1) in the TT using TL linguistic means, the best possible selection of which must have been achieved at the syntactic, lexical-semantic, terminological-phraseological, and textual levels. These levels are hierarchically interrelated and subject to pragmatic aspects (2.2.1). In this way equality or even improvement (in the case of ST defects) of 'communicative value' (Kade 1977:36) may be deemed to have been achieved.

Equivalence will be investigated on the basis of a research report - as a translationally relevant text genre (Gräf 1972; Schmitt 1993) - in the form of categorized equivalence-relevant features at the various textual levels of the English ST taking due account of pragmatic considerations. The analysis will not only enable us to establish trends in the potential equivalents in the German TT, but will also enable us to unveil how equivalence relations operate at the various hierarchically interrelated textual levels and how they are influenced by pragmatic aspects. The investigation aims at establishing more replicable and intersubjective[20] findings that can be put into use in the applied branches of the discipline, and at dynamizing and objectifying the concept of equivalence from a theoretical point of view by revealing the conditions that govern the selection from among potential equivalents at the various textual levels (Chapters 3 to 6).

Certainly, any investigation into equivalence crucially hinges on this concept being embedded in a sound and rigorous methodological framework, an aspect which will be discussed in greater detail in the following Chapter (2).

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[20]   'Intersubjective' here meaning 'verifiable by several subjects/persons'.

2   Methodology

> We should ask ourselves, therefore, how translations are to be analyzed, in order to make our research relevant both from a historical *and* from a theoretical point of view. Indeed, our methodology in this respect too often remains purely intuitive.
>
> (Lambert and van Gorp 1985:42)

> Voorwaarde voor het theorievormende onderzoek van het vertaalprodukt is de ontwikkeling van wetenschappelijk verantwoorde methoden met behulp waarvan de relatie tussen een vertaling en haar brontekst beschreven kan worden. 'Wetenschappelijk verantwoord' houdt in dat een dergelijke methode intersubjectief is.   (van Leuven-Zwart 1992:71)

> What is missing, in other words, is not isolated attempts reflecting excellent intuitions and supplying fine insights (which many of the existing studies certainly do), but a systematic branch proceeding from clear assumptions and armed with a methodology and research techniques made as explicit as possible and justified within Translation Studies itself.
>
> (Toury 1995:3)

The methodological issue is a much neglected subject in the discipline (Holmes 1988:81; van Leuven-Zwart 1992:70; Toury 1995:3) - especially for equivalence-related comparative investigations of ST-TT pairs in context on the basis of high-quality specialized corpora - but is of the utmost importance if we want to investigate equivalence as a valuable theoretical text-in-context-based concept and, at the same time, establish patterns in translation solutions for specific equivalence-relevant features (1.4.2). When it comes to methodological questions, translation theories are apparently at a loss for answers. This methodological dilemma may be due to the very specific twofold nature of translation itself which is "both a process and a product [...] a subject for research and an aid to research [...] data on creativity and a creative work" (Rose 1977:ii, quoted in Hartmann 1980:52), so that "the nature of the product cannot be understood without a comprehension of the nature of the process" (Holmes 1988:81). Holmes (1988:82) therefore claims that translation scholars "must develop an adequate model of the translation process before they can hope to develop relevant methods for the description of translation products." This demand, however, reflects the fundamental problem, viz., that what is actually accessible to investigation is the product as "indirect evidence" (Hartmann 1980:52) of the process, since "the processes themselves can never be observed directly" (Hoffstaedter 1987:76).[1] Since there are as many different models of the translation

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[1]   Holmes (1988:88) was well aware of this fact, for he claims that "a further complication is one that applies to all studies of mental processes. Since in most cases there is little or no tangible evidence of what has taken place in the translator's 'mind' except the text he has produced as compared to the original text, the scholar attempting to trace the relationship

process as there are different translation theories, it may well be doubted whether translation studies as a highly complex and highly diverse interdisciplinary field can bring forward one universally established, accepted and intersubjective methodology. Yet, if our investigations into translational phenomena or features are to yield more objective, i.e., intersubjective,[2] more representative, meaningful, controllable and replicable results, then we have to pay close attention to "a dimension that might be called the methodological or meta-theoretical, concerning itself with problems of what methods and models can best be used in research in the various branches of the discipline" (Holmes 1988:79). Such a methodological branch is still missing, and although Toury (1995:69) is right in claiming that the "achievements of actual studies can themselves supply us with clues as to necessary and possible methodological improvements" and that "if we hold up research until the most systematic methods have been found, we might never get any research done" (op. cit.:69), the basic methodological problem is still unsolved.

Another basic problem in translational research is the notorious issue of the quality of the translation product (House 1977, 1997, 2001), a point which is often simply passed over in silence. Any investigation into equivalence cannot ignore this issue, because the object of our research has to exhibit a high quality, i.e., a high degree of equivalence ("Äquivalenzgrad", see Schreiber 1993:55 ff.). This may also be one of the reasons why equivalence has become so unpopular, since talking about equivalence implies talking about translation quality (House 1997:31).[3] Although this cannot mean that a detailed "translation quality assessment" (House 1977, 1997) has to be carried out *a priori*, since this would involve a different approach, i.e., that of the translation critic, it will be necessary to establish well-defined methodological parameters, such as a 'linear' and 'selective' comparative approach (as distinguished by Reiß 1981:316-317), and a refined set of corpus selection criteria (2.2.2.1) in order to guarantee the quality of the product. This quality is then subject to a

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of the two texts likewise in most cases has no material except those two texts from which to derive his conclusions."

[2]   As Holmes (1988:89) rightly argues in this context: "Assuming that objectivity in any true sense is in such a matter a goal even more unattainable than in research dealing with tangible objects and/or events observable outside the 'mind', one can nevertheless posit that a high degree of intersubjectivity is an aim worth striving after in a research situation of this kind."

[3]   "Equivalence I take to be the fundamental criterion of translation quality." (House 1997:31)

continuous check in a dynamic process during the analytic process itself, which is carried out within a sound equivalence-related theoretical framework (2.2.1).

While the need for descriptive studies involving a shift from normativeness and prescriptivism toward an emphasis on description, explanation and prediction is stressed in the literature (e.g., Lambert and van Gorp 1985; Holmes 1988; Toury 1995), not much is said about the quality of the objects to be described or how these studies are to be performed. And although the comparison of the source text and the target text "still remains a crucial point" (Lambert and van Gorp 1985:47) in the analysis and is considered the "starting-point" for the description (van den Broeck 1985:56), again only few writers try to specify how such a comparison should be carried out. This may be due to the problems involved in establishing a reliable frame of reference for such a comparison in order to provide a *tertium comparationis*. According to van Leuven-Zwart (1992:76), a *tertium comparationis* "consists of elements which both objects have in common and which can thus be considered *invariant*" (my translation).

As can be seen from the above discussion, the scholars who deal in greater detail with methodological aspects are those of the descriptive school, such as Lambert and van Gorp (1985), Holmes (1988), Toury (1980, 1995), van Leuven-Zwart (1992), who take a 'descriptive', 'target-oriented', 'functional' and 'systemic' approach to literary translation (for a brief discussion of their methodological approaches see Appendix II). However, since the above scholars study literary translation as a historical, social and cultural phenomenon, the emphasis of their investigation is shifted from the translated text to the broader context in which the translations function. This also implies that they may tend to look at the objects of their study from the angle of the literary scholar rather than from that of the translator. As the translator sees it, therefore, systematic comparisons of ST and TT are facing growing neglect - a situation that is reflected in the indeterminacy of *the tertium comparationis* and in the vagueness of approach when it comes to describing how the ST-TT comparison is actually to be made. Although Holmes's (1988) and van Leuven-Zwart's (1992) methodologies - which emphasize hermeneutic aspects - are more comparatively and translationally oriented than those of the other scholars

mentioned, they also fail to provide the analyst with concrete tools for performing the comparison. However, aspects of the two working methods suggested by Holmes (1988:89-90) will be incorporated into this research, i.e., the establishment of a list of 'distinctive' and in our case equivalence-relevant features (1.4.2), which may be used as a "repertory of features always to be analysed" (Holmes 1988: 89) for further research, though not "regardless of what specific text is involved" (op. cit.:89), but in a specific text genre and type. This may lead to a higher degree of intersubjectivity between the results of individual researchers proceeding according to the same repertory of features. Also, Holmes's idea of the hierarchical ordering of features (op. cit.:89) will be reflected in the theoretical framework within which the comparison is carried out (2.2.1). And van Leuven-Zwart's (1992:78) notion of 'integral' comparisons, i.e., comparisons of entire STs and TTs, is also important in an equivalence-oriented investigation, because this is the only way to account for aspects of cohesion and coherence (Chapter 6), which are essential in establishing equivalence at the text-in-context level.

Descriptive scholars view equivalence as something that makes the description of literary translation impossible or obstructs the 'theory-forming' investigation (van Leuven-Zwart 1992:74), as unattainable anyhow (Holmes 1988:100-101), as of "little importance in itself" (Toury 1995:86), or, since most 'descriptivists' shun any value judgements, as assumed *per definitionem* to exist (op. cit.:86) and as being replaced by the concept of norms "as the researcher's focus of attention" (Hermans 1991:158). This means that most of the above investigations start somewhere downstream of the point where our investigation is to start, and the methodologies suggested are therefore of little help when it comes to performing a thorough and systematic ST-TT comparison at all levels and to establishing the hierarchical interrelations between these levels, an aspect which is at the root of any investigation into the highly complex, text-in-context-based concept of equivalence. Equivalence, as a desirable and attainable goal in STT, whose presence cannot always be taken for granted, does not lend itself to investigation by descriptive methods alone.[4] Moreover, any methodological approach to an investigation of equivalence

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[4]   As Snell-Hornby [1988](1995:25) notes in the context of her discussion of the "Manipulation School" (which is referred to here as the descriptive school): "One is left wondering whether the element of evaluation and judgement can ever be completely

requires an *a priori* delimitation of translation from other forms of text production (Schreiber 1993 and 1.4.1), a point which is not considered in most of the methodological approaches discussed. However, the above investigations must be given credit for stressing the requisite wider perspective of the ST-TT comparison, such as a consideration of contextual and situational aspects. The context, is, of course, a crucial dimension in an equivalence-relevant investigation and is incorporated in the theoretical/analytical framework underlying the comparison (2.2.1). Also, both contextual and situational aspects may play an important role as a "qualitative refinement" (van Doorslaer 1995:248) in the early stage of selecting the objects of our investigation, a point which is dealt with in greater detail in the sections that follow (and see 2.2.2.1).

2.1 A corpus-based investigation of translation

Many of the weaknesses and naïvetés of contemporary translation theories are a result of the fact that the theories were, by and large, developed deductively, without recourse to actual translated texts-in-function, or at best to a very restricted corpus introduced for illustration rather than for verification or falsification. (Holmes 1988:101)

[...], carefully performed studies into well-defined corpuses, or sets of problems, constitute the best means of testing, refuting, and especially modifying and amending the very *theory*, in whose terms research is carried out. (Toury 1995:1)

Almost all translation theorists - despite their different approaches to translation - agree that the methods employed so far have been largely subjective, intuitive and impressionist (Holmes 1988:90), and that we always have to take the author's word for it that the examples given are representative rather than persuasive, since generally "no references are given to investigations of a more rigorous nature, no statistics or even figures" (Lindquist 1984:261). If our findings are to be relevant for establishing patterns in translation solutions and formulating well-founded generalisations, our analysis - which is usually carried out inductively and deductively - should be performed on the basis of actual source texts and their translations in context and - depending on the purpose of our investigation - may have to go beyond the comparison of a single pair of source and target texts and be put on a more solid basis by "looking at a series of texts" (Lambert and van Gorp 1985:51). This is the

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dispensed with."

moment when a corpus-based investigation of translation comes into play and it will be presented and discussed in the following.

The term "corpus", which is derived from corpus linguistics, may be defined in the field of translation studies as a comprehensive collection of running texts which can best be handled if "held in machine-readable form and capable of being analysed automatically or semi-automatically in a variety of ways" (Baker 1995:225). However, as Baker (1993:241) rightly reminds us, the term corpus in translation studies has often been used to refer to a small number of texts which are searched manually. Corpora have been used for some time now in linguistic research *per se* and for practical applications in lexicography (Collins COBUILD corpus-based dictionary, 1987) and language teaching (Barlow 1996; see also Leech 1991:73-80).

More recently, corpora have entered the field of translation studies for use in different areas and with different research objectives (Baker 1995; Laviosa 1998a, b, 2002; see Bowker and Pearson (2002) for the use of corpora in the area of LSP). As early as 1984, Lindquist was stressing the need for corpus-based studies in translator training and complaining that "the basic material, the data" on the basis of which comprehensive comparative studies may be carried out "has not been collected" (Lindquist 1984:260-261). That time has now come. Different types of corpora as a natural-language-in-use source are employed today in terminology compilation (Sager 1990:129-162), in the development of new tools for machine or machine-aided translation and as direct knowledge bases for modern machine translation (MT) systems, e.g., translation support tools, such as translation memories (e.g., Ahrenberg and Merkel 1996) on the basis of which specific investigations can be performed (Merkel 1998), in translation-related lexicography which is, inter alia, also aimed at providing computational tools for the translator, e.g., the Pisa "prototype Translator's Workstation" (Peters and Picchi 1998:92-93), and in contrastive studies (e.g., Johansson and Oksefjell 1998). As more recent research into the use of corpora in LSP has shown (Bowker and Pearson 2002), corpora can be used to produce glossaries and extract terminology, and they can also serve as a "writing guide" and a "translation resource", in the latter case, e.g., they can be used to identify terminological equivalents, collocates, explanatory contexts or stylistic aspects in the TL (op. cit.:193-210), and may prove useful in further applications (such as the

creation of an LSP learner corpus) as well (op. cit.:135 ff.). Moreover, it is hoped that the techniques and tools of corpus linguists will fulfil "the growing need for a rigorous descriptive methodology in an attempt to increase the inter-subjectivity of the applied areas of translation studies, such as translator training and translation criticism, and of course in the pursuit of a more satisfying theoretical account of the phenomenon of translation itself" (Baker 1995:224). Baker distinguishes between three basic types of corpora designed for research in translation studies: 1) **parallel corpora** which consist "of original, source language-texts in language A and their translated versions in language B" (Baker 1995:230), and which will be used "in materials writing, computer-aided translator training" and machine translation (op. cit.:231); 2) **multilingual corpora** which refer "to sets of two or more monolingual corpora in different languages, built up either in the same or different institutions on the basis of similar design criteria" and enabling us "to study items and linguistic features in their home environment, rather than as they are used in translated text" (op. cit.:232); and 3) **comparable corpora** composed of "two separate collections of texts in the same language: one corpus consists of original texts in the language in question and the other consists of translations in that language from a given source language or languages" (op. cit.:234). Since terminology in this field is by no means uniform[5] and may, therefore, sometimes be even misleading, the following change in terminology will be suggested for the purpose of this thesis. Our own corpus of source texts and their translations will be referred to as translation corpus, firstly because this term precisely denotes the concept in question, and secondly, because the adjective 'parallel' has been traditionally used in the collocation 'parallel texts', or 'textes parallèles' in French (Vinay and Darbelnet [1958]1977:272), which denote original texts of the same text genre/type and/or on the same subject in the TL. Thus, original texts in the TL and SL will be referred to as 'parallel texts' within the scope of this thesis (see, e.g., Baumgarten et al. (2001:20) for similar terminology). However, the terminology used by the authors whose corpus-based approaches are mentioned in the following will be employed to avoid confusion when referring to their works.

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[5] What Baker calls 'multilingual corpora' is referred to by Peters and Picchi (1998:92) as 'comparable corpora'. Another term for parallel corpora is 'bilingual corpora' (Leech 1991:79), and Hartmann (1980:37-40) uses the term 'parallel texts' to designate three different classes of text collections. Cf. Johansson (1998:4-5, fn. 2) for an attempt to clarify terminology in this context.

Before discussing the aspect of the corpus as a methodological tool in an investigation of equivalence in STT, the following brief discussion of Baker's approach will delimit it from our own. Baker argues as follows:

> The vast majority of research carried out in this, shall we say emerging discipline, is still concerned exclusively with the relationship between specific source and target texts, rather than with the nature of translated texts as such. This relationship is generally investigated using notions such as equivalence, correspondence, and shifts of translation, which betray a preoccupation with practical issues such as the training of translators [sic!]. More important, the central role that these notions assume in the literature points to a general failure on the part of the theoretical branch of the discipline to define its object of study and to account for it. Instead of exploring features of translated texts as our object of study, we are still trying either to justify them or dismiss them by reference to their originals.
>
> (Baker 1993:234-235)

She claims that dispensing with source texts and equivalence is a necessary prerequisite for corpus work (1993:237). On the basis of comparable corpora (as above defined by her) she suggests looking at the distinctive, universal features of translated texts *per se*, which include 'simplification', 'explicitation', 'normalisation' or 'conservatism', and 'levelling out'.[6] Although Baker's objective is very different from this author's, we will briefly comment on her approach, since we consider dispensing with source texts and value judgements to be very problematic. Moreover, it may well be doubted whether this approach will bring the discipline any further. We may recall Holmes's statement that we cannot understand the nature of the product "without comprehension of the nature of the process" (1988:82). Our point, therefore, is that we cannot content ourselves with the description and categorization of symptoms without looking at causes, since otherwise all we would be left with is a stretching of the limits of descriptivity *ad infinitum*. We feel that the comparable corpus approach will, in the end, reach a deadlock. Even if all the hypotheses are confirmed - and they will be confirmed given the poor quality of so many translations (Schmitt 1985:39)[7] - what does this tell us? The answer can only be evaluative in that we have to improve our translation work, a step that would bring us back to the roots of translation studies, i.e., to a text-in-context based investigation of the

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6   For a definition of these terms see Baker (1996:176-177); Laviosa (2002: 43 ff.).

7   The fact is that Schmitt (1985:39) attributes the frequently occurring defects in technical translations to the feminization [sic!] of the translation profession. (see also f.n. 65). However, not only factual defects, but also register defects often occur in technical translations, both of which may point to an ignorance of pragmatic constraints. Such constraints are also often overlooked in more general LGP translation work. Cf. also Wilss (1999:84) who claims that specialist communication, which involves translation, "always runs the risk of being misunderstood, or of not being understood at all. This may be because the translator or interpreter lacks the prerequisite special knowledge."

particular relationship between a source and a target text. The 'explicitation hypothesis', e.g., formulated by Blum-Kulka (1986) and taken up by corpus-based translation studies (CTS) (e.g., Baker 1996; Laviosa 2002) according to which there is "the tendency to spell things out in translation, including, in its simplest form, the practice of adding background information" (Baker 1996:176) and according to which "translations are always longer than the originals, regardless of the languages, genres and registers concerned" (Klaudy 1998:84),[8] will be reviewed as a side issue in the process of this research (Chapters 3 to 6). 'Explicitations', after all, may occur on various grounds, including systemic, register or other translational and even adaptational grounds (see Salama-Carr 2001 for similar findings). The establishment of 'explicitations' in both parallel (translational) and comparable corpora, may, in fact, reflect a reductionist linguistic approach, the very approach that descriptive corpus-based translation scholars hope to have superseded. Any instance of 'explicitation' (or any other 'translational universal') in a particular TT has to be investigated against the ST within the larger contextual background, since it is co-textual, contextual and situational constraints that may govern the motivation behind the explicitation and inform us about a particular translational behaviour rather than the explicitation itself. As Malmkjær (1998a:539) rightly criticizes in this context:

> [...] the problem that in order to be able to provide any kinds of *explanation* of the data provided by the corpus, rather than mere statistics, analysts really need substantially more context than computers tend to search and display.

It may occasionally also be necessary to distinguish between 'explicitness' as an inherent feature of language (Wandruszka 1969:528) and 'explicitation' as a process-related behavioural concept. But where are we to draw the line between linguistically-inferred and translationally-inferred 'explicitation'? In addition to the frequent lack of contextual considerations in the analyses of corpora, there is again the problem of translation quality, since in corpus-based translational research "qualitative judgements are conspicuous by their absence" (Stewart 2000:213), which means that some instances of 'translational universals' may simply be due to a lack of

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[8]   If the translations held in electronic form in the "monolingual, multi-source-language English Comparable Corpus (ECC)" (Laviosa 1998b:557) are in general longer than their STs, this may itself be already an indicator of quality, since translations from languages tending to use rather lexical, i.e., explicit, means for certain structures, such as German and the Romance languages, into languages that tend to use rather grammatical, i.e., implicit, means for such structures, such as English (cf. also Beneš 1976:94), should be shorter linewise than their STs for systemic reasons alone. Certainly, considerations of text genre and type, i.a., may also influence TT length.

linguistic and/or translational competence on the part of the translator. Hence, the hypotheses put forward by CTS may be regarded, at most, as very general and crude hypotheses, which urgently need some refinement to be useful both in the theoretical/descriptive and applied branches of the discipline. In fact, the absoluteness of the concept of 'universals of translation' has now been somewhat relativized in Laviosa (2002:76-77).

The disregard of qualitative aspects in translational corpora may occasionally produce somewhat debatable procedures, as reflected in the distinction between, e.g., "translational equivalents" (extracted from a parallel, i.e., translational, corpus) and "natural language lexical equivalents" (extracted from a 'comparable' (here multilingual) corpus) (Peters and Picchi 1998:92), obviously to take account of the fact that most translations are not equivalent. However, there is no such thing as a 'translational equivalent' as opposed to a 'natural language lexical equivalent', since in an equivalent translation they should be one and the same thing. Apart from a terminological problem, i.e., the requisite differentiation between 'equivalents' and 'correspondences' (1.4.2), Peters's and Picchi's (1998) approach highlights a problem which is inherent in any investigation of translational relationships, specifically in a parallel corpus-based investigation, viz., that of selecting the objects of our study, viz., objects "for which we can safely assume that they tell us something relevant" (Hoffstaedter 1987:76) about what we are going to investigate. Although, e.g., Marinai et al. (1992-93:195) rightly claim that "the goal must be a high quality corpus, sufficiently representative of the object it aims at modelling [...] and sufficiently large to provide valid data for a wide range of linguistic studies", they do not indicate how equivalence in their sets of 'translationally equivalent' texts has been determined. The qualitative aspect of corpus selection is not even mentioned by Ahrenberg and Merkel (1996:189) who claim that their corpus texts "were selected partly because they were available in electronic form and partly because they represent different text types and translation methods." Marinai et al. (1992-93.195) claim that "no hard and fast guidelines are yet available which can be used to define the "correct" design criteria" (op. cit.:195), and Baker (1995.229), who lists a number of more or less established selection criteria,[9] argues that the classification of

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[9]   The most important selection criteria as mentioned in Baker (1995 229) are.
      "(i)   general language vs restricted domain

corpora along these criteria is "valid but not sufficient for the purposes of translation scholars" (Baker 1995:229). Baker, for instance, claims that to refine the criterion of typicality "the range of translators represented in the corpus" (op. cit.:230) as well as further genre considerations should also be taken on board. In this context, van Doorslaer has rightly stressed the important aspect of a "qualitative refinement" (1995:248) in corpus selection[10] which can be performed by considering "extra-textual criteria" (1995:253) - these criteria have already proved their usefulness in translation-relevant text analysis (Nord ^{2}1991) - on the basis of the first part of the (German) W-questions (based on the Lasswell formula), viz., "**Wer übermittelt wozu, wem, über welches Medium wo, wann, warum** einen Text **mit welcher Funktion?**" (Doorslaer 1995:255, quoting ^{2}Nord 1991:41).

To conclude, it can be said of the corpus-based approaches discussed that Baker's (1995) comparable corpus approach - for the reasons outlined above - can be excluded from an equivalence-related investigation. Multilingual corpora, which have been used so far in terminology compilation (Sager 1990), lexicography projects (Collins COBUILD 1987), and contrastive special languages research (e.g., Göpferich 1995a), provide a valuable source for the study of original discourse patterns in similar contexts in various languages and help to establish correspondences or potential equivalents at the syntactic, lexical-semantic, terminological-phraseological and overall textual levels. However, since there is no translational link between these sets of texts they can neither provide us with information of the particular translational relationship between a source and a target text nor answer the crucial question of how overall textual equivalence can be achieved in translation. Moreover, these corpora cannot contribute much to theoretical issues which are, of course, at the heart of the discipline, although knowledge and insights derived from these types of corpora may function as a 'refinement tool' both in the selection of a translation corpus and in its analysis and

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(ii) written vs. spoken language
(iii) synchronic vs. diachronic
(iv) typicality in terms of range of sources (writers/speakers) and genres (e.g. newspaper editorials, radio interviews, fiction, journal articles, court hearings)
(v) geographical limits, e.g. British vs. American English
(vi) monolingual vs. bilingual or multilingual"
[10]   For examples of the methodological diversity in corpus selection see van Doorslaer (1995:251).

may be considered a well-founded basis for the requisite degree of evaluativeness in the analysis (see 2.2.1). Therefore, this type of corpus may assume the function of a "monitor corpus" (Sinclair 1991:23-26)[11] or "control corpus" (Johansson 1998:6-8)[12] (see f.n. 11 and 12 for differing definitions) to verify or falsify the findings of the translation corpus (see also Baumgarten et al. 2001:19-21, who use three types of corpora in their research, i.e., translation corpora, parallel corpora and validation corpora). As regards the translation corpus proper, we may in this way also counteract what Paulussen (1996:503) calls "the potential drawback of considering only corpus based material as relevant data."

Thus, the translation corpus - though in a very refined version - backed by what is called here a reference corpus containing, i.a., SL and TL parallel texts (2.2.2.1.2), constitutes the basis for an equivalence-related investigation.

As was discussed earlier, there are many constraints and provisos surrounding a translation or parallel corpus-based investigation, such as the establishment of selection criteria, questions concerning exhaustiveness and representativeness (van Doorslaer 1995) as well as the aspect of a 'qualitative refinement' of the corpus and, of course, the computational aspects if the corpus is available in machine-readable form. The former issues have to be addressed in great detail, if an investigation of equivalence is to produce valuable results. However, it should be noted that, in an equivalence-related investigation - in contradistinction to the above research aims, which, like those of the descriptivists, are located downstream of our approach and in which the corpus appears to be an end in itself - the approach lacking, as it often does, a sound theoretical/analytical framework with contextual dimension - the corpus in our case remains merely a tool, though an important one, a means to an end, i.e., it is the quantitative extension of a thorough, systematic and theoretically well-founded comparative investigation into equivalence that aims at furnishing more intersubjective, replicable and representative results, which will in their turn, allow sound generalizations. For the purpose of this research a theoretically well-founded

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[11]   Sinclair (1991:23-26) distinguishes between "sample corpus" and "monitor corpus". The latter holds large amounts of texts for "detailed evidence of language evolution" (op. cit.:25) and provides information the 'sample corpus' cannot provide.

[12]   Johansson (1998:6) claims that a translation corpus needs to be backed by "a control corpus consisting of comparable original and translated texts in the same language."

and refined translation corpus-based comparative methodology for the investigation of equivalence in STT will be presented and discussed in the following sections.

2.2 Towards a theoretically well-founded and refined translation corpus-based comparative methodology for the investigation of equivalence in STT

When - in the context of interpreting research - Gile (1999:167) claims that we need "more research and better research", this applies equally to research into translation. His remark then triggers the questions 'more of what' and 'better in what respect'. To develop an equivalence-relevant methodology, we need to situate our research within an interrelation triangle combining the methodological, theoretical and applied branches of the discipline (Fig. 1). Such research should be carried out using methodological tools which involve, test, validate, amend or falsify theoretical and applied aspects of translation. Therefore, any investigation of equivalence in STT must be based on two methodological pillars, the first being a theoretically well-founded translation comparison (2.2.1) and the second a highly refined translation corpus (2.2.2). (see Krein-Kühle 1999 and 2001b for a very brief overview of this approach).[13] Hence, the corpus-based translation comparison will be theoretically grounded, so that the very theory in whose terms research is carried out can be tested, refuted, confirmed or amended (Toury 1995:1), while the translation corpus itself - as a reflection of actual professional translation practice - will help establish patterns in translation solutions, which can be directly put into service in the applied branches of the discipline. This two-pillar approach will be discussed in the following sections.

2.2.1 Towards a theoretically well-founded translation comparison

Translation comparisons were being made even before the emergence of translation studies as a discipline in its own right, viz., in school stylistics in the 19th century (Spillner 1981:241), in the comparative study of literature, and in contrastive linguistics (Reiß 1981:311). Depending on the purpose, such comparisons can be performed in different ways and with different methods (Reiß 1981:311). They may

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[13]   Compared with the brief overview of the methodology given in Krein-Kühle (1999, 2001b), the methodology propounded here has been revised.
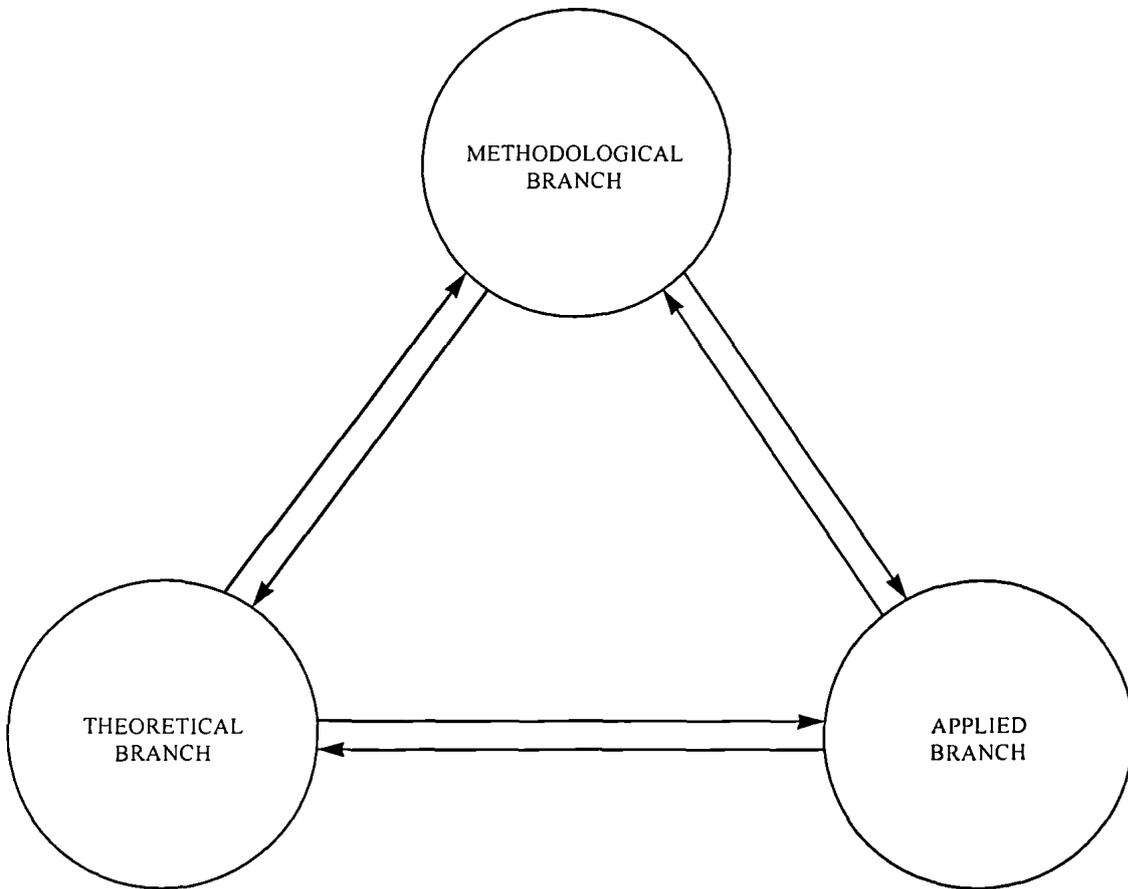
FIG. 1 INTERRELATION TRIANGLE COMBINING THE METHODOLOGICAL,
THEORETICAL AND APPLIED BRANCHES OF TRANSLATION STUDIES

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be used "either for a more exact description of a language by contrasting it with another, or for identifying the dissimilarities and similarities between the contrasted languages" (Spillner 1981:241, my translation). According to Spillner (1972:27), important advantages of the translation comparison are that it is based on "empirically underpinned" authentic data and that this kind of text comparison reveals structural differences between languages which would not have been revealed by simply comparing their grammatical systems. Thus, in the field of contrastive linguistics,[14] translation comparisons have often been used to improve foreign language teaching (e.g., Kirkwood 1966).

Contrastive linguistics (CL) as the "science of *langue*" (Koller 1978:77, italics added) investigates the conditions of "correspondence" by describing language systems using appropriate grammar models and by systematically comparing languages to identify similarities and dissimilarities at various linguistic levels, such as phonology, morphology, syntax and lexis. Translation studies "investigates the conditions of equivalence and describes the allocations of utterances and texts in two languages to which applies the criterion of translation equivalence; it is the science of *parole*" (Koller 1978:77, my translation, italics added; cf.also Koller 2000:21-23).[15] However, as Kühlwein and Wilss (1981:15) rightly state, CL is the "basic linguistic science" for translation studies, because "structural divergences between SL and TL give rise to problems of lexical, syntactic and pragmatic equivalence" (op. cit.:15, my translation). Especially as regards its 'more advanced' form, which stresses the need to go beyond the syntactic level, i.e., contrastive text linguistics (Enkvist 1978) or contrastive textology (Hartmann 1980; Spillner 1981), which has led to more recent contrastive research into special languages/text genres (e.g., Baumann and Kalverkämper 1992; Göpferich 1995a), the two disciplines may benefit mutually from their respective findings.

As has been discussed above, translation comparisons in CL were mostly linguistically and/or pedagogically (foreign language teaching) motivated, whereas the first comparisons which clearly had the practising translator in mind were those employed by the representatives of the "stylistique comparée" (Vinay and Darbelnet

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[14]   For an overview of the various methods of language comparison in contrastive textology see Spillner (1981:239-250).

[15]   For in-depth discussions of the relationship between contrastive linguistics and translation studies cf. Kühlwein et al. (1981) and especially Kühlwein and Wilss (1981:7-17).

[1958] 1977; Malblanc [4]1968)[16] and in STT by Freeman ([4]1945, [2]1944)[17] and Jumpelt (1961). For Hartmann (1980), Vinay's and Darbelnet's approach [1958](1977) "was the most original attempt so far to give discourse its proper place in language comparison", and he claims that their point of departure "was neither the global comparison of language structures nor the problem of interference in language learning [...] but rather the *hypothesis of the 'situationally equivalent text'*" (op. cit.:27). As Vinay and Darbelnet put it, "l'équivalence des textes repose sur l'équivalence des situations" [1958](1977:22). However, this hypothesis is neither specified more precisely nor proven[18] and although comparative stylistics tried to give the translator "a method of producing target-language versions which would be stylistically appropriate in corresponding contexts of situations" (Hartmann 1980:27),[19] no qualitative assessment of the objects of their study is undertaken with a view to establishing whether equivalence exists in the first place. This reflects the basic problem in any translation comparison which is to yield insights into equivalence in translation, viz., the twofold nature of equivalence which is investigated and described empirically to obtain well-founded generalizations and note regular patterns which, in their turn, can be used as input in the translation process to produce equivalence. So how do we know that equivalence exists in the first place? Although Vinay and Darbelnet [1958](1977) were well aware of this problem, since they claimed that

> [...] toute comparaison doit se baser sur des données équivalentes. Mais la reconnaissance de ces équivalences est un problème de traduction au premier chef (op. cit.:21),

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[16]   "Cette confrontation et la création de catégories de la traduction à laquelle nous sommes amenés, ne sont pas de purs jeux d'esprit. Il s'agit de faciliter au traducteur l'identification de difficultés auxquelles il se heurte et de lui permettre de les placer dans les catégories ad hoc, à côté de celles pour lesquelles une solution a déjà été proposée" (Vinay and Darbelnet [1958](1977:27).

[17]   Freeman ([4]1945, [2]1944) is a very early comparative lexical study of scientific and technical English and German who had the translator in mind.

[18]   Hartmann (1980:33) claims in this context that "linguists could not confirm or disprove the hypothesis of the situationally equivalent text until they had at their disposal a more fully developed theoretical and descriptive apparatus to tackle the internal, co-textual features of discourse [...]"

[19]   According to Hartmann (1980:27-28) this "idea [...] was quite revolutionary, but unfortunately came to be ignored or deprecated at a time when behaviourist structuralism was under fire because of its mechanistic analysis of verbal interaction in terms of the regularities that may be found in a corpus of text and the reduction of meaning to language-external stimulus-response conditions. Thus the textual equivalence hypothesis of comparative stylistics was soon overlaid by a new interest in formal correspondences between units at the levels of phonology/graphology, morphology/syntax and lexicology/semantics [...]"

they did not provide any answers to this important question. Moreover, there is a terminological and conceptual difficulty in their work, since 'equivalence' is used as referring to texts and situations ("l'équivalence des textes repose sur l'équivalence des situations"; op. cit.:22) without any further explanation, and to a translation procedure (op. cit.:8-9).[20]

The question of whether the texts used in the comparison are 'situationally equivalent' was overlooked in all translation comparisons that followed, e.g., Wandruszka's (1969) language typology-oriented multilateral comparison of literary translations in six languages and Raible's (1972) investigation of four Romance languages on the basis of a patent[21] and its translations and, more acutely, in recent DTS (descriptive translation studies) and CTS approaches discussed earlier (2 and 2.1).

Although these early translation comparisons either had the translator in mind (Vinay and Darbelnet [1958]1977) for the first time or furnished sensible linguistic and also translation-relevant insights[22] into the crucial features[23] of languages and into the important aspect of their "asystematische Disponibilität" (*non-systematic availability*) (Wandruszka 1969:528), they may be criticized for several reasons, e.g., for still being largely linguistically motivated, for ignoring the hierarchization of textual levels and their interrelations, and for failing to say how the comparisons are actually carried out or to explain and confirm their hypothesis of the 'situationally equivalent text'. What was missing at the time was a descriptive framework based on a sound translation theory for performing a systematic comparison. Thus, whereas the descriptive and corpus-based approaches and their translation comparisons (2 and 2.1) may be considered 'too wide' and located somewhere downstream of our

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[20]   "Procédé de traduction qui rend compte de la même situation que dans l'original, en ayant recours à une rédaction entièrement différente [...]" (Vinay and Darbelnet [1958]1977:8-9).

[21]   Raible (1972:3) claims that he deliberately refrained from using a literary text, i.a., because "the quality of literary translations often corresponds to the fees that are paid for literary translations [...]" (my translation).

[22]   As Wandruszka (1969:11) rightly claims: "Erst das Übersetzen, erst das kritische Vergleichen von Übersetzungen aus mehreren Sprachen in mehrere Sprachen macht uns voll bewußt, wieviel zufälliger Mangel, wieviel Zufallsreichtum, wieviel Zufallsüberfluß in unseren Sprachen ist, wieviel zufälliges Überangebot, wieviel zufälliges Unterangebot."

[23]   According to Wandruszka the features in question are "analogy and anomaly, polymorphy and polysemy, redundancy and deficiency, explication and implication" (1969:528, my translation).

investigation, the approaches of comparative stylistics and Wandruszka (1969) may be considered 'too narrow' and located somewhere upstream of our investigation. On the other hand, there are some important insights to be derived from such studies which are relevant to an equivalence-related investigation, viz., consideration of the stylistic dimension (a pragmatic dimension, after all) in corresponding contexts of situations, the bidirectionality of the comparison (Vinay and Darbelnet [1958]1977:27),[24] the importance of parallel texts, which function as a 'double check' (op. cit.:272)[25] and the fact that the analyst is evaluative (Wandruszka 1969:8)[26] when performing the comparison.

So far, there has been no universally valid definition of the term translation comparison (for three divergent conceptual ideas see Wilss 1982:28;[27] for a detailed systematics see Reiß 1981) and there is little material available about how to carry out such comparisons, although the need for "more refined and reliable techniques" (Hartmann 1981:204) has been recognized. Any comparative-descriptive examination of the highly complex concept of equivalence requires the prior establishment of well-defined comparative parameters and the embedding of the translation comparison into a well-founded theoretical framework, both of which will be discussed in the following sections.

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[24]   "Ecrivant en français pour des lecteurs en majorité francophones, nous serons naturellement portés à partir de l'anglais pour aboutir au français. Mais nous estimons cependant que la comparaison des deux langues doit se faire dans les deux sens" (Vinay and Darbelnet [1958]1977:27).

[25]   "L'avantage de la documentation parallèle est donc d'assurer des éléments unilingues, correspondant à une situation identique ou de même nature; [...]" (Vinay and Darbelnet [1958]1977:272).

[26]   He claims that "der Vergleich von Übersetzungen drängt den Sprachkundigen immer wieder zu kritischen Überlegungen: dieses Wort oder jenen Satz hätte man besser übersetzen können, da hätte man etwas freier, dort etwas genauer sein sollen, dem Original getreuer oder umgekehrt getreuer der Idiomatik der Übersetzungssprache" (Wandruszka 1969:8). Thus, Wandruszka is quite evaluative when commenting on his examples. For instance, he criticizes a "particularly clumsy rendition into German" (op. cit.:85) and frequently marks questionable translations with (!) (op. cit.:89).

[27]   According to Wilss (1982:28) the term translation comparison refers to "three divergent conceptual and methodological ideas" in the "modern science of translation":
    "1. comparing an original text and a translation from the point of view of criticizing a translation [...]
    2. comparing an original text with its translation in various TL (multilateral comparison of translations) in order to determine multilingual structural similarities and dissimilarities [...]
    3. comparing the various translations done of the same original text by different translators into a single TL in order to systematize and to objectify the teaching of translation [...]"

As early as 1965, Kade pointed out that "equating theory with scholarly inquiry (e.g., the empirical generalization of observations in the translation comparison) has a negative effect, because it leads to an underestimation of theory and may route science into 'practicistic' channels", i.e., overstressing practical work at the expense of theory (Kade 1965:164, my translation). Any investigation into equivalence in STT has to be carried out against the theoretical background of a general taxonomy of equivalence-relevant text levels and their respective equivalence-relevant features to guarantee a systematic and methodologically stringent translation comparison that furnishes insights into the highly complex concept of equivalence. Neubert (1970) in his fundamental article on "Elemente einer allgemeinen Theorie der Translation"[28] considers equivalence a semiotic category which exhibits syntactic, semantic and pragmatic components.[29] These are arranged in a hierarchical relationship, with syntactic equivalence being governed by semantic equivalence, and both of these by pragmatic equivalence. Following on from Neubert (1970) and from my own previous research into equivalence in STT (Krein-Kühle 1995a), equivalence relations will be subjected in what follows to a comparative examination at the syntactic (Chapter 3), lexical-semantic (Chapter 4), and terminological-phraseological (Chapter 5) levels. Since all of these levels are hierarchically interrelated in descending and ascending order and may be conditioned and modified by pragmatic aspects, the underlying pragmatics as manifested in translations is examined as well. Pragmatics as a contextual dimension and as understood here, is not restricted to the scientific and technical know-how specific to a certain discipline,[30] but also includes knowledge of the register appropriate to that discipline and accepted by its expert practitioners, involving knowledge of genre conventions. Since textual equivalence is not merely the sum of these levels but the cohesive and coherent final result of all relations operating between them, the comparison is necessarily extended beyond the sentence level[31] to the overall textual level (Chapter 6). In 1972 already, Raible (op. cit.:221) was stressing that there is no such thing as a 'text level' in the sense of one single plane, since any textual level is

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28   'Elements of a General Theory of Translation' (my translation)
29   Cf. Wilss (1980:12) who talks of 'semiotic text analysis' and distinguishes between syntactic, semantic and pragmatic textual levels.
30   Scientific and technical know-how is understood here to include the wider aspect of so-called 'real world knowledge' and/or encyclopaedic knowledge.
31   Raible points out that the Alexandrian grammarian Apollonios Dyskolos - writing in the 2nd century AD already - considered syntax not only to refer to sentences, but also to

made up of various coexisting levels. According to Raible (1972), this implies that a merely statistical investigation of certain linguistic features (e.g. tense) which ignores the relationship between certain features and certain levels cannot provide any meaningful insights.[32] Taking Raible's statement one step further from linguistics to translation studies, we note that it is not only the relationship between certain features and certain levels that has to be considered, but also the hierarchical interrelations between certain levels and features, taking due account of the underlying pragmatics. The hierarchization and interrelation of equivalence-relevant levels and their subjectedness to pragmatic aspects is illustrated in Fig. 2.

For the purpose of this research, we follow Ulijn's (1989:186) definition of register, since it comprises scientific and technical register (Gerzymisch-Arbogast 1993). Register is defined there as follows:

> Originally drawn from music, the term [register] suggests the various drawers of a chest (the verbal repertory of the speaker), which are pulled out in any particular communication situation. A set of such situations is inherent in the scientific and technical domain [...] The approach used here will voluntarily be situational and not diachronic or social [...] A speaker or author thus makes use of a specific register for every domain, a register which is recognized by a listener or reader belonging to the same field.

Register as a situational, use-related variety (Halliday et al. 1964; Halliday 1978; Gregory and Carroll 1978) is understood here to exceed the levels of syntax and lexis to include the textual level. In this way, register contributes to implementing genre (House 1997:107)[33] or 'Textsorte' which is taken to mean conventionalized forms of text related to specific communicative situations (Hatim and Mason 1990:241) and which becomes operative at the macro-structural level in completed

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32   sentences in texts (Raible 1972:2-3).
      "Es gibt keine »Textebene« im Sinne des Wortes 'Ebene'. Jede »Textebene« weist verschiedene Ebenen auf [...]. Diese verschiedenen Ebenen, welche - in einem anderen Sinn von 'Ebene' - die »Textebene« bilden, müssen auf jeden Fall bei jeder sprachlichen Analyse von Einheiten berücksichtigt werden, die höheren Ranges sind als die Satzeinheit - großenteils auch bei solchen, die Satzeinheiten oder kleiner als Satzeinheiten sind. Es wäre beispielsweise wenig aufschlußreich, eine Tempusuntersuchung rein statistisch durchzuführen, um auf diese Weise ein Tempusportrait bestimmter Texte zu erhalten. Interessant und relevant wäre in diesem Fall allein das Verhältnis zwischen bestimmten Tempora und bestimmten Ebenen. Überhaupt wird von einer Sprachwissenschaft her, die Syntax und Semantik als notwendigerweise dialektische Begriffe auffaßt und Ebenen im Text berücksichtigt, eine linguistische Statistik, die ohne Berücksichtigung dieser Faktoren einfach zählt, was zufällig zählbar ist oder als zählenswert erscheint, zu etwas im höchsten Maße Problematischem - ihr bleibt im Grunde nur die Hoffnung, daß die Quantität irgendwann einmal in die Qualität umschlagen wird." (Raible 1972: 221)

33   House (1997:107) regards genre "as a category linking register (which realizes genre) and the individual textual function (which exemplifies genre)."
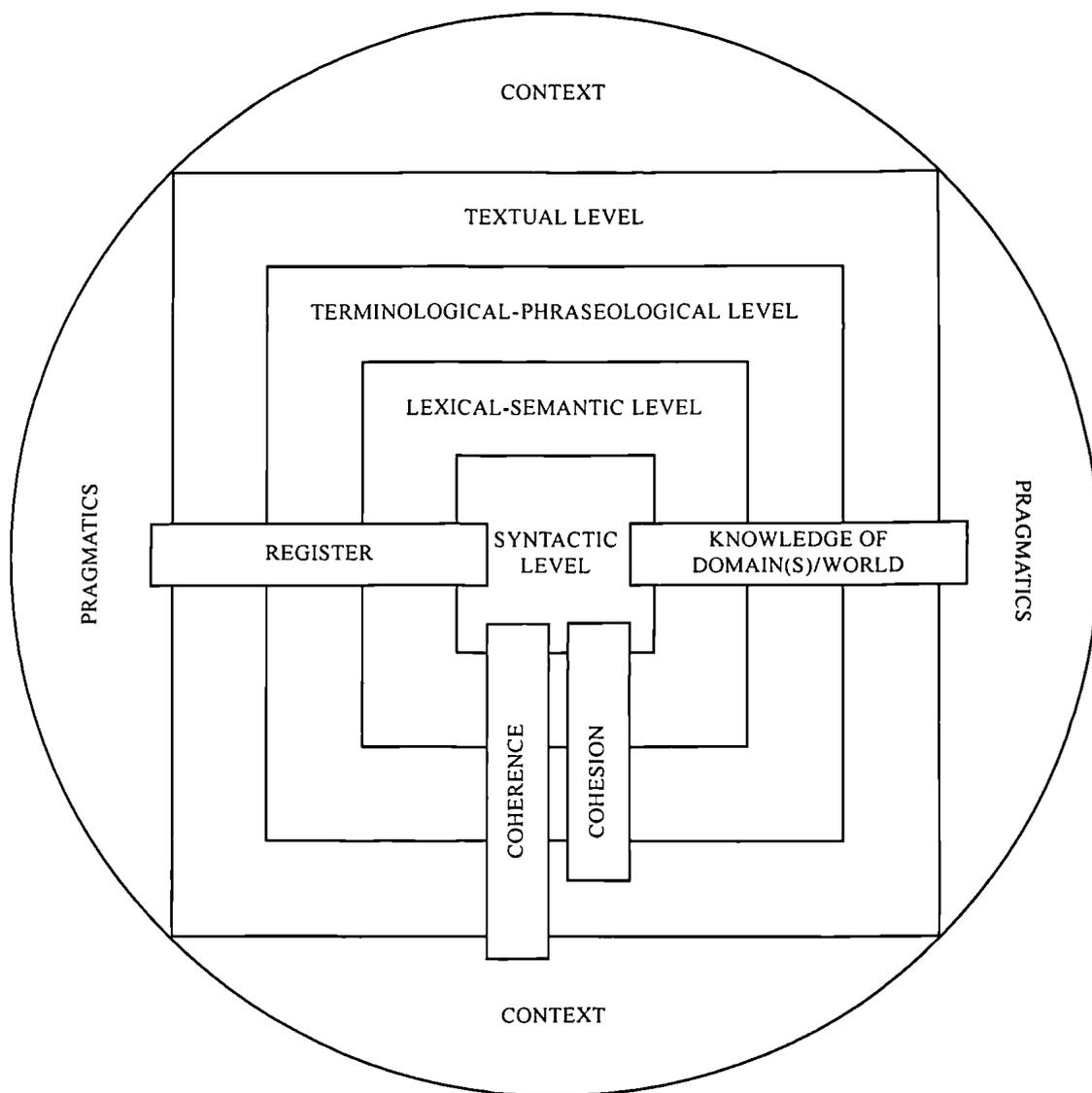
FIG. 2 TAXONOMY OF INTERRELATED TEXT LEVELS IN CONTEXT

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texts (Couture 1986)[34] (see 2.2.2.1.1). The notion of register as "a form of prediction" (Halliday 1978:32)[35] will also become a useful tool in the selection of the objects of our study (2.2.2.1.1).

Although a sensible and theoretically well-founded hierarchization of textual levels taking due account of their interrelatedness and their subjectedness to pragmatic aspects is a prerequisite for the investigation of equivalence, it should be stressed that the establishment of such levels is above all an analytical tool, since in the process of analysis (as in the process of translation) the individual equivalence-relevant features investigated (Chapters 3 to 6) will have to be considered against the background of all levels including the contextual level simultaneously in order to yield meaningful insights. This implies that textual levels may overlap and that it may occasionally be difficult to attribute specific features to specific levels (see, e.g., 4.3). On the other hand, only the segmentation of the text into hierarchically organized levels will enable us to demonstrate how equivalence relations operate at and between such levels and to explain what kind of shifts occur and why. In the present work, the notion of shifts (see Bakker et al. (1998) for an overview and Koster (2000:87 ff.) for a detailed study of shifts from a DTS point of view) will be defined as changes occurring in the translation process and - by extension in the product - for systemic, register- or domain-induced or other translational reasons. The closest attention will be paid to those translational shifts which can be attributed to pragmatic considerations, i.e., register aspects or domain knowledge, to investigate in what way they may condition and modify equivalence at the syntactic, lexical-semantic, terminological-phraseological and overall textual levels. In the present research we will not follow traditional distinctions, such as those between obligatory shifts (due to constraints in different grammatical systems) and optional shifts (e.g., stylistic preferences) (e.g., Blum-Kulka 1986:33), since it is pragmatic aspects that may constrain 'stylistic', or in STT, register choices (Salama-Carr 2001). Investigating translational shifts implies looking at the level at which the shifts occur and trying to explain the motivation behind the shifts. For example, a shift may have to be made for systemic ('obligatory') reasons at the syntactic level (see, e.g., the expanded

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[34] For an attempt to demarcate register from genre see Swales (1990:38-42).
[35] "The notion of register is thus a form of prediction: given that we know the situation, the social context of language use, we can predict a great deal about the language that will occur, with reasonable probability of being right." (Halliday 1978:32)

postmodifying past participle in 3.2.1.1.1), which may leave the translator with a variety of correspondence options in the TL (such as relative clauses). The established trend in the translation solutions leading to equivalence at the syntactic level (trend towards prenominal attributes) may have been governed, however, by pragmatic, i.e., register, aspects. Describing stylistic, here register, shifts as 'optional' would imply that, as Salama-Carr (2001:218) rightly points out, pragmatic factors do not represent real constraints.[36]

In addition to being embedded in a sound theoretical framework as described above, the translation comparison - as mentioned earlier - also presupposes the prior establishment of certain comparative parameters:

■   Complete written real ST-TTs in 'communicative function' (Schmidt 1972:10), who talks of "Text in kommunikativer Funktion" or Holmes (1988:101), who calls such texts "actual translated texts-in-function"), i.e., the ST-TT pair should have been the object of an actual translation assignment. The ST and TT should then be read independently by the analyst (van Doorslaer 1995:256) against the background of her/his linguistic-translational and domain-related knowledge to gain a first insight into the way the textual content is expressed in both the ST and TT, and whether the TT reads like an 'original' writing in the TL.[37]

■   A comparison procedure that is both 'linear' and 'selective' (as distinguished by Reiß (1981:316-317).[38] The comparison should be carried out linearly in order to gain insights into overall textual equivalence and relevant frequency patterns. This procedure represents the proof-reading/supervising approach of the analyst in her/his

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[36]   As Salama-Carr (2001:218) rightly claims in a similar context: "Ce qui reviendrait à dire que les facteurs pragmatiques ne représentent pas des contraintes véritables, et à nier en quelque sorte l'influence des normes textuelles et traductionnelles."

[37]   Although the translation of scientific and technical discourse should generally be highly TL oriented and may assume the status of an original source text in the TL culture, the adjective 'original' must not obscure the fact that there is always a tension between - even the best - translation and original writing in a particular TL, simply because there has been an ST in the first place.

[38]   According to Reiß (1981:316-317), the linear method juxtaposes and compares "word for word, syntagma for syntagma, sentence for sentence, etc." taking due account of the inter-relationships of the individual segments and their linguistic and situational context. The selective method chooses and systematically compares individual phenomena which are to be translationally relevant, because from a linguistic point of view any element can be relevant.

second contact with the ST-TT pair to establish the suitability of the latter for the comparison.[39] The comparison is then performed selectively in order to describe and investigate in greater detail the predominant and recurring features which may make equivalence difficult to achieve at all levels. By allocating these features to the previously hierarchically arranged levels, a "hierarchical ordering of the features" (Holmes 1988:89) can be achieved as well. In this way a "repertory of features" (op. cit.:89) which are relevant to an equivalence-related investigation can be determined. Although this repertory obviously cannot be exhaustive, it is hoped that this method in tandem with a well-defined translation corpus (2.2.2) will bring about a reasonable degree of intersubjectivity of the results of the analysis.

■   A well-defined translation unit, viz., the text (in context) in all its complexity (e.g., Barchudarow (1979);[40] Reiß (1981); Neubert (1984, 1985, 1988); for an overview of the 'unit of translation' see Malmkjær 1998b). The text is, at the same time, the unit of comparison. According to Weinrich (^{5}1974:19), "words [...] belong in sentences, texts and situations" (my translation). However, this complex translation unit is considered a dynamic rather than a static variable (cf. Koller ^{4}1992:100), because the establishment of overall textual equivalence requires that we go down to lower levels, such as terminological-phraseological, lexical-semantic and syntactic levels in our case, and simultaneously back up transphrastically to the textual level in order to establish their hierarchical interrelatedness and interdependencies. Thus, Neubert (1988:85) rightly argues that the top-down process has to be backed by bottom-up processes in order to avoid inaccuracy in detail.

■   A reliable *tertium comparationis*, viz., the 'sense' or 'das Gemeinte' ('what is meant') (cf. Coseriu 1978; 1981) as the basis for the comparison. The notion of 'sense' is defined by Coseriu (1978:21) as "the particular content of a text or a textual unit, as far as this content does not simply coincide with meaning and designation" (my translation). Following de Beaugrande and Dressler (1981:84), we

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[39]   This procedure will help the analyst to detect any additions or omissions in the TT
        going beyond the level of ST intended sense (cf. also van Leuven-Zwart 1992:78) and
        which would have to be classified as adaptational elements (see 1.4.1).

[40]   "Bei der Übersetzung kommt es aber nicht auf die Äquivalenz der Bedeutungen einzelner
        Wörter und auch nicht isolierter Sätze an, sondern auf die Äquivalenz des zu
        übersetzenden Textes (Redeprodukts) als Ganzheit gegenüber dem gesamten
        Übersetzungstext" (Barchudarow 1979:17).

define meaning as "the *potential* of a language expression" for relaying knowledge, whereas sense desginates "the knowledge that *actually* is conveyed by expressions occurring in a text." Though expressions may have "several virtual meanings", they generally have only one sense in a text (cf. also Weinrich 1974:24)[41]. Moreover, since scientific and technical discourse may be defective (Schmitt 1987b; Horn-Helf 1999), the somewhat vague concept of content/textual content - which has been often considered a sound *tertium comparationis* in STT (e.g., Reiß 1981:317;[42] Jumpelt 1961:18)[43] - may not always be a reliable basis. Therefore it is the 'sense'or 'das Gemeinte' ('what is meant') that is the essential element in the textual content (alongside designations),[44] and this sense is a product of both linguistic and extra-linguistic knowledge (in our case the extra-linguistic factual knowledge/domain specific know-how). Thus, to be more precise: the sense, including 'intended sense', or 'Gemeinte' - whose existence may be checked by referring to the 'objective reality' underlying it (Kade 1964b:94)[45] - is the element common to both ST and TT and may be considered the *tertium comparationis* and the element that has to be kept invariant in the process of translation. Any comparative investigation into equivalence will try to establish how equivalence is implemented - despite the interlingual syntactic, semantic and pragmatic differences in presenting this sense - on the basis of its actual manifestation in ST and TT.

■ The directionality of the comparison, viz., bidirectionality.[46] Although the translation process itself is always unidirectional and irreversible (Wilss 1982:59) -

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[41] Cf. also Weinrich (⁵1974:24) who emphasizes the intimate link between sense and text. According to him, the text adds the constraint to the sum of words, i.e., by removing most of the sum of meanings, it establishes the sense which is "the result of the plus of meanings and the minus of constraints" (my translation).

[42] Reiß (1981:317) argues that in informative text types, content structure, genre aspects and 'stylistic' level may function as the basis for the comparison.

[43] Jumpelt (1961:18) does not explicitly speak of a *tertium comparationis*, but claims that content orientation may function as a reference basis for an "objective representation of STT." (my translation)

[44] "The communicated textual content consists entirely of designation and sense." (Coseriu 1978:22, my translation). Like Coseriu (1978), we feel that the task of translation is to render 'sense' not 'meaning'. Unlike Coseriu, however, who demands sameness of sense and sameness of designation (*Bezeichnung*) via the means of another language as obligatory criteria for translation (op. cit.:21), we feel that the designation must change in translation in order to maintain the sense. Coseriu (1978:25 ff.) was well aware of the potential conflicts that may arise from this demand.

[45] Kade (1964b:94) rightly points to the possibility of referring to the facts of the case ('Sachverhalt'), i.e., the objective reality, underlying the 'Gemeinte', which may serve as a reference basis for proving the existence of the 'interlingual Gemeinte'.

[46] Certainly, the aspect of bidirectionality does not apply in those cases where translators

with the exception of, e.g., back-translation and word-for-word translation - because it is directed from an ST to a TT,[47] any translation comparison aimed at investigating equivalence in tandem with specific equivalence-relevant features is, by virtue of the term itself (1.4.2), bi- or adirectional (Vinay and Darbelnet [1958]1977:27; James 1981).[48] A similar view - though in a somewhat different and wider context - has also been argued more recently by van Leuven-Zwart (1992:80) and van Doorslaer (1995:256), who claims that the translation comparison is a "two way interaction" with the analyst "working simultaneously along the comparative lines ST-TT and TT-ST."[49] The bidirectional comparison of equivalence-relevant features may provide more meaningful and more powerful findings which may be applicable in both translation directions and even lead to findings that go beyond the particular language pair examined.[50]

■   The competence of the analyst, including the requisite, by no means, arbitrary evaluativeness. In performing an equivalence-relevant translation comparison, the analyst has to combine the two abilities which Wilss (1982:220) requires of the translation critic, i.e., "the ability to recognize equivalent/non-equivalent utterances in the context of his intertextual competence, and the ability to translate in the context

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remedy factual or 'stylistic' defects in STs (Schmitt 1987b; Horn-Helf 1999), a procedure which is often required in the translation of scientific and technical texts to achieve overall TL textual equivalence via the sense.

[47]   This unidirectional, irreversible, and ST→TT-directed translation process, however, should be considered a dynamic 'open-loop process', since the translator constantly compares her/his translation product with the ST, and, by having recourse to parallel texts, may perform back-translations to ensure that, e.g., terminology or syntagmatic expressions found in the parallel text really are the equivalents sought-after for specific terms and expressions in the ST.

[48]   James's (1981:127) statement as regards contrastive analysis that "CAs are neutral in directionality, that is, inherently adirectional", since "we are dealing with equations rather than with operations" (op. cit.:129), also holds true for the translation comparison, since we are comparing the ST with the product of the translation process, i.e., the TT; this, however, should by no means be understood to mean that the 'operation', i.e., the process, can be ignored, as will be highlighted further on in this research (see Chapters 3 to 6).

[49]   In this context, van Doorslaer criticizes Toury's (1980:113) early suggestion that the translation comparison is "unilateral and irreversible" (this had to do with Toury's ST-oriented notion of the *Adequate Translation* which functions as the *tertium comparationis*) (see Appendix II). Van Doorslaer, however, also reminds us that Toury was well aware of the practical problems inherent in this principle and therefore suggested proceeding "simultaneously along two lines" (Toury 1980:120).

[50]   For example, the postmodifying past participle used in relative clause reduction (3.2.1.1.1) is an equivalence-relevant feature in many other European languages in addition to English, such as the Romance languages, French, Spanish and Italian. Thus, the trend established in the translation solutions may also hold true for the translation direction of these Romance languages into German. Of course, further generalizations would require recourse to a different language pair-based or multilingual corpus.

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of his own translation competence". The first aspect implies that the analyst needs to be evaluative, because 'non-equivalent utterances' which would distort the results of the analysis have to be detected in the translation products and discussed separately. As Jumpelt (1961:41) rightly argues, "not all findings are suited for a system which tries to deduce regularities from them" (my translation). The second aspect involves looking at the translation process, since the analyst has to reverse the transfer procedure and replicate the translator's decisions (Holmes 1988:81-91) and "the psycholinguistic processes leading to the TLT [target language text]" (Wilss 1982:220). By investigating equivalence on the basis of the products, we will learn also more about the 'blackbox' of the process, simply because "the one is the result of the other" (Holmes 1988:81),[51] so that our investigation, it is hoped, will not only yield an account of intersubjective regularities in the equivalence relations between STs and TTs, but also shed more light on the important question of precisely how the complex mechanism of equivalence relations operates and can be uncovered step by step in the translation process. Both aspects are of the utmost importance in the improvement of translation quality and in translator training in the field of STT.

The evaluativeness of the analyst is not arbitrary, firstly, because it is rooted in the linguistic-translational and domain-related specialized knowledge which make up her/his analytical competence; secondly, because it is guided and governed by a sound theoretical framework (as propounded earlier); and, thirdly, because it is guided and constrained by equivalence-relevant knowledge and insights derived from related research work in the fields of translation and LSP and by findings derived from parallel texts and/or further 'refinement tools' which are considered with the translation corpus (2.2.2.1.2). Thus, the higher the 'refinement degree' of the corpus, the lower the arbitrariness in its evaluative analysis. The latter aspect is all the more important, since it helps counteract the risk that the tendencies observed in the

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[51] As Holmes (1988:81) rightly claims: "True, it is very useful to make a distinction between the product-oriented study of translations and the process-oriented study of translating. But this distinction cannot give the scholar leave to ignore the self-evident fact that the one is the result of the other, and that the nature of the product cannot be understood without a comprehension of the nature of the process." Cf. also Wilss (1980:9) who claims that "die ÜW [Übersetzungswissenschaft] ist sowohl eine prospektive, prozeßorientierte als auch eine retrospektive, resultatorientierte Disziplin [...]". And Emery (1996:143) who, referring to Ivir (1981:213), more recently claims that "consideration of whether two texts are translationally equivalent does not *ipso facto* entail viewing them as products" and that "assessment of translational equivalence, adducing and considering strategies and reasons for choosing one translational alternative over another is no less dynamic than viewing translation as process".

translation corpus may only reflect "translation *practices* rather than significant translation *regularities*" (Hewson and Martin 1991:211).

To summarize the above discussion, it should be noted that any translation comparison, if it is to yield equivalence-relevant insights, needs to be performed within a theoretically robust framework with due account being taken of the hierarchization and interrelatedness of textual levels and their subjectedness to pragmatic aspects and requires the prior establishment of equivalence-relevant comparative parameters, such as the completeness of written texts in 'communicative function' (Schmidt 1972), a comparison procedure that is both 'linear' and 'selective' (as distinguished by Reiß 1981:316-317), a well-defined translation unit (viz., the text), a reliable *tertium comparationis* (viz., the 'sense' or 'Gemeinte'), the directionality of the comparison (viz., bidirectionality) and the competence of the analyst including her/his requisite - though by no means arbitrary - evaluativeness.

As mentioned before, equivalence-relevant knowledge and insights derived from related research work in the fields of LSP/contrastive special languages research (e.g., Sager et al. 1980, Sager 1990; Beier 1980; Fluck [2]1997; Göpferich 1995a) and scientific and technical translation (e.g., Jumpelt 1961; Spitzbardt 1972; Pinchuck 1977; Franck 1980; Schmitt 1985, 1987b, 1989, 1999; Schröter [3]1990; Horn-Helf 1999) will be considered and their relevance either refuted or confirmed in the course of the analysis on the basis of the corpus. The latter aspect, of course, applies all the more so to the theoretical framework postulated here and in whose terms the investigation is carried out.

As has been stressed several times in the above discussion, any translation comparison can only provide meaningful and substantiated insights, if it is based on a highly refined translation corpus, and this is defined and presented in detail in the sections that follow.

2.2.2 Towards an equivalence-relevant translation corpus

As van Doorslaer (1995:251) rightly points out, "there is no established way to make a selection [of texts] for a translation comparison". Since it is only recently that corpora have entered the field of translation studies on a larger scale for use in

different areas and with different research objectives (Baker 1995; Laviosa 1998a, 2002), there is a lack of robust selection criteria including "extra-textual information" (van Doorslaer 1995:256), so that most "selections are made at random" (van Doorslaer 1995:251).[52] This situation leaves it "up to the analyst to find relevant methodology for describing [and selecting] his data as well as relevant argumentation for his proposals" (Tirkkonen-Condit 1989:16). The need to draw up a list of relevant selection criteria including 'extra-textual information' to make the corpus translationally more relevant has been stressed in the literature (van Doorslaer 1995), and it goes without saying that the corpus design always directly correlates with the subject matter of the investigation.

Any research into equivalence in STT needs to be based on well-devised selection criteria to design a corpus that promises relevant and intersubjective insights into and results for this highly complex concept. To this end, a three-fold set of selection criteria with a special emphasis on the qualitative aspect has been devised to create an equivalence-relevant translation corpus which is so constituted as to contain only - wherever reasonably possible - what Kade (1964a) calls "druckreife Übersetzungen" (*publishable translations*), implying the highest quality level.[53] This three-fold set consists of general selection criteria (2.2.2.1.1), qualitative criteria (2.2.2.1.2), and a quantitative criterion (2.2.2.1.3), all of which are relevant to an equivalence-oriented investigation and are listed and discussed in the following.

2.2.2.1   Corpus selection criteria

Corpus design requires well-founded selection criteria with special emphasis on those aspects which are particularly relevant to a specific investigation. Depending on the purpose of the investigation, the corpus and text attributes may, but need not coincide in full with those established in corpus linguistics (see Atkins et al. 1992), though some of the latter may also be relevant to TS. As mentioned above, an equivalence-relevant three-fold set of selection criteria has been devised which consists of general selection criteria (2.2.2.1.1), qualitative criteria (2.2.2.1.2), and a quantitative criterion (2.2.2.1.3). Since only one text was sampled for this research,

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[52]   Cf. also Biber (1993:243), who mentions that in corpus linguistics samples are often collected "without a prior definition of the target population".

[53]   For the publishable translation Kade (1964a:257) demands "an optimum selection of the TL means used within the scope of the objectively given equivalence relations between SL and TL" (my translation).

the criterion of relevance has been included as well to justify the selection of a particular language combination, domain and genre. The relevance criterion may help demonstrate that the ST-TT pair is representative of a specific genre and domain and of the translation assignments that actually exist.

2.2.2.1.1   General selection criteria

The following selection criteria involve both corpus attributes - a) to d) - and text attributes - e) to l), though these attributes may overlap.

a)   Full text

Since it is only within the framework of the text that the complex concept of equivalence can be fully considered (2.2.1), the investigation has to be carried out on the basis of complete[54] written texts-in-contexts (see Schmidt 1972:10, who talks of "Text in kommunikativer Funktion") to demonstrate how equivalence relations operate at all levels up to the crucial textual level with due account being taken of the underlying pragmatics. The ST-TT pair/s should have been the object of a real translation assignment and the ST/s should be a real example as opposed to texts that have been written in a certain predescribed or idealistic way or revised *a posteriori* to a higher standard. In STT it is common to be "confronted with the burden of recoining poorly written originals" (Paulussen 1996:504; Horn-Helf 1999), and it may be very insightful to see how translators deal with such sources to achieve equivalence in translation. This criterion coincides to a certain degree with the first comparative parameter mentioned in 2.2.1.

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[54]   Cf. also Bausch (1971:53-54) who lists a couple of preconditions for selecting a translation corpus: "*a*) Il faut se baser sur des textes avec leurs traductions, tout en assimilant les résultats de la linguistique de la parole, et non pas se baser sur des syntagmes, des unités lexicales, etc., isolés du texte intégral; [...]"
More recently Baker (1995:240) rightly points out that "corpora which consist of whole texts are, on the whole, far more useful than those which consist of text fragments [...] a corpus which consists of text fragments has obvious limitations in terms of studying larger text patterns, such as patterns of cohesion across chapters [...] And a corpus which consists of a set of sentences will not even allow a study of more modest patterns, such as paragraphing and inter-sentential cohesion [...]"

b) Synchronicity

The ST-TT pair/s should date from the same period of time, since we are not interested in the diachronic aspect, but want to know how equivalence relations operate between SL and TL that exist as a 'state' at a particular point in time (de Saussure [1916]1975). The ST-TT pair under investigation dates from May 1993.

c) Bilinguality

Any translation corpus is *per definitionem* a bilingual corpus, i.e., it contains STs and their translations in the target language (TTs). However, any translation corpus which is to provide meaningful insights into equivalence in STT has to be backed by a reference corpus for qualitative reasons as discussed in 2.2.2.1.2. In the present case, the translation direction is English (ST) into German (TT).

d) Central corpus and reference corpus

The central corpus is a specialized translation corpus, i.e., the ST-TT pair, which is held in electronic form. The reference corpus, which is not held in electronic form[55], is used for validation purposes. The textual data constituting the reference corpus are described in 2.2.2.1.2 a).

e) Register considerations

Due to its predictive force, the notion of register (see 2.2.1) is a useful tool in the selection and analysis of the object of our study, since specific domains/contexts will trigger specific uses of language, and these can be identified prior to corpus construction (Biber 1993:245).[56] From the point of view of translation and depending on the language combination involved, the TL register may impose constraints which may lead to considerable shifts at various textual levels. Thus, knowledge of TL register requirements is a must for the analyst to enable her/him to uncover and explain such shifts. The dimensions of register (according to Halliday et al. 1964; Halliday 1978) will be described as follows:

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[55]   For further research with a growing translation corpus, it would certainly be appropriate to hold the reference corpus in machine-readable form, too, to provide easy and quicker access to the latter.

[56]   "[...] registers are based on the different situations, purposes, and functions of text in a speech community, and these can be identified prior to the construction of a corpus." (Biber 1993:245)

i) Field:

Scientific and technical discourse, i.e., the scientific research
report, covering the following domains:

<u>Domain/sub-domain</u>: coprocessing, which is a coal liquefaction process and
refers to the combined hydrogenation of heavy mineral oil fractions and coal.
<u>Superordinate domain</u>: coal-based chemistry
<u>Adjacent/intersecting domains/sub-domains</u>: coal technology, chemistry,
chemical engineering/chemical process technology, reactor technology,
physics, mathematics, kinetics and others.

ii) Tenor:

Highly dense, factual-informational, native speaker
scientific and technical English (American/Canadian) report describing the
results of a 3-year research programme into coprocessing. Strikingly, the
author often uses modal verbs and modal expressions (see 4.2) as a built-in
safety margin to tone down the absoluteness of statements and conclusions,
which may have to do with the fact that the report deals with cutting-edge
research. The scientific and technical language of this report is by no means
an instance of a so-called 'restricted register' (Hatim and Mason 1990:53) or
controlled language as used, e.g., in weather reports (Nordman 1998), but is
rather varied and touches on the various domains mentioned under i) Field.
<u>Direction of communication or intended audience</u>: Communication is directed
from expert to expert in the same field ("fachinterne Kommunikation", Möhn
1979). The intended audience is a group of (German) experts in that
particular field with an interest in the latest research findings.

iii) Mode:

<u>Medium</u>: Written to be read.
<u>Participation</u>: monologue, non-interactive, i.e., the reader is referred
to in one instance only (see 4.2.1.1.2), informational, scientific
and technical exposition.

f) Genre considerations

Genre becomes operative at the macro-structural level of discourse in
complete texts and "specifies conditions for beginning, continuing and ending a text"
(Couture 1986:82).[57] Like register, genre, too, may have a predictive force as regards
the way a text is structured in a particular language, since TL genre conventions may
impose constraints which may lead to shifts at the overall textual level. Thus,
knowledge of TL genre conventions is a must for the analyst to enable her/him to
uncover and explain such shifts. However, in the genre investigated, the translation
problems tend to be due to the very high degree of technicality (see j)) (involving,

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[57]   "Unlike register, genre can only be realized in completed texts or texts that can be projected
as complete, for a genre does more than specify kinds of codes extant in a group of related
texts; it specifies conditions for beginning, continuing, and ending a text." (Couture
1986:82)

above all, domain knowledge and register knowledge) rather than considerations of discourse structures. Two equivalence-relevant dimensions of genre will be described as follows:

i)   Genre constancy or 'Textsorteninvarianz'.
In an equivalence-relevant investigation the TT genre equals the ST genre.

ii)   Genre classification
According to Göpferich's (1995a, 1995b) "pragmatic classification of LSP texts in science and technology", the genre examined here belongs to "progress-oriented actualizing texts" (Göpferich 1995a, 1995b) whose main communicative function is to convey "information intended to advance science and technology" by presenting the findings of cutting-edge research "which may also be a (re-)evaluation of current knowledge" (Göpferich 1995b:308).
For a macro-structural description of the research report examined (ST-TT) see Appendix III.

g)   Functional constancy

Function is understood here to refer to text function as defined by House (1997:36) (1.4.1) and to imply that ST and TT have the same communicative function among experts in the SL and TL communities. Functional constancy as a prerequisite for equivalence is closely related to the question of delimiting translation from other forms of text production (1.4.1). Functional constancy also implies genre constancy (see above).

h)   Text typology

The text typological selection presented in the following is motivated by the object of this thesis, which is the establishment of equivalence in STT, viz., for the reasons outlined in the Introduction. The ST-TT pair belongs to what Reiß (1971:31-37) calls the "content-centred" and later the "informative text type" (Reiß and Vermeer [2]1991:206 ff.) which is the text type specific to and representative of scientific and technical discourse.

i)   Text status

The text status relates to the question of whether the texts included in the corpus are published or not. The texts included in the central corpus have not been published and are, moreover, marked as classified documentation. Therefore, some alterations and omissions have occasionally to be made in exemplification (e.g., proper names and some processes are replaced by letters, e.g., X, Y, Z, and omissions indicated by three dots), though these do not impair the general argument.

j)   Degree of technicality

The research report investigated exhibits a very high degree of technicality and ranks X on a scale of difficulties in ascending order from I to XI (Arntz 1993:161). The ascending levels of difficulty (I-XI) correspond to the increasing amount of specialized knowledge "required in the translation process to clarify technical subject matter-related aspects" (op. cit.:161, my translation).

k)   Geographical considerations

The present English ST was written by a single author in Canadian/American English. With English becoming the *lingua franca* in the last 80 years in the domain of sciences in particular (Hoberg 1995:3), and with the growing globalization and internationalization of science and technology, research reports and journal articles, in particular, often reflect the work of an international team of researchers who either use English as their mother tongue or language of habitual use. The potential excessive influences of American, Australian or Canadian English, for example, may be contained by the fact that technical texts have to optimally perform their communicative function in the case of both English STs and English TTs in their respective scientific communities at international level (international audience constraint) and by the "notice to authors" in the case of journal articles (editorial constraint).[58] From the point of view of STT, therefore, the emphasis is on what can be called 'international (scientific and technical) English' (at least as regards the native English-speaking countries) rather than on a specific variety of English. Admittedly, this only applies to an English→German translation corpus[59] and from a

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[58]   The 'editorial constraint' is, e.g., also relevant in the preparation of scientific and technical papers to be given in English at international conferences.

[59]   With a German→English translation corpus, the differences in the varieties of English,

global point of view, there may be more pronounced differences in the scientific 'World Englishes' used (Montgomery 2000:253 ff.).

l) Relevance considerations

As mentioned in 2.2.2.1, relevance considerations may help demonstrate that the ST-TT pair is representative of a specific genre (see f) above) and domain (see e) above) and of the translation assignments that actually exist. Relevance attributes are: genre typicality, domain specificity and language pair aspect. According to a survey by Schmitt (1993:3-10), the genre investigated here is not only relevant in the field of STT (see also Gräf (1972) and 1.4.3), but also a typical representative of scientific and technical discourse.[60] Domain specificity is a function of the relevance of the subject fields as reflected in the actual demand for translations. The field of chemistry (in its broadest sense) ranks second in the translation volume in Germany according to the above survey. The main working language in the field of translation in Germany is English, with translations from English into German and from German into English almost holding the balance in quantity terms with a slight lead for the latter language direction.[61]

2.2.2.1.2   Qualitative selection criteria based on textual and extra-textual data

Qualitative selection criteria involve textual and extra-textual data which are to be taken on board to make the corpus more relevant for the purpose of the investigation. These criteria are designed to ensure the presence of 'publishable translations' (Kade 1964a) on the basis of which the comparison is carried out and which refer to both textual and contextual-situational aspects. The textual data are combined to form what we have called the reference corpus (2.2.2.1.1, d)). These criteria are presented in the following:

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[60] such as spelling differences, may have to be taken into account.
It should be noted that already in 1961, Jumpelt (1961:39) was claiming that the lion's share of translated scientific and technical literature consists of "Fachaufsätze und Monographien, Forschungsberichte, Patente, Betriebsanleitungen sowie die jahrgangsweise vollständig übersetzten Zeitschriften (cover-to-cover translations) [...]"

[61] Due to globalization, this may have changed in the meantime towards a somewhat more pronounced trend towards translations from German into English.

a) Textual data constituting the reference corpus

Since prototypical considerations may enforce "a number of selection restrictions which function as a much more refined filter than the [...] general equivalence relations between L_1 and L_2" (Neubert 1984:66), since they provide the translator with "a network of restricted text-bound equivalences" (op. cit.:66), inclusion of SL and TL prototypes, i.e., the typical representatives of a particular genre in the SL and TL, may function as a qualitative refinement in corpus selection and analysis. For qualitative reasons, a bilingual translation corpus should ideally be 'bidirectional', i.e., in our case it should consist of both translations from English into German and vice versa (Johansson 1998:6-8) of the same genre and the same subject field to achieve a higher degree of intersubjectivity in the results of the investigation. Under these conditions, the English and German STs may function as prototypical SL and TL texts for their respective translated counterparts. For reasons of availability, this requirement is often difficult to fulfil. Here the concept of 'parallel texts' (Vinay and Darbelnet [1958]1977:272) comes into play which denotes original texts of the same or a similar genre and on the same domain(s) in the SL and TL. Recourse to TL parallel texts, in particular, represents the traditional way professional translators work and these parallel texts should therefore be included as reference material in the corpus. These parallel texts may help refute or confirm and substantiate equivalence-related findings at all levels and therefore contribute to objectifying results by performing a 'double check' function (Vinay and Darbelnet [1958]1977:272). In this research, German parallel texts from the field of coprocessing were used as a basis of comparison for the TT (see Bibliography II).

The textual refinement material, which is included in the reference corpus and considered with the translation corpus, involves both SL and TL parallel texts (prototypology aspects), project reports preceding the research report examined (intertextuality aspect),[62] domain-related and/or other monolingual scientific encyclopaedias in the SL and TL, specialized dictionaries, glossaries, databases, and termbanks. Also included are a few translations from other scientific and technical fields for exemplification purposes to demonstrate that the findings of this research

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[62] For confidentiality reasons, the project reports preceding the research report cannot be disclosed at present. They consist of a total of 159 pages.

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may go beyond the domain/genre investigated. As regards the aspect of prototypology, it should be noted that due to the absence of a German research report on the same domain(s), recourse was had to a similar genre, i.e., articles in learned journals. This may be justified by the priority of the domain covering cutting-edge research over genre in this case. Moreover, scientific research reports, journal articles and conference proceedings are grouped together in a more recent and in-depth study of scientific and technical genres (see Göpferich 1995a and 2.2.2.1.1, f)). The textual data contained in the reference corpus is listed in Bibliography II.

It should be emphasized that the translation comparison is being carried out on the basis of the translation corpus proper (though backed by knowledge derived from the reference corpus), since it should be kept in mind that L_2 text types in the field of science and technology, in particular, "are constantly enriched by 'translated material'" (Neubert 1985:123) and that creating an equivalent L_2 text means approximating the L_2 prototype "without having to attain it fully", (Neubert 1984:63) (see f.n. 37).

b)   Extra-textual data

Extra-textual data refer to contextual-situational aspects which are relevant to the compilation and analysis of the corpus. These aspects are presented below.

i)   Typicality in terms of the range of ST authors and translators[63] and translator's competence

The ST author is a coprocessing expert who has published widely in the field. The translators represented in the corpus are experienced (more than 10 years of experience) professional TL native speaker staff translators (university graduates) endowed with the requisite domain-specific knowledge.[64] The translators are competent professionals who adhere to what Chesterman (1997:64-70) calls

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[63] Consideration of the translators represented in the corpus is demanded by Baker
       (1995:230), too, who claims: "Thus the criterion for typicality, for instance, would need to
       be refined to take on board, in addition to writers/speakers, the range of translators
       represented in the corpus (both how many and whether they are professional/amateur,
       staff/freelance, translating into or out of their mother tongue [...]"
[64] Cf. also Bausch (1971:53) who claims that "les traductions doivent être déjà faites, comme
       J. Ellis le dit, *«by practical translators, for some non-metalinguistic purpose...»* [...]"

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"expectancy norms" and "professional norms". The translation was made in a joint effort by two female translators.[65]

ii) Conditions of the origin of the translations (Wilss 1982:220)[66]

Awareness of the conditions under which the translations in the corpus were produced may provide clues as to the quality considerations which have guided the translators. In an equivalence-relevant corpus these quality considerations must be the highest possible and, optimally, the translations should have been carried out in close cooperation with the author or with TL experts in the respective fields. The TT was proof-read by the head of the in-house translation service and by the 'customer'[67], i.e., the TL expert in the company's R&D division, who commissioned the translation, against the background of their linguistic-translational proficiency and/or domain-specific knowledge. The TT was then released by the 'customer'.

iii) Publication aspect

Although the publication aspect is generally considered the most relevant qualitative criterion in corpus design (e.g., Johansson 1998:11;[68] Baumgarten et al. 2001:19), for the purpose of our investigation, this aspect alone can never be a sufficient qualitative selection criterion, since even published translations in the field of STT may by no means always be equivalent to their ST counterparts.[69] Moreover, both source texts and translations are often reworked for publication reasons in such

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[65] This aspect is of relevance in so far as it will help rectify the contention that 'translation errors' in STT are due to the 'feminization' of the translation profession [sic!] (Schmitt 1985:39) (cf. f.n. 7). It should also be pointed out that the gender aspect in translation may be a serious and interesting area of research in its own right (see von Flotow (1998:130-132) and Chamberlain (1998:93-96) for brief overviews).

[66] The important aspect of knowledge of the conditions of the origin of the translation in the area of translation criticism is stressed by Wilss (1982: 220).

[67] In large companies with their own in-house translation services, the customer in the area of STT is almost always an expert in her/his field, and very frequently customer and author of the ST are one and the same person. Cf. also Hewson and Martin (1991:166), who claim that "the professional will often have to deal with a document *produced by the TI* [translation initiator] *himself or herself.*"

[68] "For both languages we included published texts only, as publication presumably guarantees that the texts (both the originals and the translations) have gone through an editing process and can be expected to conform to some standard of acceptability for each language." (Johansson 1998:11)

[69] For example, on the basis of my own terminological research into the field of coal gasification (Krein-Kühle 1995b), the English translation of a German book on coal gasification (Schilling et al. 1979/1981) cannot be considered equivalent, since no equivalence exists at the terminological-phraseological and pragmatic levels.

a way that, in the case of the translation, the borderline between translation and adaptation (Schreiber 1993) may have been transgressed, so that they lose their practicability for an equivalence-oriented investigation. Hence, as was discussed in 1.4.1, the delimitation of translation proper is a prerequisite for the analysis. Also, a revised ST would not reflect the run-of-the-mill technical ST, which is often defective (e.g., Horn-Helf 1999) for the reasons outlined in 1.4.3 and requires corrective translation procedures to achieve equivalence. With a revised ST, such procedures could not be uncovered. Certainly, the TT should have reached a 'publishable status', as is the case with the TT examined here, this status having been validated by the initiator of the translation, a TL expert in the field.

The publication criterion has always to be backed by other investigation-relevant aspects as considered here.

iv) Homogeneity vs. Heterogeneity in the range of translators, genres and domains

Since equivalence is considered to be a text-in-context-related concept, only one, though quite comprehensive ST-TT pair of one genre and one domain is used here, with the translation being carried out by competent professional translators. For further research into this subject on the basis of a more comprehensive corpus, the homogeneity criterion should be met as regards domain and translators, to achieve a meaningful degree of intersubjectivity in the findings of this research. The genre aspect could be extended to include other "progress-oriented actualizing texts" (Göpferich 1995a, 1995b), such as project definitions or conference proceedings, though each ST-TT pair should be looked at individually.

If, however, individual features only are to be investigated on the basis of a more comprehensive scientific and technical translation corpus, heterogeneity in the range of domains may provide generalizations which apply across domains. This approach, too, would presuppose a high-quality corpus, the analysis of which must not ignore the text-in-contextual dimension. Jumpelt (1961:3), for example, investigated STs and TTs, i.e., his own translations, from a wide range of domains, apparently for the same reason but without justifying his selection.[70]

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[70] "Sofern nicht besonders angegeben, stammen die Beispiele aus eigenen Übersetzungen, die vorwiegend Gebiete der Luftfahrtwissenschaften, Flugzeugbau, Elektronik, Fernmeldetechnik und Kernphysik betreffen. Über diese hinaus wurde eine möglichst gleichmäßige Auswahl von Belegen aus allen Gebieten der Technik und

Heterogeneity in the range of translators may help obtain more sophisticated insights and findings with regard to potential equivalence-relevant differences between translations made by professional TL native speaker translators and TL native speaker experts in the field.

Depending on the purpose of the examination, the validity and applicability of the findings of our research, which point beyond the domain, genre and occasionally the language-pair examined (see 2.2.1, f.n. 50 and 3.2.4), could be underpinned by further research into both homogeneous and heterogeneous specialized translation corpora.

v)   Exclusion of idiosyncratic translator behaviour

Idiosyncratic translator behaviour should be excluded as far as reasonably possible in the translations represented in the corpus. As early as 1961, Jumpelt was claiming that the translations used must be appropriate to a certain purpose and a certain audience irrespective of the individual touch of the translator (op. cit.:41-42), since in STT, in particular, the individuality of the translator takes second place behind the objectifiable transfer of the 'interlingual Gemeinte' (Kade 1964b:94) into the TL "within the scope of the objectively existing equivalence relations between SL and TL" (Kade 1964a:257, my translation). An attempt was made to exclude idiosyncratic translator's behaviour by adhering to the demands put forward in the first two comparative parameters (see 2.2.1) involving two in-depth readings of the TT prior to analysis. Exclusion of such behaviour may also help confirm the assumption put forward by Vinay and Darbelnet [1958](1977:23-24)[71] that 'non-univocity' in translation is not an inherent characteristic of the discipline, but stems rather from an incomplete exploration of reality, and that we would achieve a greater number of uniform solutions, if we had better knowledge of the methods that govern the transfer from one language to another. Although this remark may not generally

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[71] Naturwissenschaften angestrebt" (Jumpelt 1961:3).
"[...], cette non-univocité [...] de la traduction ne provient pas d'un caractère inhérent à notre discipline, mais plutôt d'une exploration incomplète de la réalité. Il est permis de supposer que si nous connaissions mieux les méthodes qui gouvernent le passage d'une langue à l'autre, nous arriverions dans un nombre toujours plus grand de cas à des solutions uniques" (Vinay and Darbelnet [1958]1977:23-24).

apply to all text types and genres, it certainly applies to the text types and genres encountered in scientific and technical translation.

vi)   Recourse to ST authors, translators and/or experts in the field

Ideally the analyst should have recourse to the translator/s, ST author, or experts in the field to deal with any doubts, to enable her/him to correctly identify and classify shifts which are due to pragmatic considerations (in particular specialized knowledge-induced shifts) or to exclude non-equivalent utterances. Such recourse would also enable us to allow for any potential arbitrariness in the critical, i.e., evaluative, comparison. In the present case recourse was had to the translators, the TL initiator (as expert in the field), and other TL experts in the various intersecting fields reflected in the research report. It was not possible to contact the ST author due to non-availability and time constraints, a problem frequently encountered in practical translation work.

vii)   Knowledge of communicative effect of the translations on the receptors

Although the communicative effect of the translations in the TL is often difficult to establish, because it is hardly possible to query a large number of receptors, some feedback was established by referring to the person who commissioned the translation, so that it can be said that the TT fulfils the same communicative function among specialists in the TL culture as the ST in the SL culture, i.e., it functions as 'equivalent substitute' for the ST.

2.2.2.1.3   Quantitative selection criterion

Although the need is stressed in the literature (van Doorslaer 1995:245-260) to find a sound balance between exhaustiveness and representativeness and to establish a corpus that "lies somewhere between accidental exemplification and a justifiable basis from which to propose adequately-supported generalizations" (Swales 1981:9),[72] de

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[72]   Figures, if mentioned, vary widely in CL and CTS. For example, Swales (1981:9) investigated 48 article introductions "of usually between 100 and 500 words"; Wandruszka (1969:7) investigated 60 literary works in six languages with the respective translations in five other languages; Lindquist (1984:261) talks of "ten modern novels, translated by established professional translators" and based his pilot investigation "on a small corpus of 400 examples from four of the books" (op. cit.:262); Ahrenberg and Merkel (1996:189) use a corpus of four to six million words and the *Hansard Corpus* consists of 60

Haan (1992:3) claims that "there is no such thing as the best, or optimum, sample size as such." Biber, too, (1993:243), mentions that "sample size is not the most important consideration in selecting a representative sample; rather, a thorough definition of the target population and decisions concerning the method of sampling" are of prior concern. A reasonable degree of representativeness of the sampled ST-TT pair under investigation may have been achieved by establishing specific selection criteria, such as register and genre criteria and the relevance criterion (see 2.2.2.1.1), which, at the same time, reflect and indirectly define the 'target population' from which the texts are sampled. More recently and in much the same vein, Bowker and Pearson (2002) suggest that more useful information may be retrieved from "a corpus that is small but well designed than from one that is larger but is not customized to meet your needs" (op. cit.:45-46).[73]

Although the corpus should be extensive enough to provide a sound basis from which to propose statistically underpinned generalizations, corpus size is seen to depend on two further aspects, i.e., the purpose of the investigation and the applicability of electronic tools. As regards the first aspect, it is obvious that, for example, a corpus of a few million words cannot be dealt with by a single researcher in an equivalence-relevant investigation due to the complexity of this concept. Moreover, if the researcher strives for complete exhaustiveness, s/he may not be able to carry out research with the depth of analysis (van Doorslaer 1995:247-248) required to shed some light on the equivalence concept and to establish results that may be used as input in the applied branches of the discipline. As for the second aspect, it may well be assumed that a huge amount of running text can be analysed by computer wherever certain specific linguistic features are to be investigated (e.g., prepositions). However, this will only be possible to a limited extent in an equivalence-related investigation where the focus of attention is extended to include the text-in-context level and where particular features are attributed to particular levels which are, in their turn, subject to a hierarchization and an interrelatedness of levels and pragmatic considerations. This being so, an equivalence-relevant corpus is not one that lends itself easily to fully automated analysis, a circumstance that clearly imposes certain quantitative constraints. However, as Swales (1981:9) rightly claims,

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[73]   million words (Leech 1991:79).
        As Bowker and Pearson have demonstrated (2002:46), a specialized corpus of 10,000 words may be sufficient to perform sucessfully specific tasks, e.g., the learning of the vocabulary of a particular domain.

the reliability and utility of the established results can always be enhanced by testing them out on a further "similar-sized" and similar-motivated selection of, in the present case, STs and TTs.

2.2.2.2 Description and analysis of the translation corpus, and the aims of corpus-based research

According to de Haan (1992:3), 20,000 word samples "are sufficiently large to yield statistically reliable results on frequency and distribution", but he stresses that sample size depends on the particular study to be undertaken. And Bowker and Pearson (2002:48) claim that "a small corpus can be a very useful resource provided it is well designed".[74] Since an equivalence-relevant investigation poses quantitative constraints as outlined in the previous section, a corpus size of 20,946 words (see Table 1) is considered to be sufficient to exclude "accidental exemplification" and representative enough to provide a sound basis for generating soundly based generalizations which may be used as input in the applied branches of TS.

Table 1   **Statistical data on the corpus**

	English ST	German TT
Words	10,620	10,326
Lines	989	1,326
Pages	20	28 (single space)

As mentioned in f.n. 8, TT size may already be an indicator of quality, since translations from languages that tend to use rather grammatical, i.e., implicit, structures, such as English (see, e.g., the non-finite verb forms, Chapter 3) into languages that tend to use rather lexical, i.e., explicit, means for such structures, such as German and the Romance languages (cf. also Beneš 1976:94), are generally longer linewise and pagewise than their STs for systemic reasons alone, a fact which is underpinned by the line and page data given in Table 1 above. Certainly, other factors such as text genre and type, i.a., may also influence TT length. Still, this observation

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[74]   According to Bowker and Pearson (2002:48), "well-designed corpora that are anywhere from about ten thousand to several hundreds of thousands of words in size have proved to be exceptionally useful in LSP studies."

itself may cast some doubt on the universal validity of the 'explicitation hypothesis' (e.g., Baker 1996; Laviosa 2002), in particular, as regards translations from the above languages into English.

2.2.2.2.1   Analysis of the corpus

To put the analysis of the corpus on a sound statistical basis, equivalence-relevant features at the syntactic, lexical-semantic, terminological-phraseological and overall textual levels have been counted in order to establish a frequency ranking both in their occurrence in the ST and in their various translation solutions in the TT. The counting mode involves categorization and description of equivalence-relevant features (1.4.2) and helps establish a hierarchy of relevance both from a statistical and from an equivalence-related point of view. This certainly does not mean that less frequently occurring features may be less relevant in equivalence terms, as the investigation will show. The point is that equivalence-relevant features with a high frequency yield statistically corroborated findings from which reliable extrapolations can be made and generalizations inferred. As the results will show, these textual levels are all interwoven and overlap and may be conditioned and modified by aspects of pragmatics.

It should be noted that statistical counting in the translation field may not always fulfil the stricter requirements of mathematical statistics (see also a similar remark by Beneš (1976:89) in the field of special languages research). If it is to do justice to the high complexity of the concept of equivalence, any statistical account of equivalence-relevant regularities must be given in both quantitative and qualitative terms. Although it is certainly desirable, wherever possible, to further underpin the results of the investigation with similar and more extensive corpus-based work based on descriptive statistics (Biber 1993), the most significant trends observed in the main categories, which have been arrived at by straightforward counting and percentage calculation, should be reliable enough for generalization and for application in both translation directions.

For the reasons mentioned in 2.2.2.1.3, the corpus, which is held in electronic form, has been tagged manually and analyzed both manually and semi-automatically using the functions of the word processing system *Microsoft® Word 6.0.*

2.2.2.2.2   Aims of corpus-based research

The aim of the analysis is to identify equivalence-relevant intersubjective regular patterns in the complex translation relations between STs and TTs on the basis of which meaningful generalizations can be deduced. Both regularities and generalizations should be capable of implementation in the applied branches of TS, such as translation teaching, practice and criticism. Since time is of the essence in professional translation (Wilss 1992), consideration of these generalizations and internalization of these patterns as routines will help trainee translators and practising translators alike to speed up their translation work and leave more time for the very varied and more intricate cases in which equivalence is more difficult to achieve. At the same time, the very theory (2.2.1) in whose terms our research is performed will be tested out (Toury 1995:1), and it is hoped that this test will contribute to the much-needed clarification, dynamization and objectivization of the complex concept of equivalence.

2.3   Summary of this chapter

This chapter deals with the methodological issue in translation studies and propounds an equivalence-relevant methodology. The methodological issue is a much neglected branch of the discipline (Holmes 1988; van Leuven-Zwart 1992; Toury 1995), but of the utmost importance if our investigations into translational and equivalence-relevant features, in particular, are to yield more objective - i.e., intersubjective - and more representative, meaningful, controllable, replicable and falsifiable results. This chapter reviews the existing methodological approaches to translation and examines whether these can be put into use for the investigation in question. So far, only the scholars of the 'descriptive school' (Holmes 1988; van Leuven-Zwart 1992; Lambert and van Gorp 1985; Toury 1980, 1995; see Appendix II) have dealt in greater detail with methodological issues. Also, the emphasis of their investigation has shifted from the

translated text to the broader context in which translations function, since they view translation (especially literary translation) as a historical, social and cultural phenomenon. This implies that they may tend to look at the objects of their study from the angle of the literary scholar rather than that of the translator. Thus, from the translator's point of view, systematic comparisons of ST and TT are facing growing neglect. Still, it is precisely such systematic comparisons that are at the heart of an equivalence relevant-investigation. All the same, the methodological approach of the descriptive school must be given credit for stressing the requisite wider perspective of the ST-TT comparison, such as the consideration of contextual and situational aspects. Context, is, of course, a crucial dimension in an equivalence-relevant investigation and is incorporated in the theoretical/analytical framework of this research.

The first comparisons that clearly had the translator in mind were those employed by the representatives of the "stylistique comparée" (Vinay and Darbelnet [1958](1977); Malblanc [4]1968) and in STT by Jumpelt (1961). However, these comparisons may be criticized for several reasons, e.g., for still being largely linguistically motivated, for ignoring the hierarchization of textual levels and their interrelations, and for failing to say how the comparisons are actually carried out or to explain and confirm their hypothesis of the 'situationally equivalent text'. What was missing at the time was a descriptive framework based on a sound translation theory for performing a systematic comparison. Thus, whereas the descriptivists' approaches may be considered 'too wide' and located somewhere downstream of our own investigation, the approaches offered by comparative stylistics may be considered 'too narrow' and located somewhere upstream of our investigation. However, some important insights may be derived from the latter which are relevant to an equivalence-related investigation, viz., the consideration of the stylistic dimension (a pragmatic dimension, after all) in corresponding contexts of situations, the bidirectionality of the comparison (Vinay and Darbelnet [1958]1977:27), the importance of parallel texts, which function as a 'double check' (Vinay and Darbelnet [1958]1977:272) and the fact that the analyst is evaluative (Wandruszka 1969:8) when performing the comparison.

More recently, corpora, i.e, comprehensive selections of running texts, have entered the field of translation studies and are being employed in different areas and with different research objectives (Baker 1995, Laviosa 1998a, 2002). This chapter also gives an overview and a critical account of this issue to determine its relevance for the investigation in question (2.1). Of the different types of corpora, it is a parallel corpus - or, as it is called here, a translation corpus, i.e., ST-TT pair/s - that will be used to identify equivalence-relevant features with a high frequency in order to obtain statistically backed findings that permit reliable extrapolations. However, in contradistinction to most of the research aims of corpus-based translation studies, which - like those of the descriptivists - are also located downstream of our approach (e.g., research into 'universals of translation' (Baker 1996; Laviosa 2002) based on comparable corpora) and in which the corpus appears to be an end in itself, since this approach often lacks a sound theoretical/analytical framework and neglects the contextual dimension, the corpus here remains merely a tool, though an important one, a means to an end, i.e., it is the quantitative extension of a thorough, systematic, and theoretically well-founded comparative investigation into equivalence. Only corpus-based work makes it possible to study actually existing ST-TT pairs and enables us to perform a shift from normativeness (in the original sense of the term) and prescriptivism toward an emphasis on description, explanation and prediction. It must be stressed, however, that such description in an investigation of equivalence requires a high-quality corpus and cannot be done without evaluation and judgement.

To develop an equivalence-relevant methodology, we need to situate our research within an interrelation triangle combining the methodological, theoretical and applied branches of the discipline (see Fig. 1, 2.2.1). Such research should be carried out using methodological tools which involve, test, validate, amend or falsify theoretical and applied aspects of translation. Therefore, any investigation of equivalence in STT should be based on two methodological pillars, the first being a theoretically well-founded translation comparison (2.2.1) and the second a highly refined translation corpus (2.2.2.).

Any investigation into equivalence in STT has to be carried out against the theoretical background of a general taxonomy of equivalence-relevant text levels and their respective equivalence-relevant features in order to guarantee a

methodologically systematic and stringent translation comparison which will furnish insights into this highly complex concept. Following on from Neubert (1970) and my own previous research into equivalence in this field (Krein-Kühle 1995a), equivalence-relevant features are investigated here at the syntactic, lexical-semantic, and terminological-phraseological levels (Chapters 3 to 5). Since all of these levels are hierarchically interrelated in descending and ascending order and may be conditioned and modified by pragmatic aspects, the underlying pragmatics as manifested in the translations is also examined. Pragmatics as a contextual dimension and as understood here, is not confined to the scientific and technical know-how specific to a certain discipline, but also includes knowledge of the register appropriate to that discipline and accepted by its expert practitioners, involving knowledge of genre conventions. Since textual equivalence is more than the sum of these three levels and is, in fact, the cohesive and coherent final result of all the relations operating between them, the comparison must necessarily be extended beyond sentence level to the overall textual level (Chapter 6).

The translation comparison also presupposes the prior establishment of some comparative parameters, such as the completeness of written real ST-TT pairs in 'communicative function', a comparison procedure that is both 'linear' and 'selective' (as distinguished by Reiß (1981:316-17), a well-defined translation unit, viz., the text, a reliable *tertium comparationis* (viz., the 'sense' or 'Gemeinte' including 'intended sense'), the bidirectionality of the comparison and the competence of the analyst, including the requisite, by no means, arbitrary evaluativeness.

Any corpus used for research into equivalence in STT needs to be based on well-devised selection criteria including "extra-textual information" (van Doorslaer 1995) to design a corpus that promises relevant and intersubjective insights into this highly complex concept. For this purpose, a three-fold set of selection criteria with special emphasis on the qualitative aspect has been devised to create an equivalence-relevant translation corpus containing only - wherever reasonably possible - what Kade (1964a) calls "druckreife Übersetzungen" (*publishable translations*), implying the highest quality level. This three-fold set consists of general selection criteria (2.2.2.1.1), qualitative criteria (2.2.2.1.2), and a quantitative criterion (2.2.2.1.3). The selection criteria were established on the basis of the purpose of this

investigation. The general selection criteria include both corpus attributes, viz., full text, synchronicity, bilinguality, central corpus and reference corpus, and text attributes, viz., register and genre considerations, functional constancy, text typology, text status, degree of technicality, geographical considerations and the relevance criterion that may help demonstrate that the ST-TT pair selected is representative of a specific genre or domain and of actual translation assignments. The qualitative selection criteria are based on textual and extra-textual data. The textual data constitute the reference corpus (Bibliography II) containing, e.g., parallel texts, which denote original SL and TL texts of the same or a similar genre and in the same domain, scientific encyclopaedias, specialized dictionaries, etc. Extra-textual criteria which refer to contextual-situational aspects involve typicality in terms of the range of ST authors and translators and translator's competence, the conditions under which the translations were produced (origin), the publication aspect, homogeneity vs. heterogeneity in the range of translators, genres and domains, exclusion of idiosyncratic translator behaviour, recourse to ST authors, translators, and/or experts in the field, and knowledge of the communicative effect of the translations on the receptors. The textual data collected in the reference corpus together with the extra-textual data may help refute or confirm and substantiate equivalence-related findings at all levels and therefore contribute to intersubjectifying the results of this investigation.

The quantitative criterion relates to the size and the representativeness of the sampled ST-TT pair. Although the corpus should be extensive enough to provide a sound basis from which to propose statistically underpinned generalizations, corpus size clearly depends on the purpose of the investigation (de Haan 1992:3) and the applicability of electronic tools. In an investigation of equivalence, the focus of attention is extended to include the text-in-context level and particular features are attributed to particular levels which are, in their turn, subject to a hierarchization and an interrelatedness of levels and pragmatic considerations. Due to this complexity an equivalence-relevant corpus is not one that lends itself easily to fully automated analysis, a circumstance that clearly imposes certain quantitative constraints. A corpus size of 20,946 words (see 2.2.2.2, Table 1) is considered to be sufficient (de Haan 1992:3) to exclude "accidental exemplification" (Swales 1981:9) and representative enough (see relevance, register and genre aspects under 2.2.2.1.1) to

provide a sound basis for generating well-underpinned generalizations which may be used as input in the applied branches of TS. The present corpus consists of an English language ST and a German TT from the field of coprocessing, which is a coal liquefaction process and refers to the combined hydrogenation of heavy mineral oil fractions and coal. The corpus is held in electronic form and has been analysed both manually and semi-automatically.

The purpose of the corpus is to help establish equivalence-relevant features of high frequency with a view to obtaining statistically corroborated intersubjective regularities/patterns in the complex translation relations between STs and TTs on the basis of which meaningful generalizations can be deduced. Both regularities/patterns and generalizations should be capable of implementation in the applied branches of TS. At the same time, the theoretical framework within which research is carried out will be tested and it is hoped that this test will help clarify, dynamize and objectivize the complex concept of equivalence. How equivalence operates at the syntactic, lexical-semantic, terminological-phraseological and overall textual levels will be examined and described in Chapters 3 to 6 which follow.

3 Equivalence at the syntactic level:
An investigation of the English non-finite verb forms and their German potential equivalents

Die relative syntaktische Äquivalenz, die zum korrekten Aufbau des ZS-Textes benötigt wird, ist die schwächste Forderung an eine äquivalente Übersetzung [...]
Die syntaktische Äquivalenz garantierenden Übersetzungseinheiten ordnen sich den semantischen und diese den pragmatischen Übersetzungeinheiten unter.
(Neubert 1970:451-452, 456)

The sentence is probably the typical unit of translation equivalence, but only in the sense that it represents the most convenient collection of items to work with, providing we already know the more general context, the subject field.
(Pinchuck 1977:46)

If, in spite of everything, equivalences are to be sought, the syntactic level promises to be a potentially fruitful area of exploration, [...]
(Draskau 1988:470)

Despite recent context-based studies of syntax in LGP/literary translation (e.g., Doherty 1999; Schmid 1999), Draskau's (1988:470) remark that "studies of translation have tended to neglect syntax" is still particularly true of STT, since the challenge of STT has long been considered to lie solely in its terminology aspects. And although the syntactic level has been the object of or has been included in LSP-related monolingual research (e.g., Beneš 1976 or more recently Kretzenbacher 1991; Göpferich 1995a), the findings of such research - though highly useful in themselves - may often be of limited value in the realm of translation due to the lack of a translational link between the texts investigated in such research. From the point of view of technical translation, Köhler (1981:239), for example, claims that the problem of formulating a "real" German technical text (in translation) often lies in the fact that the syntactic constructions of the ST are simply taken over into the TT, although the TL may use completely different constructions with a different frequency than the SL. This points to the importance of register aspects.

The sometimes considerable gap between English and German sentence structure[1] calls for a detailed investigation of certain recurrent syntactic features in order to describe how equivalence operates at the syntactic level and how it is interwoven with and governed by semantic and pragmatic aspects.

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[1] Pinchuck (1977:218) points out that the translation distance between English and German is greater than between English and French, for example.

The non-finite verb forms may be the most prominent example of such recurrent syntactic features which - due to systemic differences - pose equivalence-relevant translation problems. English scientific and technical discourse favours non-finite verb forms, because they contribute to economy of expression by syntactic compression and condensation of meaning and are typical features of the nominalized register in that language (see Gerbert 1970:61 ff.; Beier 1980:59-61; Sager et al. 1980:212-218; Weise 1980:79-89). Some of these forms have no structural counterpart in German, and even when there is one, this is often merely indicative of a grammatical correspondence rather than equivalence in a translational context.[2] The non-finite verb forms are implicit by nature (Wilss 1971:560) and their "sharply reduced explicitness" (Quirk et al. [13]1995:17.33) when used in postmodification in sentence/clause-reducing function - involving problems of, e.g., blurred intra-sentential reference relationships or implicit tense, mood or modality - may require a great deal of context-sensitive inferencing and interpreting skills on the part of the translator. So, the investigation of the non-finite verb forms may also allow us to say something about how equivalence is achieved in translation as regards the implicitness inherent in these structures.

The percentage distribution of the non-finite verb forms counted in the ST is given in the following table, as are comparative figures established by Barber (1962) and Weise (1980):

Table 2 Distribution of the features (non-finite verb forms) investigated at syntactic level

ST under analysis			Barber's corpus[3] (1962)	Weise's corpus[4] (1980)
	Percentage	Occurrences (total: 782)	Percentage	Percentage
infinitives	16%	121	19%	18%
past participles	36%	282	34%	35%
-ing forms	48%	379	47%	44%[5]

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[2] Wilss (1971:555) rightly claims that English participle constructions cannot generally be replaced by a formal 1:1-correspondence.

[3] Barber's (1962:21-22) corpus contains three text passages from American university textbooks on electronics, biochemistry and astronomy amounting to a total of approximately 23,400 words.

[4] Weise's (1980:79) corpus contains a wide range of chemical texts and amounts to 50,000 words.

[5] There is a discrepancy in Weise's (1980) figures, which add up to 97%.

As the above figures show, the frequency of occurrence of the non-finite verb forms in the corpus under investigation is comparable with those established in other LSP research. The object of the following detailed and context-sensitive investigation based on meaningful categorization is the establishment of equivalence with these forms in their sentence-/clause reducing function, in particular. In the process, potential equivalents reflecting trends in translation will be identified and it will be shown that and how equivalence at the syntactic level is interwoven with semantic and pragmatic aspects, i.e., register considerations, in particular.

3.1 English infinitive constructions and their German potential equivalents

The infinitive contributes substantially to logical structuring and syntactic compression in scientific and technical discourse (Gerbert 1970:61-70; Sager et al. 1980:212-14; Weise 1980:82-84). Of the non-finite verb forms counted in the corpus, the infinitive accounts for 16% (121 occurrences). Owing to its grammatical flexibility and versatility, it can perform various syntactic functions. As Weise (1980:82) mentions, the *to*-infinitive can function as subject, attribute, as part of the predicate or adverbial phrase. For example, it can be used to reduce subordinate clauses, mostly adverbial clauses of purpose or result, but also to replace a relative clause (Huddleston 1971:255-58). As part of the predicate it may occur in AcI (accusativus cum infinitivo) (3.1.2.1.5) and NcI (nominativus cum infinitivo) (3.1.2.1.4, 3.1.2.2.1) constructions. In the latter case it may appear in concatenation with specific verbs, such as verbs of assumption, e.g., *believe, consider, assume, expect*, etc., expressing modality (see NcI constructions under 3.1.2.1.4). Modality (see 4.2) is also expressed by the passive infinitive which acts as a reduced attributive clause,[6] as in:

A sample of the mixture to be analysed is introduced into the tube (Weise 1980:82)
(underlining added).

The above infinitive constructions are only a small selection of the many infinitive constructions performing multiple functions in scientific and technical discourse.[7] This multifunctionality will also be reflected in the various categories

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[6] In this case, not only modality, but tense and mood, too, have to be inferred from the infinitive clause. For an illustration of the variety of implicit tense and modality with this construction in LGP see Quirk et al. ([13]1995:17.31).

[7] For an overview of the various infinitive constructions found in a corpus of a broad range of chemical texts see Weise (1980:82-84).

established on the basis of the present corpus. Classification of the infinitives is difficult precisely due to this multifunctionality which may lead to a certain degree of ambiguity or uncertainty in specific instances. For example, it is not always unequivocally clear whether an infinitive clause has a subordinate clause function or not (Göpferich 1995a:431). Although the analysis is based on a categorization of equivalence-relevant infinitive structures occurring with a high frequency and designed to yield statistically corroborated data, mention will also be made of less common infinitive structures which are, nonetheless, relevant from an equivalence point of view, since they exhibit considerable shifts in translation and can be considered 'universals' in scientific and technical discourse regardless of the genre under analysis.

The categorization and description of the infinitive constructions found in the corpus and investigated here is based on the following counting mode: all infinitives (*to*-infinitives) contained in the corpus were counted. Not included were infinitives preceded by an auxiliary or modal verb (e.g., bare infinitives as in "this may be the most economical route") as part of a finite verb. These are considered to be finite verb forms and were excluded from the analysis.

Exemplification of counting mode:

To achieve (*counted*) equivalent pitch conversions, the bench-scale CSTR had to be (*not counted*) operated at ≈5°C higher temperature.

The following infinitive constructions will be investigated: infinitive clauses[8] expressing purpose, accounting for 44% of all the infinitives counted, and some modal infinitive constructions (3.1.2.1), such as catenative verb constructions (3.1.2.1.1), NcI (3.1.2.1.4) and AcI (3.1.2.1.5) constructions, and nonmodal infinitive constructions (3.1.2.2), such as the terminological infinitive (3.1.2.2.2), accounting together for 40%. The remaining 16% mostly include further infinitives as part of the predicate, clauses of result[9] and others. The categorization, description and

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[8] The term 'infinitive clause' (cf. also Sager et al. 1980:193, 214) is used here instead of 'infinitive phrase' (cf. Barber 1962:34; Weise 1980:83), since the infinitives in this category function as finite subordinate clause substitutes.

[9] Infinitive clauses of result only account for 4% of all infinitives counted in the corpus. This category includes *to*-infinitive clauses and the degree adverb *enough*+infinitive construction (see f.n. 25).

investigation of the equivalence-relevant infinitive constructions are dealt with in what follows.

3.1.1 Infinitive clauses expressing purpose

The infinitive used to reduce adverbial clauses of purpose or result is a very common feature of English scientific and technical discourse (Barber 1962:34; Weise 1980:83; Sager et al. 1980:193). This is not only because it allows a more concise wording, thus contributing to compactness of expression, but also because it is one of the linguistic means which can fulfil the technical writer's need "to inform the reader about the reasons for and the effects of actions" (Sager et al. 1980:214). As Sager et al. (1980:190) rightly claim:

> The logical formulation of the laws of nature and explanation of the functioning of
> processes and machinery can often best be achieved in terms of cause and effect, i.e.
> by stating what will happen or may be expected to happen in a given set of circumstances.

Infinitive clauses expressing purpose account for 44% (52 occurrences) of all infinitives counted[10] and represent the only infinitive construction in the ST under analysis to occur frequently enough to yield statistically corroborated findings. Infinitive clauses of result seem to occur with a much lower frequency, i.e., they account for only 4% (cf. also Barber 1962:34; Weise 1980:83). The high figure for the purpose clauses is not surprising, given that a research report continuously describes the aims, intentions and purposes of the research carried out. To cope with one specific characteristic of this discourse genre, the category of infinitive clauses of purpose has been further subdivided. Whereas both finite and infinitive clauses of purpose or result generally indicate "the effect 'caused by' the subject and predicate" (Sager et al. 1980:193), this research report exhibits frequently and repeatedly used sentences, in which the author informs the reader of the aims or purpose of the

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[10]   This category includes two instances in which the infinitive expresses purpose when used
as relative clause replacement. Postmodifying *to*-infinitive clauses can replace relative
clauses, in particular, if the antecedent has a "restrictive marker", such as adjectives in the
superlative degree or general ordinals or ordinal numerals (Quirk et al. [13]1995:17.32) in
order to express purpose (Thomson and Martinet 1969:54.b), as in: "One of the best ways
to reduce the mineral matter in the coal prior to coprocessing is [...]". The use of
preposition plus abstract noun (prepositional phrasing) is the key to TT equivalence in
these cases: "Eines der besten Verfahren *zur Reduzierung* der mineralischen Bestandteile
der Kohle vor dem Coprocessing stellt [...] dar." Huddleston, too, (1971:255-258), who
examines "infinitival relative clauses" gives an example of an 'infinitival relative' with an
element of purpose.

investigations being carried out. In these sentences the infinitive clause expresses the aim or purpose of the action 'carried out' by the subject and predicate.

For example:

Studies/experiments/research work etc.   were/was carried out/undertaken/performed etc.
to determine/evaluate/measure etc.   + direct object or *wh*-interrogative clause

(Quirk et al. [13]1995:15.5, 16.35)

This is a frequent and obviously typical feature of the discourse genre under analysis. These infinitives account for 16% of all infinitives and for 36% (19 occurrences) of the infinitive clauses expressing purpose. In 74% of these cases, a passive predicate directly precedes the infinitive which is followed by a direct object or a *wh*-interrogative clause. These infinitives were included in a separate semantic sub-category (3.1.1.1.1), because they are more genre-specific than the regular clauses of purpose (3.1.1.1) and would certainly have somewhat distorted the overall result for this category.

The regular clauses of purpose represent the main category (3.1.1.1) and make up 28%[11] (33 occurrences) of all the infinitives counted and 64% of the infinitive clauses of purpose. In 15% of these cases, the infinitive clause is given prominence by placing it at the beginning of the sentence. In 62% it occurs in final position and in 23% in the middle of the sentence. These figures suggest adherence to the logical sequence of presenting a cause and effect relationship in English by mentioning the cause first and the effect (infinitive clause of purpose or result) second. This logical sequence is less strictly followed in German, so that intra-sentential shifts may occur in translation for reasons of cohesion and coherence. Unlike the infinitive in sub-category 3.1.1.1.1 described above, the infinitive in category 3.1.1.1 is directly preceded by a passive predicate in only 9%[12] of the cases and is always followed by a direct object.

As the discussion so far has shown, both semantic and structural aspects are considered in the selected categories. Both semantic and pragmatic aspects play a pivotal part in delimiting infinitive clauses of purpose from infinitive clauses of result

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[11]   This figure correlates with findings in LSP research. In this context, Barber (1962:34) mentions a figure of 29% for phrases of purpose and Weise (1980:83) a figure of 32% for infinitive phrases of purpose and result. The latter figure coincides exactly with the findings of this research, when we add the percentage for the infinitive clauses of result, i.e., 4%, to that for the regular infinitive clauses of purpose, i.e., 28%.

[12]   As regards the translation solutions, two third of this 9% are in the 'Others' category, 3.1.1.1, iii). Weise (1980:83) rightly points to a potential ambiguity of this structure.

and other infinitive constructions. Weise's (1980:83) remark that final meaning is often indicated already by the preposition *to* in front of the infinitive should be taken with some qualification, since the *to*-infinitive may also express a different meaning, i.e., it may have a temporal aspect, as in the following example:[13]

> This is a silica sol product containing [...] and is widely used *to process* high
> nitrogen content [...] VGOs. (italics added) (*to process* here substitutes *in the processing of*)

This aspect in tandem with the fact that clauses of purpose and clauses of result (Quirk et al. [13]1995:15.48 and 15.49, respectively) overlap in meaning (Quirk et al. [13]1995:15.49), i.e., they blend the meanings of purpose and result, requires account to be taken of semantic and pragmatic considerations in the categorization to exclude those infinitive clauses which are unequivocally resultative[14] or temporal from the analysis in order to avoid distortion of the results. This is sometimes easier said than done, since the English *to*-infinitive clause blurs these semantic differences,[15] but these differences may well be relevant from a translation point of view. For example, the resultative, i.e., the achievement, aspect may have to be made explicit in the TL by having recourse to specific translation solutions to achieve equivalence, as the presentation of the findings will show.

What has been categorized here as infinitive clauses of purpose will be presented and discussed next.

3.1.1.1 Regular infinitive clauses of purpose

These infinitives account for 28% (33 occurrences) of all the infinitives counted and 64% of the infinitive clauses of purpose. These infinitive clauses are used to indicate "the effect 'caused by' the subject and predicate" (Sager et al. 1980:193). The distribution of translation solutions for this category is as follows:

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[13]   Certainly, it is true that, in most cases, a simple *to*-infinitive expresses finality, but finality can also be expressed more explicitly by the "subordinators of purpose" *in order to* and *so as to* (Quirk et al. [13]1995:15.48) (cf. also Weise 1980:83).

[14]   According to Quirk et al. ([13]1995:15.49), the main semantic difference between the clauses of purpose and result is that "in the result clause the result is achieved, whereas in the purpose clause it is yet to be achieved [...]".

[15]   In this context, technical writers obviously sacrifice unambiguousness (and sometimes also grammatical correctness) for the sake of conciseness of expression. For example: "Clearly, this combination was at or near its upper coking propensity temperature limit to achieve this mediocre performance [...]" [so that as a result it achieved...] (paraphrase in brackets added).

i) Preposition+article *zur*[16] or preposition *für* plus abstract noun   56%
(nominalization with *-ung* suffix[17] or other[18]) to express purpose.

Example:
To simulate an integrated two stage process, the heavy ends product from [...] was used as feed to a CSTR unit which [...]
Zur Simulierung eines integrierten Zweistufenverfahrens wurde die hochsiedende Fraktion aus [...] als Einsatzmaterial einer CSTR-Anlage zugeführt, die [...]

ii) Infinitive conjunction *um - zu* (Duden vol. 4, [5]1995:691, 2)   35%

(*um [so] - zu; um - zu [können]*)
(infinitive construction of purpose)

Example:
Due to the nature and low melting point of the low coal residue, it should be fed as a liquid rather than a solid *to prevent excessive bed elutriation*.

Aufgrund der Beschaffenheit und des niedrigen Schmelzpunkts des Rückstands aus dem Einsatzmaterial mit geringer Kohlekonzentration sollte dieser in flüssiger und nicht in fester Form zugeführt werden, *um ein übermäßiges Austragen aus der Wirbelschicht zu vermeiden*.

iii) Others   9%

Other translation solutions include considerable syntactic shifts
for reasons of cohesion and coherence involving a shift from infinitive to adjective
as in the following example:

To maximize sulphur capture with high efficiency combustion, i.e., low carbon loss, optimum bed temperatures were estimated to be between [...]°C and [...]°C.

Die optimalen Wirbelschichttemperaturen *für eine maximale Schwefeleinbindung bei hohem Verbrennungswirkungsgrad*, d.h. niedrigem Kohlenstoffverlust, lagen schätzungsweise zwischen [...] °C und [...] °C.

n.b.: Full finite subordinate clauses are avoided in all cases.

As the results show, there is a clear trend towards prepositional phrasing, i.e., preposition+article *zur* or preposition *für* plus abstract noun. The high percentage for this nominal expression - which is used as an alternative to the *um - zu* infinitive construction in scientific and technical discourse (Beneš 1981:205) - must be seen in part against the background of the overall result for all the investigated infinitive clauses expressing purpose and intention (3.1.3), since tedious repetition of one

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[16]   *Zur* is a preposition melted together with the definite article (Duden vol. 9, [4]1997:588).
[17]   What is referred to as abstract noun here Liang (1984:130) calls a verbal noun formed by "explizite Ableitung" (*explicit derivation*) using the suffix *-ung*.
[18]   There was only one instance in which the *-ung* suffix was not used in nominalization, e.g., "To produce this amount of [...]" - "Zur Produktion dieser Menge [...]"

specific TT construction has been avoided for register reasons in order to achieve equivalence at the overall textual level. Moreover, the shortness of this nominal expression in the TT helps structure long sentences occurring quite often in the SL research report investigated.[19] Abstract nouns, i.e., nouns with an -*ung* suffix, are a very frequent and highly productive feature in German LSP, because they not only designate continuous activities but also denote the completion, result or means of the activities (Liang 1984:130 quoting VDI 2271) (cf. also Duden vol. 4, [5]1995:875). Liang's (1984:130) suggestion that this slight vagueness in semantic range causes a certain ambiguity is quite interesting as regards the case investigated here, since although the final meaning is clearly expressed by the prepositions *zur* and *für*, the -*ung* suffix of the abstract noun may add a ring of "resultativeness".

As Franck (1980:64-66) rightly claims, the abstract noun is a very flexible form in this respect, since, when used in tandem with a preposition, it can replace any subordinate clause.[20] This is an important aspect for equivalence, since the level of abstraction may change - with the sense remaining unchanged - when subordinate clauses/reduced clauses are translated into German (Franck 1980:65). Like the German infinitive construction with *um* - *zu*, preposition plus abstract noun is a preferred feature of scientific and technical discourse in German, since it contributes to condensation of meaning by eliminating finite subordinate clauses, as infinitive clauses do in English. Moreover, prepositional phrasing meets the register requirement of a higher level of abstraction in the TL.[21]

Infinitive constructions with *um* - *zu*, which account for 35% of the translation solutions, are a very common feature in German scientific and technical discourse,[22] because they can replace almost any kind of clause of purpose in that language (Beneš 1976:93; 1981:205; Kretzenbacher 1991:126; Fluck [2]1997:115-

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[19]   Whether the findings are valid for the translation of a variety of scientific and technical genres, certainly, would have to be corroborated on the basis of pertinent more comprehensive corpora.

[20]   Franck (1980:65) points out that abstract nouns are not simply the opposite of concrete nouns, but may render the content of a whole sentence to make it an essential element of a new statement in a new sentence. Thus they contribute to cohesion and coherence in the TL.

[21]   Franck (1980:66) gives the general recommendation that the number of abstract nouns (prepositional phrasing) and subordinate clauses in German should constitute a sound balance.

[22]   As mentioned in Beneš (1981:205), the ratio of *um* - *zu* infinitive constructions to final subordinate clauses in scientific discourse is 95% to 5%.

116). Another reason for their frequency of occurrence may be that they can be used both in terms expressing finality to denote purpose or intention and in terms expressing consecutiveness to denote result (Duden vol. 4, [5]1995:691, 2).[23][24] As the results also show, further semantic aspects may have to be made explicit within the *um - zu* construction to achieve equivalence in translation, e.g., *um - zu können* makes the 'can aspect' of a final clause (Duden vol. 4, [5]1995:1343) explicit. Or an adverb, such as *so*, may be introduced to account either for a *so as to* infinitive construction in English or for higher ranking register aspects in the TL, such as the use of adverbs as "content markers" (Franck 1980:75, my translation) for reasons of cohesion and coherence.

The question of when to choose which form, i.e., *um - zu* infinitive conjunction or preposition+abstract noun, is certainly more intricate and may depend on the complexity of the complete sentence and/or of the infinitive clause itself, as well as on further supra-sentential aspects of cohesion and coherence. However, changes in the level of abstraction may be a useful decision aid at sentential and also at textual level. Such changes help avoid both excessive use of the *um - zu* infinitive construction, which would violate the register requirement of counteracting tedious repetition of one and the same structure and excessive use of prepositional phrasing, which would violate the requirement of clarity of expression where a prepositional phrase is very complex.

The 'Others' category highlights how further semantic considerations and other register aspects may come into play and lead to different translation solutions. In the example quoted, not only did the infinitive class-shift to an adjective within a prepositional phrase, but the latter was itself shifted within the sentence for reasons of intra-sentential cohesion.

It is also interesting to note that equivalence can be achieved by a 1:0-correspondence for the infinitive, when it has a structural rather than a semantic function, as in "to allow removal of the solids", "zur Entfernung der Feststoffe". This

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[23]   As Kretzenbacher (1991:126) rightly points out, the *um - zu* construction can also have a temporal meaning.
[24]   'Die Konjunktion *um - zu* wird final zur Kennzeichnung des Zweckes, der Absicht oder aber konsekutiv zur Kennzeichnung der Folge gebraucht [...]' (Duden vol. 4, [5]1995:691, 2).

is particularly interesting from the point of view of translation into English, since this finding implies that a semantically weak infinitive may be required for structural reasons where there is a prepositional phrase expressing purpose or result in German, as in:

Am Auslauf ist der Stollen *zur Wassernutzung* gefaßt. (DIN 38 402 Teil 18, Seite 3, 3.2.2, 1991)
The outlet is lined *to facilitate utilization of the water*. (Official English translation of (also possible: *to allow*) DIN 38 402, Part 18) (italics added)

It is also interesting to note that 21% of the preposition+abstract noun translation solutions are shifted within the sentence either for reasons of intra-sentential cohesion and/or to comply with TL syntactic structures which may have been influenced by other shifts, such as shifts induced by translating instances of 'secondary subjectification' (4.3). No intra-sentential shifts are noted with the *um - zu* infinitive constructions, which may be more difficult to shift within a complex sentence than prepositions+abstract nouns. Of course, this does not mean that such shifts never occur, as the results of the following sub-category 3.1.1.1.1 show. Before these results are presented, it should be pointed out that the translation solutions established for this category do not exhibit finite subordinate clauses, i.e., they are by no means more explicit than the English *to*-infinitive clauses of purpose.

3.1.1.1.1   Special infinitive clauses of purpose

These are clauses of purpose of the type:

Studies/experiments/research work etc.   were/was carried out/undertaken/performed etc. to determine/evaluate/measure etc.
+ direct object or *wh*-interrogative clause   (Quirk et al. [13]1995: 15.5; 16.35)

In these sentences, the infinitive clause expresses the aim, intention or purpose of the action 'carried out' by the subject and predicate. These infinitives account for 16% (19 occurrences) of all the infinitives counted and for 36% of the infinitive clauses expressing purpose. The distribution of translation solutions for this category is as follows:

i) Infinitive conjunction *um - zu*; [*um zu*]   **42%**
    (infinitive construction expressing purpose)

Example:
Experiments were also carried out using [...] coprocessing VGO blended with X
to investigate whether such blends would provide a viable FCC option.

Ferner wurden Versuche mit einem Gemisch aus [...] Coprocessing-VGO und X ge-
fahren, *um zu untersuchen, ob derartige Gemische eine wirtschaftliche Alternative beim
FCC darstellen.*

ii) Infinitive construction *mit dem Ziel,...zu*+infinitive   37%

Example:
PDU studies were carried out *to investigate* feedstock performance at high
severity and high throughput reactor operation; *to measure* X and *to compare* Y and Z.

Die Untersuchungen im Technikum wurden *mit dem Ziel* durchgeführt, das Leistungs-
verhalten des Einsatzmaterials unter verschärften Verfahrensbedingungen und bei
hohem Durchsatz *zu untersuchen*, X *zu messen* und Y und Z *miteinander zu vergleichen.*

iii) Preposition (*zur* or *für*) plus abstract noun   16%
   (nominalization with *-ung* suffix) to express purpose

Example:
Some preliminary experiments were undertaken *to answer this question.*
Zur Beantwortung dieser Frage wurden einige Vorversuche unternommen.

iv) Others   5%

n.b.: Full finite subordinate clauses are avoided in all cases.

The lead for the *um - zu* construction (42%) in German may be due to the
specific structural and semantic aspects of this category described earlier, specifically
the ST *wh*-interrogative clause which functions as object and which, for structural
reasons, restricts the options for having prepositions+abstract nouns in German.
While the *um - zu* construction shifted to the beginning of the sentence in only one
instance, all 16% of the preposition+abstract noun complex shifted, for reasons of
intra-sentential cohesion, either to the beginning of the sentence or to a middle
position in the clause. In some instances the aspect of a high noun-based formality in
German TL register came into play and influenced the infinitives+*wh*-interrogative
clause complements, as is shown in the following example:

Due to a limited amount of coprocessing residue, not enough experiments could be
performed *to determine* exactly why the solids could not be removed.

Aufgrund der begrenzten Menge zur Verfügung stehender Coprocessing-Rückstände
konnten nicht genügend Versuche durchgeführt werden, *um die genaue Ursache dafür zu
ermitteln*, warum die Feststoffe sich nicht entfernen ließen.

Equivalence is achieved not only by inserting the noun *Ursache* (backtranslated: 'to determine the exact reason why') but also by inserting the pronominal adverb *dafür* which functions as cohesive device in the German TT.

In case of the second most frequent translation solution (37%), again register aspects have come into play, as the example demonstrates. Finality is here made explicit by inserting the expression *mit dem Ziel*, a finding which was corroborated by a TL parallel text (Lenz et al. 1988). As in the example discussed above, the slight increase in the degree of explicitness is not performed at random, but motivated by register considerations.

As regards the translation solutions for the infinitive clauses of result (4%) equivalence is achieved universally by finite *so...*, *daß* consecutive clauses[25] (Duden vol. 4, [5]1995:1326) and in one instance, where the English infinitive had a structural rather than a semantic function, by a 1:0-correspondence for the infinitive and relying on a preposition. However, since these infinitive clauses account for only 4%, the results should be underpinned on the basis of a larger corpus. This result also reflects the need to distinguish in specific cases between clauses of purpose and clauses of result despite an overlap of meaning. It is noteworthy that whereas English has one structure which may have a final, resultative or even temporal meaning, German may need different structures to differentiate more explicitly between these meanings for both systemic and register reasons. Therefore, the slight increase in the degree of explicitness in the translation solution of finite consecutive clauses is due to systemic and register constraints and is not an instance of "explicitation" as "a universal

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[25]   In two instances the degree adverb *enough* (Quirk et al. [13]1995:15.73) precedes a *to*-infinitive clause of result. Though this is not a very common infinitive construction, it does occur in chemical scientific and technical discourse (Weise 1980:83) to express consecutiveness, as in:
"The residuum molecules in the feedstock that were converted to distillates were the ones that were hydrogenated *enough to increase* their H/C ratios to X or greater [...]"
"Es wurden diejenigen Moleküle im Einsatzmaterial in Destillate umgewandelt, die *so stark* hydriert wurden, *daß* ihr atomares H/C-Verhältnis auf X oder darüber stieg [...]"
In these cases equivalence in translation is achieved by a finite *so...*, *daß* consecutive clause (Duden vol. 4, [5]1995:1326) in German. The aspect of sufficiency inherent in the English adverb *enough* is not expressed by its German adverbial correspondence *genug*, but by different lexical means such as an adjective. However, quite different translation solutions may exist for other infinitive constructions expressing result. These would have to be investigated on the basis of a larger corpus to yield statistically underpinned data.

strategy inherent in any process of language mediation" (Laviosa-Braithwaite 1998:289).

3.1.2. Other equivalence-relevant infinitive constructions

As was mentioned in the introduction, the English infinitive can occur in various structures performing different functions. Although, understandably not all structures can occur in a single corpus with a high frequency to yield statistically underpinned data, some of them may be repeated several times so that some signs of a trend in the search for equivalence in translation can be detected. These include, e.g., NcI and AcI constructions and others. Since such structures may be considered typical of a wide range of scientific and technical texts and are relevant from an equivalence point of view, they will be briefly discussed and presented in the following. The various infinitive constructions investigated below account for 40% (47 occurrences) of all the infinitives counted. For semantic reasons, a distinction has been made between modal (see 4.2 for modality) and nonmodal infinitive constructions.

3.1.2.1   Modal infinitive constructions

These are catenative verb constructions, pseudo-subject *it*+be+adjective+*to*-infinitive, the infinitive in statements of the aims of a study/project, and NcI constructions with verbs of assumption and AcI constructions (see categories below).

3.1.2.1.1   The catenative verb construction *seem* and *appear*+infinitive
(Quirk et al. [13]1995:3.49)

The above construction, in which the infinitive is part of the predicate, accounts for 4% (5 occurrences) of all the infinitives counted. It is used in English scientific and technical discourse to express "subjective uncertainty" (Weise 1980:82). This may be expressed by different means in the TL to achieve equivalence. Although literal translation may lead to grammatically and syntactically 'correct' solutions, these might violate TL register requirements. Hence, equivalence may be achieved by the adverbs *offenbar* and *offensichtlich* in German, as in:

> The X process *seems to correlate* the worst, but this is probably due to [...]
> Beim X-Prozeß *ist die Korrelation offenbar* am schlechtesten, was aber wahrscheinlich auf [...] zurückzuführen ist.

In the above infinitive construction, additional shifts are necessary to achieve equivalence: the infinitive shifted to a noun (see 3.1.2.2.2), the finite verb *seem* to the adverb (*offenbar*) - which also requires the introduction of the verb *sein* - and the subject to a prepositional phrase.

3.1.2.1.2 Pseudo-subject *it*+*be*+adjective+*to*-infinitive

This construction is often used in English scientific and technical discourse (Barber 1962:35; Weise 1980:82). According to Weise (ibid.), the following adjectives occur most frequently with this construction: "*important, common, essential, difficult, easy, (im)possible, (un)necessary, (un)usual*". In our corpus only the adjective *possible* and its negated form *not possible* are used. This construction accounts for 5% (6 occurrences) of all the infinitives counted, and substantial shifts occur in translation to achieve equivalence. With one exception, the pseudo-subject *it* was eliminated in translation which gives rise to considerable shifts at the syntactic level, i.e., the English object[26] becomes the German subject and the semantics of the adjective *possible* is absorbed by the modal auxiliary *können* or the reflexive verb *sich lassen* which, together with the infinitive, form the predicate complex, as in the following example:

> However, *it was possible to investigate* the coprocessing performance of seven different types of catalysts or catalyst precursors.

> Jedoch *konnte* die Coprocessing-Leistung von sieben verschiedenen Katalysatortypen bzw. Vorkatalysatoren *untersucht werden*, [...]

This result is certainly due in part to the equivalence-relevant aspect that the German structure avoids monotonous repetition of the grammatically correct correspondence *es ist möglich/nicht möglich*+*zu*+infinitive, thus helping counter the potential excessive use of *zu*+infinitive constructions on an overall textual level. Of course, this should not be taken to mean that this correspondence may not be regarded as a potential equivalent (and was in fact used in one instance for reasons of

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26   According to Quirk et al. ([13]1995:18.33), *it* in the example given may also be defined as 'anticipatory subject' with the 'postponed subject' being "to investigate [...]", so that the sentence would run as follows: "To investigate the coprocessing performance of seven different types of catalysts or catalyst precursors was possible." However, to explain the shifts in translation, it is more advisable to look at the term "coprocessing performance" as the object in the example under discussion.

cohesion), but here it is definitely less common than the other translation option for register reasons.

3.1.2.1.3   The infinitive in statements of the aims of a study/project

This infinitive occurs in the corpus in concatenation with the noun *objective(s)* in the antecedent subject complex, as in the following example:

> The objective(s) of the/this project/study was/were to examine/determine etc.
>   + direct object or *wh*-interrogative clause (Quirk et al. [13]1995:15.5, 16.35)

The infinitives used in this frequently repeated construction account for 10% (12 occurrences) of all the infinitives counted. Statements of the type "The aim/purpose/object of this study is" are typically found in introductions to English research articles (Gnutzmann 1991:12, no. 3). In the corpus investigated, the above construction was used throughout the text to introduce the aims of a specific research activity/area. In this construction *be* is followed by a nominal *to*-infinitive clause (Quirk et al. [13]1995:15.10). The construction under investigation also expresses aim, intention or purpose, so that it correlates in meaning with the infinitive clauses of purpose investigated in 3.1.1.1.1. However, in view of the functional difference and the explicitly modal component reflected by the noun *objective(s)*, they are not treated together, since it may well be assumed that different translation solutions could emerge - as the results do in fact show. The ranking of translation solutions for this construction in descending order of frequency is as follows:

> a) Prepositional phrasing+modal verb *sollen* (1:0-correspondence for *objective*)
> b) Prepositional phrasing with impersonal *man* and modal verb *wollen*
>   (1:0-correspondence for *objective*)
> c) impersonal *es*+modal verb *sollen* (1:0-correspondence for the subject complex)
> d) *zum Ziel haben*+*zu*+infinitive
> Examples: The objective(s) of this project/study was/were to examine/determine+direct
>   object or *wh*-interrogative clause (Quirk et al. [13]1995:15.5, 16.35)
> a) Im Rahmen dieses Projektes/dieser Untersuchung sollte/sollten...untersucht werden.
>   (sollte untersucht werden, ob...)
> b) Im Rahmen/mit (hiermit)...wollte man herausfinden, ob...
> c) Es sollte(n)...X untersucht werden.
> d) Die/diese Untersuchung/Studie hatte zum Ziel,...zu ermitteln.

As the result shows, this construction requires considerable syntactic shifts to achieve equivalence. The most common translation solution is prepositional phrasing+the modal verb *sollen*,[27] which is the third most common modal verb in

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[27]   The German modal verb *sollen* may express task, purpose, aim, function (Duden vol. 4,

German scientific and technical discourse (after *können* and *müssen*) (Fluck ²1997:101). It may be argued that this translation solution reflects the inanimateness of the underlying structure of this construction, which can be paraphrased as follows:

The/this project/study was to examine/determine etc.

In the paraphrase, we no longer have an infinitive clause, but the modal idiom *be to*+infinitive, with the modality inherent in the noun *objective(s)* now being reflected by the modal idiom *be to* (Quirk et al. ¹³1995:3.46 (d)).[28] Since the subject-predicate structure implies inanimateness, i.e., it constitutes an instance of 'secondary subjectification', it is shifted in translation to a prepositional phrasing which is a common translation solution in this case (4.3). The variety in translation solutions is chosen for register reasons, since German scientific and technical discourse avoids tedious repetitions of one and the same structure.[29]

3.1.2.1.4   NcI constructions with the verbs of assumption *expect* and *project*

The NcI construction, i.e., subject+passive verb+*to*-infinitive (see also 3.1.2.2.1), is a very common construction in scientific and technical discourse (Gerbert 1970:66-67; Weise 1980:83; Sager et al. 1980:213-214), especially in association with verbs of thinking, saying, reporting and planning (Gerbert 1970:66), because this construction "enables the writer [of articles in technical journals] to report new developments in research and industry without expressing his own opinion about the validity of claims made by manufacturers or other interested parties" (Sager et al. 1980:213). According to Gerbert (1970:66-67), verbs of assumption, such as *believe*, *expect*, *suppose*, *understand*, function as a sort of "Sicherheitsventil" (safety device) to help technical writers counteract the risk of being too absolute in their statements. The use of such verbs is particularly evident in cutting-edge research reports, in which the data presented may have to be corroborated by further testing.

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⁵1995:165, c)).

[28]   "BE *to* is an idiom expressing futurity, with varied connotations of 'compulsion', 'plan', 'destiny', etc, according to context. In the past, *was to* and *were to* express futurity from the standpoint of past time orientation [...]" (Quirk et al. ¹³1995:3.46 (d)).

[29]   It should be noted that the German correspondences "Ziel/Zweck/Gegenstand dieser Arbeit ist/stellt dar/bildet [...]" mentioned by Gnutzmann (1991:12, no. 3) for "The aim/purpose/object of this study is", do not appear in the present corpus, but may also be considered potential equivalents under certain syntactic-semantic-pragmatic circumstances.

The verbs *expect* and *project* plus infinitive, are frequently used in the corpus, of course, accounting for 7% (8 occurrences) of all the infinitives counted.[30] The translation solutions indicate a trend towards an adverbial construction with the adverb *voraussichtlich* to achieve equivalence, as in:

> Overall, these residues would be *expected to perform* as good or better than [...]
> Insgesamt würden diese Rückstände *voraussichtlich* ebenso gute oder bessere *Ergebnisse erzielen* als [...]

In the above example, the infinitive is additionally modulated and transposed to a noun+semantically weak functional verb for TL register reasons. Certainly, the co-textual semantics of this construction in the ST and further register requirements in the TL (e.g., avoidance of repetitive adverbial use), may lead to different translation solutions in the search for equivalence, e.g., "X is *expected to be* a first step" - "X *gilt* als erster Schritt". Although other potential equivalents for *expect*+infinitives do occur, such as impersonal *es ist zu erwarten, daß* and *gelten*, there is a clear trend towards an adverbial construction.[31]

3.1.2.1.5   AcI constructions

The AcI, i.e., verb+object+*to*-infinitive, occurs in technical language specifically with the verbs *enable, allow, permit, cause* and *require*, and requires restructuring in translation into German (Krein-Kühle 1995a:68-69). As Gerbert (1970:63) rightly claims in this context:

> Dabei ist vermutlich ihr Gebrauch nicht einmal auf eine besondere Eignung der AcI-
> Konstruktion für die Sprache der Technik zurückzuführen, sondern er scheint eher
> einem Mangel im System der defekten Hilfsverben und deren strukturellen
> Bedingungen zu entspringen.

In order to achieve equivalence, we can follow Gerbert's recommendation that the verbs *enable, permit* and *allow* be translated by the modal auxiliary *können* or by its semantic correspondences *es ist möglich, es besteht die Möglichkeit* in German (op. cit.:63-64). Similarly, the verb *require* should be translated by the modal auxiliary *müssen* or *erforderlich sein/machen*. Since the verbs in question typically occur in instances of 'secondary subjectification' (4.3), they have been included there for analysis. We can,

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[30]   As mentioned in Gerbert (1970:66), NcI constructions are three times more common in
technical texts of specific domains than AcI constructions, a finding which is
underpinned by this research (see AcI, 3.1.2.1.5). Weise (1980:83), too, found that the AcI
occurred relatively rarely in his corpus.

[31]   An adverb was also used in the TT for the NcI construction exemplified in 3.1.1.1, iii).

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however, state here already that Gerbert's recommendation is underpinned by the findings of this research. In our corpus, the AcI occurs in its expanded form, i.e., verb+object+*to be*+past participle, but accounts for only 2% (2 occurrences) (see f.n. 30). With this construction, equivalence is achieved by adhering to the above recommendation involving prepositional phrasing in the TT, see example:

> This bench-scale study provided the basic data which would *allow larger scale fluidized bed tests to be conducted* [...]
> Aus dieser Laboruntersuchung gingen die Basisdaten hervor, anhand derer *Wirbelschichtversuche in größerem Maßstab* [...] *durchgeführt werden können.*

3.1.2.2 Nonmodal infinitive constructions

These are NcI constructions with the verbs of knowledge *find* and *show* and the terminological infinitive (see categories below).

3.1.2.2.1 NcI constructions with the verbs of knowledge *find* and *show*

Among the verbs frequently used in NcI constructions are those denoting the generation or presentation of knowledge ("Erkenntnis bzw. deren Wiedergabe") (Weise 1980:83), such as "*find, know, say, show*". In the corpus investigated, the verbs occurring as part of this construction are *find* and *show*. The frequently repeated NcI construction, involving these two verbs, accounts for 7% (8 occurrences) of all the infinitives counted.[32]

When used with a *to be* infinitive plus adjective, the passive predicate (*show*) is always translated by a reflexive verb (*sich erweisen als*) in the TL, e.g., "High throughput coprocessing [...] was shown to be feasible" - "Eine Verfahrensführung mit hohem Durchsatz [...] erwies sich als machbar" (also: *durchführbar*). In the case of all other infinitives following *find* and *show*, these verbs are rendered by a 1:0-correspondence in translation with the infinitive becoming the finite predicate, as in:

> For the X and Y fractions, *coal was found to contribute* [...] ethers.
> Bei den X- und Yfraktionen *steuerte die Kohle* [...] Ether bei.

These verbs in the passive voice are obviously used for structural rather than for semantic reasons, an aspect which is reflected in translation. However, whereas the English construction with *find* makes explicit both the procedural and resultative

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[32] Modal plus nonmodal NcI constructions account for 14% in the corpus investigated (cf. Weise (1980:83), who mentions a figure of 20%).

aspect of scientific research, i.e., the generation and presentation of a specific knowledge, the German construction only presents the resultative aspect, leaving the procedural aspect implicit. Of course, these translation solutions would have to be checked on the basis of a more comprehensive corpus to yield statistically robust results.

The corpus-based investigation of a large number of both modal and nonmodal NcI constructions occurring with verbs of different semantic classification (Weise 1980:83) would be a fruitful area for further research into translation equivalence.

3.1.2.2   The terminological infinitive

Like nouns, verbs, and phrases, the infinitive, too, can contribute to the terminology of a specialized text. These infinitives may be preceded by verbs, adjectives or nouns. Owing to the highly noun-based terminological specificity in the TL, these infinitives call for nominalization in translation to achieve equivalence. Additional aspects, such as co-text and context, may lead to further translational shifts, as in the following example:

> the *ability to scavenge* heavy metals present in the feed.
> *Fängereffekt* für im Einsatzmaterial vorliegende Schwermetalle.

In the above example the infinitive functions as an attribute and is dependent on the antecedent noun. The example also demonstrates that besides terminological aspects, pragmatic aspects, too, i.e., domain knowledge and register, may come into play and modify syntax.

Although these terminological infinitives only account for 5% (6 occurrences) of all the infinitives counted, they are - as the discussion has shown - relevant from an equivalence point of view. All of these infinitives have been nominalized in translation.

Moreover, it is interesting to note that 29% of all the infinitives counted in the corpus are nominalized in translation. Most of these nominalized forms are abstract nouns with *-ung* suffix ('explicit derivation', see Liang 1984:130)[33] (cf. the results of 3.1.1.1), but we also find "substantive infinitives" (op. cit.:129) (e.g., *Mischen*), and

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[33]   According to Liang (1984:130), "explicit derivation" with *-ung* is very productive and very common in German specialized languages.

other solutions, e.g., infinitives which are shifted to nouns plus functional verbs as in *perform - Ergebnisse erzielen*. Abstract nouns with *-ung* suffix, and "substantive infinitives" contribute both to economy of expression and to nominalization in German scientific and technical discourse.[34] The above result suggests that in the process of translation the nominalization of certain infinitives may be necessary to meet both terminological and register requirements in the TL to achieve equivalence.

To conclude the investigations of the infinitive, it is interesting to note that the infinitive in English technical discourse is frequently preceded by verbs that take on a more structural or functional character, such as *use, provide, make, have, help, cause*, nominalized phrases, e.g., *to have the potential to*, or by impersonal expressions, such as pseudo-subject *it* constructions (3.1.2.1.2), which are used by the technical author for sentence structuring reasons to retain the infinitive which carries the semantic content (Schröter [3]1990:14; Krein-Kühle 1995a:68). These structural verb+infinitive constructions may give rise to substantial shifts at the syntactic level, e.g., prepositional phrasing in German, with the infinitive becoming part of the finite verb form and a 1:0-correspondence for the structural verb, as in:

> Samples of low and high solids content residues derived from processing [...] *were used to generate* a [...] fluidized bed combustion feedstock.

> *Aus* Rückstandsproben mit niedrigem bzw. hohem Feststoffgehalt aus der Verarbeitung von [...] *wurden* Einsatzstoffe [...] für die Wirbelschichtverbrennung *hergestellt*.

It can be argued that the verb+infinitive structure in the above example - when seen in concatenation with the subject and when stripped of the structural verb - is an instance of 'secondary subjectification' (see also 3.1.2.1.3 and 3.1.2.1.5), i.e., "samples produce/generate a feedstock", a structure that favours a prepositional phrasing in the TL (4.3).

However, modulation of the structural verb plus nominalization of the infinitive, too, may be the key to equivalence fulfilling the register requirement of abstraction and condensation, as is demonstrated in the following example:

> The frame is used to align the extruded strips with the mould cavities.
> Der Rahmen dient der Ausrichtung der extrudierten Bänder auf die Formnester.
> (Krein-Kühle 1995a:68)

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[34]   See Liang (1984) for an investigation of "'substantive infinitives' (SI)" in German technical discourse.

The English semantically weak structural verb in the passive voice has shifted to a semantically weak verb in the active voice, and the infinitive to an abstract noun in the TL. As the discussion has shown, it is advisable to look very closely at verb+infinitive structures, to exactly determine their semantic value. The fact that the verb is often chosen for sentence structuring reasons may have considerable implications for translation equivalence, leading to 1:0-correspondence for, or to modulation of the structural verb and entailing further shifts at the syntactic level. A detailed investigation of this infinitive structure on the basis of a very large corpus would be a fruitful area for further research.

3.1.3 Summary of this section

For the final presentation of the findings, the two categories and percentages for the infinitive clauses of purpose (3.1.1.1 and 3.1.1.1.1) have been combined. This has not been done for statistical reasons alone, but also for the sake of obtaining an overview of the general textual distribution of infinitive constructions in the TT in this regard.

Taken together, the infinitive clauses of purpose account for 44% of all the infinitives counted. The distribution of the translation solutions for the infinitive clause of purpose, which is the only infinitive construction that occurs frequently enough to yield statistically underpinned data, is as follows:

Table 3   **Distribution of translation solutions for infinitive clauses of purpose (categories 3.1.1.1 and 3.1.1.1.1)**

Preposition (*zur/für*)+abstract noun	41%
Infinitive conjunction *um - zu* [*um (so) - zu*; *um - zu können*; *um zu...*,]	38%
Infinitive construction *mit dem Ziel,...+zu*+infinitive	13%
Others	8%

The overall distribution shows that the figures for the two main translation solutions have shifted closer together, reflecting a sensible balance between the infintive construction with *um - zu* conjunction (38%) and prepositional phrasing (41%) (i.e., preposition+abstract noun). The infinitive construction of intention/purpose *mit dem Ziel,... zu* (13%) is a specific feature of the genre under

analysis. The translation solutions under 'Others' (8%) include considerable syntactic shifts for reasons of cohesion and coherence.

On the basis of the above result the following transfer procedure for English infinitive clauses of purpose in the text type and genre investigated can be recommended to achieve equivalence in translation:

Table 4   Recommended transfer procedure for English infinitive clauses of purpose

(E) Infinitive clause of purpose
(G) A sensible balance in the distribution of *um - zu* [*um (so) - zu*; *um - zu können*] infinitive construction and preposition (*zur/für*)+abstract noun (besides other translation solutions) on a sentential and textual basis.

The decision as to which of the above main forms is to be chosen in a particular text is certainly more intricate and may depend on the complexity of the complete sentence and/or of the infinitive clause itself, as well as on further supra-sentential aspects of cohesion and coherence. However, requisite changes in the level of abstraction in translation into German, which may occur for grammatical and register reasons, for example to counteract an excessive use of subordinate clauses, may be a useful decision aid at sentential and also at textual level.

It should also be noted that full finite subordinate clauses have been avoided in all cases, which can be seen as a clear trend towards using 'equivalent' sentence-reducing linguistic means in the TT, a step which is governed by register considerations, so that equivalence can be deemed achieved not only at the syntactic level, but also at the overall text-in-context level. The fact that the two main translation solutions, in particular, may imply both final and resultative meaning, as may their English infinitive counterparts, shows that equivalence is also implemented at the semantic level. These results also point to the importance of register considerations when it comes to achieving equivalence at the syntactic level.

As regards the results for the infinitive structures investigated under 3.1.2, the following indicators of trends can be observed for the modal and nonmodal infinitive constructions investigated. Certainly, these trends would have to be corroborated on the basis of a larger corpus.

a)   Modal infinitive constructions:

The catenative verbs *seem* and *appear* plus infinitive (3.1.2.1.1) are rendered by an adverb (*offenbar/offensichtlich*) with the infinitive becoming the finite verb (or other, e.g., nominalization of infinitive plus *sein*). The same trend can be observed for the verbs *expect* and *project* in NcI constructions (German adverb: *voraussichtlich*) (3.1.2.1.4). The pseudo-subject *it*+be+possible+*to*-infinitive construction (3.1.2.1.2) shows a trend towards the modal auxiliary *können* or the reflexive verb *sich lassen* in the TL. In the AcI construction (3.1.2.1.5), the verbs *enable, permit* and *allow* are rendered by the German modal auxiliary *können* or its substitute forms, and English *require* is rendered by the German modal auxiliary *müssen* or *erforderlich sein/machen*. Since these verbs typically point to instances of 'secondary subjectification' (4.3), prepositional phrasing plus modal auxiliaries is the key to equivalence. This is also true of the structure "subject (= *objective*)+*be*+*to*+infinitive" (3.1.2.1.3), with the TL modal auxiliary being *sollen* in this case.

b)   Nonmodal infinitive constructions:

The verbs *find* and *show* in NcI constructions (3.1.2.2.1) show a trend towards a 1:0-correspondence in translation with the infinitive becoming the finite verb. The verb *show*+*to be* infinitive+adjective was translated by a reflexive verb (*sich erweisen als*) in German.

As the investigation has shown, the infinitive also contributes to the terminology of a specialized text. To achieve equivalence, these terminological infinitives (3.1.2.2.2) have to be nominalized owing to a high noun-based terminological specificity in the TL. Moreover, it is interesting to note that roughly one third of all infinitives counted in the corpus were nominalized in translation. Of course, more research into this aspect is required to further determine the specific circumstances in which what infinitives are nominalized.

As regards infinitive constructions preceded by verbs with a rather structural function (see also 3.1.2.2.1), achieving equivalence is a more intricate process and may require substantial shifts at the syntactic level. Equivalence may be achieved for example by a 1:0-correspondence for, or by modulation of the structural verb, with the infinitive becoming a passive finite form and a noun, respectively. Certainly, the infinitive itself may have a structural function only and, therefore, may be rendered by a 1:0-correspondence in translation (see 3.1.1.1).

Of course, all findings should be underpinned on the basis of a more comprehensive corpus. The individual syntactic-semantic categories investigated here could not only be tested out but also extended on the basis of a larger corpus, e.g., the category of NcI constructions could be extended to include other verbs of assumption, such as *consider, assume, believe,* etc., in order to yield more specific equivalence-relevant data which should find its way into a translation-geared dictionary or handbook.

The investigation of the translation solutions for the various infinitive structures occurring in scientific and technical discourse (Weise 1980:82-84) on the basis of a larger corpus would be a promising area for further research. Such research would have to take due account of the multifunctionality and potential ambiguity of these structures by establishing precise categories in order to obtain equivalence-relevant findings.

The results of the anaylsis also show that changes in the degree of both explicitness and implicitness may occur in the process of translation in the categories investigated for systemic and/or register reasons. Therefore, the translation solutions established do not constitute instances of "explicitation" (Baker 1996), but contribute to "equivalence in difference" (Jakobson [1959]1992) at overall textual level.

The findings also point to an interrelatedness of certain features investigated, e.g., certain infinitive constructions (3.1.2.1.3, 3.1.2.1.5, structural verbs+infinitive) and the inanimate subject sharing the aspect of 'secondary subjectification' (4.3) which favours a specific translation solution in the TL (prepositional phrasing) to achieve equivalence. This also implies the interrelatedness of what superficially may be deemed isolated translation procedures.

3.2 English past participle constructions and their German potential equivalents

Apart from its appearance in the perfect tenses and the passive voice, the past participle in scientific and technical discourse is frequently used as an attribute in both

the premodification and the postmodification of a noun (Weise 1980:84-86, Sager et al. 1980:214-215; Baakes 1994:79 ff.). In premodification it functions as an adjective,[35] and in postmodification it is used, i.a., as a clause reducing device with the following syntactic functions: reduction of relative clauses (Huddleston 1971:249 ff.) and reduction of adverbial clauses (Weise 1980:85-86).[36] In its clause reducing function, in particular, the past participle like the present participle (3.3.1) contributes to syntactic compression and condensation of meaning. Of the non-finite verb forms counted in the corpus, the past participle accounts for 36% (282 occurrences).

The categorization and description of the past participles found in the corpus - some of which are investigated here - is based on the following counting mode: All past participles contained in the corpus were counted. Of the total, 44% are used in the passive voice[37] (222 occurrences), 1% in perfect tenses (5 occurrences), 33% in clause reduction[38] (166 occurrences) and 22% (116 occurrences) as premodified adjectives. Past participles occurring in the passive voice and perfect tenses are excluded from the investigation, since they are considered to be finite verb forms and, for the same reason, they have been excluded from the calculation of the non-finite verb forms.

It is interesting to note that, of the past participles used as premodified adjectives, 72% are terminologically 'laden', i.e., they occur as constituent parts of terminological units such as multiple compound nouns, e.g., *fluidized bed combustion*. For an investigation of the two element 'past participle+noun' compound see 5.2.2.2.

For statistical reasons based on the frequency of occurrence in the corpus and for reasons of equivalence, it is the past participle used in clause reduction that is of particular interest here, so that the following sections will discuss the categorization,

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[35]   These are also called participial adjectives (Quirk et al. [13]1995:7.15).
[36]   For further uses of the past participle in scientific and technical discourse see, e.g., Weise
        (1980) and Baakes (1994).
[37]   Passive voice is understood to include all forms of the passive, such as present, past, modal,
        perfective, etc. (Quirk et al. [13]1995:3.64).
[38]   This group also contains a few past participle constructions of a lower frequency which -
        from a strictly grammatical point of view - cannot be regarded as having a clause reducing
        function (see, e.g., 3.2.1.1.2). However, since similar translation solutions are expected for
        these constructions they have been subsumed under this heading, but given separate
        consideration. Certainly, if the past participle were the only feature to be investigated on
        the basis of a more comprehensive corpus, several different headings would be sensible.

description and investigation of equivalence-relevant past participles used in clause reduction.

3.2.1 The past participle used in clause reduction and its German potential equivalents

The past participle used in clause reduction accounts for 33% (166 occurrences) of all the past participles counted (as against 22% for the present participle in the same function, see 3.3.1). This high percentage involves above all relative clause reduction (3.2.1.1). The past participle used in this function accounts for 61% (101 occurrences) of all past participles involved in clause reduction (as against 40% for the present participle, cf. 3.3.1.1), whereas only 16% (26 occurrences) are accounted for by adverbial clause reduction (3.2.1.2). Of the latter, 15% (4 occurrences) involve related adverbial clauses and 85% (22 occurrences) what Swales (1971:153) calls "linking *as*-clauses". In contrast to the present participle involved in adverbial clause reduction, the implied subject of the related past participle clause is not identical with the subject of the main clause, but may have different antecedents within or beyond the sentence (3.2.1.2.1). The 'Others' category accounts for 23% (39 occurrences) and contains what in the present work is called prepositional past participles and/or sentential past participles (3.2.1.3). The latter may refer back to an entire clausal or sentential statement. The excessive use of these past participles, most of which are in prepositional function, point to a repetitive and highly condensed style which may have to be compensated for by the translator in the search for equivalence. Some instances may even reflect a somewhat careless style on the part of the researcher who is often in a hurry to present her/his findings and who considers the results themselves more important than the language in which they are described (see 1.4.3). Since such instances understandably do present problems for translators in their search for equivalence, they, too, will be investigated here.

Although an attempt has been made to match categories with those for the present participle, the use and function of the past participles in the corpus shows that comparability is possible to a limited extent only. For example, as Baakes (1994:89) rightly claims, absolute past participle clauses are "much less common than the absolute present participle clause" and the unrelated past participle clause construction "is very rare as compared to the use of the unrelated present participle

clause" (1994:91).[39] In the corpus no absolute or unrelated past participle clauses were found. However, some matching and comparability can be achieved in the case of past participles used in relative clause reduction, as will be discussed in what follows.

3.2.1.1 The postmodifying past participle as reduced relative clause

Like the postmodifying present participle (3.3.1.1), the postmodifying past participle may appear at the head of a reduced relative clause. Unlike the present participle, which reduces an active relative clause, the past participle reduces a passive relative clause. The reduction of relative clauses is an extremely common feature in this type of discourse, "because it gives a more concise wording" (Sager et al. 1980:214). Similarly, Baakes (1994:85) explains its frequency by "the writer's [...] desire for objectivity and conciseness of expression". Since this participle construction has no structural counterpart in German,[40] equivalence is often more difficult to achieve. As the results of the investigation will show, syntactic equivalence is dependent on and interwoven with register requirements involving different and more or less complex syntactic transformations in translation.

As mentioned earlier, the past participle reducing a relative clause accounts for 61% (101 occurrences) of all past participles in clause reduction, so that it is the most common type of past participle under investigation. This past participle is further subdivided into expanded and unexpanded[41] past participles to allow comparability with the present participle (although this does not appear in an unexpanded form in the present corpus). The expanded past participle (3.2.1.1.1) accounts for 84% (85 occurrences) and the unexpanded (3.2.1.1.2) for 16% (16

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[39]   The categories 'related' ("the implied subject is identical with that of the main clause"), 'unrelated' ("the participle has neither its own subject nor does it provide a link with that of the main clause") and 'absolute' clause ("the participle has its own overt subject that is different from that of the main clause") are taken over from Baakes (1994:64 ff.), but - as this research shows - may have to be defined differently to take account of the factual reality of the present ST (see 3.2.1.2.1). It should be noted that terminology is by no means uniform in this context (see f.n. 65).

[40]   Strictly speaking, there is, of course, a structural correspondence in German which is, however, a grammatical correspondence rather than a translational equivalent (cf. also Wilss 1971). This grammatical correspondence may become an equivalent in specific register or genre-related cases (e.g., in patent translations).

[41]   The terms 'expanded' and 'unexpanded' will be explained in greater detail in the discussion of the respective categories.

occurrences) of the past participles in question. In the case of the expanded past participle, one sub-category is:

The 'detached' reduced relative clause (3.2.1.1.1.1). This sub-category is based on the fact that the past participle, like the present participle (3.3.1.1.1.1), does not always directly follow the antecedent noun to which it refers, but can be 'detached' from it. This clause accounts for 6% (5 occurrences) of all expanded past participles.

The findings for categories 3.2.1.1.1, 3.2.1.1.1.1, and 3.2.1.1.2 are presented and discussed below.

3.2.1.1.1   The expanded postmodifying past participle as reduced relative clause[42]

The expanded past participle accounts for 51% (85 occurences) of all past participles used in clause reduction in the corpus and is the most frequent category of all past participles in this function (as against 33% for the present participle in the same function, 3.3.1.1.1). It accounts for 84% (85 occurrences) of all participles in relative clause reduction. Of these, 87% (74 occurrences) reduce restrictive and 13% (11 occurrences) non-restrictive relative clauses. Expanded participle constructions[43] are understood to refer to antecedent nouns[44] and to contain at least an adverb complement, but more frequently a complement of greater complexity (at least a noun or a noun-containing construction). Thus, this category also comprises what Quirk et al. ([13]1995:15.57) call an "adnominal relative clause" (cf. also Göpferich 1995a:422). The distribution of translation solutions for this category is as follows:

i) Lengthy premodification ('prenominal attributes')   44%

Example:
The results indicated that both residues are more reactive than most coals *tested in the same unit under similar conditions* and can be burnt with low carbon residence times.

Aus den Ergebnissen ging hervor, daß beide Rückstände eine höhere Reaktivität aufweisen als die meisten, *unter ähnlichen Bedingungen in der gleichen Anlage erprobten* Kohlen und sich mit niedrigen Kohlenstoffverweilzeiten verbrennen lassen.

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[42]   The results for this category have been published in Krein-Kühle (1999).
[43]   Weise (1980: 84) calls these constructions "erweiterte Partizipien".
[44]   This category also includes one instance in which an adverb was inserted between the past participle and the antecedent noun and one instance in which an adjective was inserted between the past participle and the antecedent noun.

ii) 1:0-correspondence (and relying on preposition
or other)*   29%

Example:
It was also shown that coal derived liquid products [...] would result in greater catalytic activity loss for aromatics hydrogenation compared with a heavy gas oil fraction *derived from coprocessing*.

Es zeigte sich ebenso, daß bei kohlestämmigen Flüssigprodukten [...] der Verlust der Katalysatoraktivität bei der Aromatenhydrierung höher ist als bei schwerem Gasöl *aus dem Coprocessing*.

*(e.g., attributive *als* or attributive genitive)

iii) Relative clause introduced by a relative pronoun   6%

Example:
This report is based on the results of the studies *carried out in the four major areas described below*.

Der vorliegende Bericht basiert auf Ergebnissen von Untersuchungen, *die in den vier nachstehend beschriebenen Hauptbereichen durchgeführt wurden*.

iv) Word group in prepositional function[45]   5%

Example:
An important question *related to such a two stage concept* is what effect the X additive would have on the performance of the second stage.

Eine wichtige Frage *in bezug auf ein Zweistufenkonzept* ist, welche Auswirkung ein X-Additiv auf die Verarbeitungsleistung der zweiten Stufe hat.

v) Others   16%

Experiments were also carried out using [...] coprocessing VGO *blended with X* to investigate whether such blends would provide a viable FCC option.

Ferner wurden Versuche mit einem *Gemisch aus* [...] Coprocessing-VGO *und X* gefahren, um zu untersuchen, ob derartige Gemische eine wirtschaftliche Alternative beim FCC darstellen.

n.b.: Of all translation solutions only 8% are accounted for by a relative/subordinate clause, whereas in 92% of all cases subordination was avoided.

As the results show, lengthy premodification for this type of past participle is the key to equivalence in most cases. The option of using German relative clauses, which may be considered a 'standard solution' by many translators, would lead to

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[45]   This term derives from Beneš (1976:93) who talks of "word groups approaching the function of a preposition" (my translation), such as *auf Grund, mit Hilfe, unter Einsatz, unter Verwendung*.

syntactically 'correct' translations, but not to equivalence, because they would have violated the TL register requirements of economy of expression and a high level of formality. Lengthy premodification (prenominal attributes)[46] or "anteponierte Attributkette" (Kretzenbacher 1991:129) is a frequent feature that is characteristic of German scientific and technical syntax (see also Beneš 1976:93; Göpferich 1995a:422 ff.; Fluck [2]1997:112-13).[47] These prenominal attributes help save subordinate clauses in German, as the postmodifying past participles do in English. In the two languages involved these structures contribute to a clearer representation/organization of the subject matter.

Apart from its semantic function, the past participle may take on a more structural binding function and in this case equivalence may be achieved by a 1:0-correspondence and by relying on prepositions. This is a very interesting point, since it implies that the use of a preposition in a German ST may require a past participle, i.e., a 0:1-correspondence, in translation into English to achieve equivalence. In addition to the semantics of the underlying verb, the aspect of sentential complexity, too, has obviously influenced the translator's decision of which translation solution is chosen under certain given circumstances. The ST sentences which lead to premodification in the TL are generally less complex than those leading to a 1:0-correspondence.[48] Most of the English ST sentences which gave rise to a 1:0-correspondence are highly complex, i.e., they exhibit coordination and subordination and several past and present participles, and some of them contain more than sixty words.

The relatively high percentage for the 1:0-correspondence may also be attributed to the multiple inclusion of the type "Fe loaded on coal" or "Mo introduced as..." which makes up 42% of all cases in which a 1:0-correspondence was opted for.

Use of the relative clause in German is obviously possible as a syntactically equivalent solution when the ST sentence contains another past participle (see above example under iii)), which is premodified in translation. The relative clause solution

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[46] Göpferich (1995a:422), for example, talks in this context of "pränominale Attribute".
[47] This frequency may, of course, be genre-specific (Göpferich 1995a).
[48] Cf. also Reinhardt et al. ([3]1992:165-166) who warn against overloading this construction, i.e., making the prenominal attributes too complex.

may be chosen in the case of ST sentential complexity and the use of two past participles in tandem with the semantics of their underlying verbs. The relative clause solution is also chosen when the past participle refers back to two different antecedent nouns.

The use of word groups in prepositional function (see f.n. 45), another common feature of German scientific and technical discourse (Beneš 1976:93), corresponds to the use of past participles in the English ST in prepositional function (see iv)).

As for the 'Others' category, higher-ranking textual levels and further pragmatic aspects, i.e., knowledge of domain and register, may come into play and modify syntax. In the example quoted (see v)), for example, terminological-phraseological aspects of equivalence, i.e., high noun-based terminological specificity (cf. also the findings for the infinitives, 3.1.3), and considerations of cohesion (*Gemisch* and its lexical, or rather, terminological cohesion with *Gemische*) take precedence over mere syntactic aspects. Also, aspects of coherence, e.g., redundancy considerations in the TT, may occasionally come into play and shorten an otherwise lengthy premodification, e.g.:

> X is a function of the heteroatom content of the coal-oil combination *used as feed*.
> X hängt von dem Heteroatomgehalt der *eingesetzten* Kohle-Öl-Kombination ab.

The fact that the coal-oil combination is used *as feed* is redundant in German and is implicit in *eingesetzte Kohle-Öl-Kombination*, which suggests "put in", i.e., "input".

The 'Others' category also contains one instance in which the translator has made a conceptual reality somewhat more explicit by using a subordinate clause (and by introducing a missing noun as reference) to compensate for a carelessly expressed conceptual reality in the ST, thus contributing to coherence in the TT. It should be stressed that this is a case of ST defectiveness-induced TT explicitness, a task of technical translators who often have to make allowance for defective STs (Schmitt 1987b; Horn-Helf 1999) in their search for equivalence.

Due to the intersection of subject fields in scientific and technical discourse, variations in register requirements may become relevant and modify syntax. In the

corpus examined here, the register requirements of mathematical discourse determined the use of a 1:1-correspondence in the TT in some isolated cases to achieve equivalence, e.g.:

> The analysis was simplified by converting X and Y into one independent variable [...] which is Z ([...] *correlated* with Y) *divided* by X.

> Diese Analyse wurde durch Umrechnung von X und Y in eine unabhängige Variable [...] vereinfacht, bei der es sich um Z ([...] *korreliert* mit Y) *dividiert* durch X handelt.

The past participle is also the key to equivalence in 55% of the non-restrictive relatives, all of which may be considered appositions in brackets in the ST, e.g.:

> Molyvan-L (manufactured by X Co. and supplied by Y).
> Molyvan-L (von X Co. hergestellt und von Y geliefert).

However, the past participle, which was obviously used in these instances for the sake of brevity, cannot be considered a case of a strict 1:1-correspondence but rather part of a 'reduced' passive, because it underwent a shift in position in the TT sentence for grammatical-syntactic and register reasons. As for the remaining 45% of the non-restrictive relatives, premodification, 1:0-correspondence and prepositional word groups are the key to equivalence. However, the aspect of non-restrictiveness in reduced relatives and its potential equivalence-relevant consequences would have to be further investigated on the basis of a more comprehensive corpus. As regards the translation solutions for the non-restrictive reduced relatives in the TT, subordination was avoided in all cases.

It is interesting to note that of all translation solutions in the TT, subordination was avoided in 92% of the cases, which corroborates a tendency to achieve condensation of meaning and syntactic compression by the various linguistic means available in the TL, e.g., prenominal attributes, 1:0-correspondence and other, to achieve "equivalence in difference" (Jakobson [1959]1992) at overall textual level. Of course, this should not be taken to mean that the subordinated solutions (8%) cannot be considered equivalent. As was discussed above, excessive sentential complexity, which may be brought about, e.g., by the use of several past and present participles in one sentence in the ST, may necessitate a relative clause solution in the TL for both syntactic and semantic reasons. Overall, the German translation solutions are by no means more explicit than their English past participle counterpart.

3.2.1.1.1.1 The expanded postmodifying past participle as 'detached' reduced relative clause

The postmodifying past participle functioning as a 'detached' reduced relative clause accounts for 6% (5 occurrences) of all expanded past participles in this function. Unlike the present participle, which accounts for 18% in this function (see 3.3.1.1.1.1) and which involves both restrictive and non-restrictive instances in its respective category, the reduced relatives in this category are all restrictive.

The distribution of translation solutions for this sub-category is as follows:

i) Relative clause introduced by a relative pronoun

60%

Example:
A new approach to solids removal from residues *based on* emulsification of the residues in water showed promise although it was not successful in reducing the solids level in the pilot plant testing.

Ein neuer Ansatz für die Feststoffentfernung aus Rückständen, *der* auf der Emulgierung dieser Rückstände in Wasser *beruht*, war vielversprechend, obwohl der Feststoffgehalt in Pilotversuchen nicht erfolgreich reduziert werden konnte.

ii) Word group in prepositional function   40%

Example:
This report reviews the overall program of the Coprocessing consortium *related to* four major areas as shown in Fig. 1.

Im vorliegenden Bericht wird das Gesamtprogramm des Coprocessing-Konsortiums *in bezug auf* die vier in Bild 1 dargestellten Hauptarbeitsbereiche behandelt.

n.b.: Of all translation solutions 60% are accounted for by a relative/subordinate clause, whereas in 40% of all cases subordination was avoided.

As the results show, the figures shifted toward a relative clause solution in the TL. The relative clause solution in German contributes to clarity of expression in the TL - especially as regards complex ST sentences - by making the relationship between relative pronoun and antecedent noun of reference explicit, a relationship which in the ST sentence may occasionally be ambiguous owing to the detachment of the participle used in clause reduction. Again, this kind of explicitness, i.e., having recourse to a lexical item, e.g., a relative pronoun and ensuing subordination in the TL, is due to systemic or register constraints rather than an instance of "explicitation" as a 'translational universal' (Baker 1996; Laviosa 2002).

Prepositional word groups, too, are a common translation solution in this sub-category. The results for this sub-category correlate neatly with the results obtained for the appropriate present participle category (see 3.3.1.1.1.1), in that they suggest that detachment of a present and past participle used in relative clause reduction in the ST tends to favour an almost equal share of relative clauses, on the one hand, and prepositions or prepositional word groups, on the other, in the TT. In both cases, the subordinate translation solutions may have become operative for grammatical-syntactic, semantic and pragmatic reasons. However, since the detached past participle accounts for only 6% of all expanded past participles reducing a relative clause (so that it is less common than the present participle in the same function), the findings obtained would have to be underpinned by a more comprehensive corpus.

3.2.1.1.2   The unexpanded postmodifying past participle

While the expanded postmodifying past participle is considered to be a relative clause reduction, the unexpanded postmodifying past participle is verbal in nature (Weise 1980:84; Baakes 1994:80). However, from an equivalence point of view, this grammatical distinction is less relevant, because it may be argued that the unexpanded past participle, too, can be paraphrased by a relative clause, e.g., "the severe operating conditions selected" meaning "the severe operating conditions which are selected (here/in this investigation)". Still, to allow comparability with the present participle (see 3.3.1 ff.), which did not occur in the corpus in this form, and to take some account of the grammatical distinction, the unexpanded past participle construction will be considered separately. And although premodification as a participial adjective in the TL can be generally expected, the results will show that here again, terminological and other register considerations generate equivalence-relevant shifts in the TT.

The unexpanded postmodifying past participle accounts for 16% (16 occurrences) of all past participles used in relative clause reduction. The distribution of translation solutions for this sub-category is as follows:

i) Premodification   **63%**

Example:
However, even at the severe operating conditions *selected*, the measured coke yields were
[...]

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Jedoch lagen die ermittelten Koksausbeuten selbst bei den *ausgewählten* scharfen Betriebsbedingungen [...]

ii) Others **37%**

E.g., participle to noun class shifts, 1:0-correspondence and other, see example.

Example:
Drying methods *studied* were slurry drying, drying while being crushed in the pulverizer at X, vacuum drying [...]

Die folgenden Trocknungsverfahren *wurden untersucht*: Slurry-in-situ-Trocknung, Trocknung während der Zerkleinerung in der Mühle im [...] X, Vakuumtrocknung [...]

n.b.: Subordination was avoided in all translation solutions.

As the results show, premodification of the past participle as a participial adjective is the key to equivalence in most cases. Still, with its 37% the 'Others' category is quite substantial and the translation solutions chosen show how terminological considerations and further register aspects come into play and modify this structure. In the example shown, the past participle shifted to the finite passive verb and the adjective "folgende", which introduces/refers to the following listing of drying methods, was inserted for reasons of cohesion.

The most frequent translation options are class shifts (i.e., from participle to noun) owing to the requirement of high noun-based terminological specificity in the TL, which in the example below leads to a compound:

total distillables *produced* - destillierbare Gesamt*ausbeute*

Also 1:0-correspondence may be the key to equivalence, when aspects of coherence, e.g., redundancy, come into play and influence the translation solution in the TL, such as in:

The net effect is that X is more expensive than Y by Z per barrel of synthetic crude oil *produced*.
Insgesamt ist X um Z pro Barrel synthetischen Rohöls teurer als Y.

The fact that the above 'crude oil' is 'synthetic', which means 'synthetically produced', makes the past participle 'produced' redundant in the TT (actually, it is redundant in the ST as well).

The results for this category are very interesting in that they suggest that the translator's first choice, i.e., premodification for grammatical-syntactic reasons, may not always be the key to equivalence, and that translators should be aware, in

particular, of the aspect of high noun-based terminological specificity (3.1.2.2.2, 3.1.3) and other register aspects of cohesion and coherence in the TL in their search for equivalence in the case of the unexpanded past participle.

As expected, there is no subordination for grammatical-syntactic reasons so that "equivalence in difference" (Jakobson [1952]1992) can be considered achieved.

Although the three categories (3.2.1.1.1, 3.2.1.1.1.1 and 3.2.1.1.2) will be outlined in the summary of this section (3.2.4), an overview of the distribution of all translation solutions is given below for quick reference:

Table 5 Distribution of translation solutions for the expanded postmodifying past participle as reduced relative clause, the expanded postmodifying past participle as 'detached' reduced relative clause and the unexpanded postmodifying past participle (categories 3.2.1.1.1, 3.2.1.1.1.1 and 3.2.1.1.2)

Premodification	44%
1:0-correspondence	23%
Relative clause	8%
Prepositional word group	6%
Others	19%
subordination: 9% no subordination: 91%	

3.2.1.2 The past participle used in adverbial clause reduction

As mentioned earlier, the past participle used in adverbial clause reduction makes up 16% (26 occurrences) of all the past participles in clause reduction. Of this figure, 15% (4 occurrences) are accounted for by related adverbial clauses and 85% (22 occurrences) by "linking as-clauses" (Swales 1971:153) which have no subject of their own. These two categories will be dealt with in what follows:

3.2.1.2.1   The related past participle clause

Due to the very low frequency of the related past participle clause in the corpus (see above figures), only few signs of a trend can be established for this category. It is worth mentioning here that the implied subject of this participle clause is not identical with the subject of the main clause, but in all instances refers to other parts in complex sentences, such as the object/object complement of the main clause or

subordinate clause, or even to the subject complement of a preceding sentence, an aspect which is not covered by Baakes's (1994:86-88) categorization, but is particularly challenging for the translator, who may need to have recourse to specialized knowledge to get the reference right. In all instances, the related past participle clauses are clauses of contingency (Quirk et al. [13]1995:15.30) or time (Quirk et al. [13]1995:15.25), which are introduced by the conjunction *when* or *while*. *When* - in addition to *as* - is one of the most commonly used conjunctions in this context (Baakes 1994:87).

The distribution of translation solutions for this category is as follows:

i) Prepositional phrasing   75%

Example:
Fig. 15 shows the time on stream behaviour for the two feedstocks in terms of nitrogen conversion and product aromatics content *when processed* at 380°C, [...] with a commercial X catalyst [...]

In Bild 15 ist das Verweilzeitverhalten der beiden Einsatzmaterialien im Hinblick auf Stickstoffumsatz und Aromatengehalt im Produkt *bei einer Verarbeitung* bei 380 °C, [...] unter Einsatz eines handelsüblichen X-Katalysators [...] dargestellt.

ii) Others   25%

n.b.: Of all translation solutions 25% involve a subordinate clause, whereas in 75% of all cases subordination was avoided.

As the results show, prepositional phrasing is the key to equivalence in the category analyzed. The fact that subordination was avoided in 75% of all cases shows that 'equivalent' sentence-reducing linguistic means were employed in the TL to achieve equivalence at overall textual level by maintaining the implicitness of the relationship between the implied subject of the English adverbial clause and the antecedent to which it refers in the TT as well. In 25% of the translation solutions, this relationship is made somewhat more explicit by subordination and by insertion of the implied subject-related pronoun in the TT clause both on the grounds of the semantics of the underlying verb and for reasons of cohesion, e.g., to avoid excessive sentential complexity in the TT. Again, this is not an instance of an explicitational universal (Baker 1996), but a requisite register-induced shift to achieve "equivalence in difference" at both syntactic and overall textual levels.

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However, due to the very low frequency of the related past participle clause, the findings for this category would have to be corroborated on the basis of a more comprehensive corpus.

3.2.1.2.2 "Linking *as*-clauses" (Swales 1971:153)

Subjectless "linking *as*-clauses" are a common feature in scientific and technical discourse. This type of clause refers to the whole main clause and functions as a "thought-connective" (Swales 1971:153), since it is often employed with verbs "which allow it to be used as an ideal means of back and forward reference" (Baakes 1994:88). As Baakes rightly claims, the verbs involved are verbs of *"statement, description, judgement/opinion* and *perception"* (ibid.). The verbs encountered in this construction in the corpus are *show, illustrate, evidence* and *expect.* Apart from two instances, the clauses under analysis are reduced "linking *as*-clauses".[49] They may occur in initial, middle or final position in the sentence. Also included in this category is the unexpanded construction *"as+Ved"* (Weise 1980:86).[50] Although there is only one instance of this construction in the corpus, viz., "as expected",[51] this is repeated very frequently and thus creates an equivalence-relevant problem.

The distribution of translation solutions for this category is as follows:

i) Subjectless adverbial phrase introduced by *wie*   59%

Example:
As shown in Fig. 1, these reports cover four main areas: [...]

Wie Bild 1 zu entnehmen ist, werden in diesen Berichten im wesentlichen die folgenden vier Themenkreise behandelt: [...]

**ii) Adverbial clause introduced by *wie* plus insertion of
    neuter demonstrative pronoun *dies*   14%**

Example:
At WHSV = X, the bench-scale unit resulted in lower pitch conversions for all temperatures investigated *as expected* when comparing a CSTR with a tubular reactor.

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[49]   Example of reduced form: "As shown in Fig. [...]" Example of regular form: "As is shown in Fig. [...]"

[50]   According to Weise (1980:86), the construction *"as + Ved"* expresses a comparison, whereas *"as + Ving"* (not in the corpus) after verbs such as *consider, regard,* etc. serves to formulate a hypothesis.

[51]   In one instance "as expected" is part of a subordinate clause "which is as expected". Equivalence is achieved here with a simple adverb, viz., "erwartungsgemäß" for the entire subordinate clause.

Bei WHSV = X lieferte die Laboranlage geringere Pechumsätze bei allen untersuchten Temperaturen, *wie man dies* bei einem Vergleich zwischen einem kontinuierlichen Rührkesselreaktor und einem Rohrreaktor *erwarten kann*.

iii) Others   27%

Example:
As expected, the conventional X VGO performed best overall.
Erwartungsgemäß erbrachte das handelsübliche X-VGO insgesamt die besten Ergebnisse.

**n.b.: Of all translation solutions 14% involve a subordinate
clause, whereas in 86% of all cases subordination was avoided.**

As the results show, there is a clear trend towards a subjectless adverbial phrase in the TL in the search for equivalence. Although equivalence is achieved here by a structural near-1:1-correspondence, higher-ranking register aspects requiring a reduced "monotony of expression" (Reinhardt et al. [3]1992)[52] in the TT may also come into play. For example, the frequent and monotonous repetition of "As shown in Fig..." is compensated for by verbal synonyms in the TL, while maintaining the basic structure of the phrase, so that the following potential equivalents can be ascertained:[53]

as shown in Fig. x	wie in Bild x dargestellt
	wie Bild x zu entnehmen ist
	wie aus Bild x hervorgeht
	wie Bild x zeigt

In 14% of all translation solutions, the neuter demonstrative pronoun *dies* (occasionally with impersonal *man*) was inserted into a finite adverbial clause, which makes the reference to the rest of the sentence somewhat more explicit than the subjectless adverbial phrase.[54] Moreover, in the example under ii), the 'can aspect' implicit in the linking *as*-clause is made explicit for semantic reasons. This solution was also opted for in one instance in which two "linking *as*-clauses" were used in one ST sentence, so that the subordinate clause in German helps establish a particular

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[52]   What Reinhardt et al. ([3]1992) require as regards the excessive use of the passive, i.e., avoidance of monotony of expression, is certainly also true of other frequently repeated structures in German scientific and technical discourse: "Bei den vielseitigen Vorzügen des Passivs liegt es nahe, daß diese Fügungen in der Fachliteratur zu häufig gebraucht werden. Bei aller Angemessenheit der Form kann dadurch eine Monotonie des Ausdrucks entstehen, die auch bei fachlichen Darlegungen vermieden werden sollte." (op. cit.:134)

[53]   These findings correlate with those of the 'documentary subjects' in instances of 'secondary subjectification' (4.3.2.1).

[54]   German *dies* may refer to the whole sentence (Duden vol. 4, [5]1995:562), but see our discussion in Chapter 6.

register-induced syntactic structure involving a prenominal attribute (3.2.1.1.1). In some instances, this translation solution may also have been chosen to counteract tedious repetition of one and the same structure in German.

As this discussion shows, the slight increase in the degree of explicitness in the translation option of adverbial clause involving insertion of *dies* has become operative above all for register reasons.

As regards the 'Others' category, prepositional or adverbial translation solutions may become operative, above all on register grounds, i.e., to reduce monotonous repetition, but also to compensate for a rather careless style. For example, in one instance a "linking *as*-clause" was used rather carelessly, but from a semantic point of view unequivocally instead of a reduced relative clause, which led to a prenominal attribute (3.2.1.1.1) in the TT. In those cases in which a simple "*as+Ved*" construction occurs in the ST (here: "as expected"), equivalence can be achieved not only by what in German is called an incomplete subordinate clause (Duden vol. 9, [4]1997:821),[55] i.e., a simple adverbial phrase, e.g., "as expected" - "wie erwartet", but also by an adverb, e.g., "erwartungsgemäß". On the basis of the above results, the potential equivalents for "as expected", which occurs with a very high frequency in the corpus, are as follows:

as expected	wie erwartet (adverbial phrase)
	erwartungsgemäß (adverb)
	entgegen/gemäß den Erwartungen (prepositional phrasing)

as expected when comparing   wie man dies bei einem Vergleich...erwarten kann
                                                          (adverbial clause)
                            (see example under ii))
                            also possible: wie bei einem Vergleich...zu erwarten ist/war
                                                          (infinitive)

The investigation of this category shows how register requirements, i.e., reduced "monotony of expression" (Reinhardt et al. [3]1992), may come into play and modify not only the grammatical-syntactic level, e.g., shift from incomplete adverbial construction "*as+Ved*" to adverb "erwartungsgemäß" in the TT, but also the lexical-semantic level, e.g., use of verbal synonyms for *show*, in order to achieve overall textual equivalence. The fact that subordination was avoided in 86% of all cases shows that 'equivalent' sentence-reducing linguistic means were employed in the TL

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[55]   "Unvollständige Nebensätze, die mit *wie* eingeleitet werden, sind häufig formelhaft geworden und wirken wie eine einfache Umstandsangabe." (Duden vol. 9, [4]1997:821)

to achieve equivalence. The adverbial clause solution (14%) is due above all to register considerations.

3.2.1.3 Prepositional past participles and/or sentential past participles

The above category accounts for 23% (39 occurrences) of all past participles involved in clause reduction. The past participles in question which are listed in the following in their order of frequency of occurrence are: *based on* (44%) (17 occurrences), *compared with* (38%) (15 occurrences), *followed by* (13%) (5 occurrences) and others (5%) (2 occurrences). The excessive use of these past participles, most of which are in prepositional function, point to a repetitive, highly condensed, and occasionally somewhat careless style which may have to be compensated for by the translator in the search for equivalence. The translation solutions for the above past participles are discussed and presented in the following:

3.2.1.3.1   *Based on* as a prepositional and/or sentential past participle

This accounts for 44% (17 occurrences) of all participles in this category. In 65% (11 occurrences) of all cases, *based on* is used at the beginning of the sentence and in 35% (6 occurrences) it is used in middle position, i.e., it introduces a clause in final position. Its function oscillates between preposition and a kind of sentential past participle,[56] with one or the other function requiring special consideration in translation depending on the sentential co-text. When used at the beginning of the sentence, e.g., "based on x", it can be paraphrased by "when x is taken as a basis/when we take x as a basis" and is commonly treated as a preposition both in the ST and the TT. When used in middle position, it can be paraphrased by "this being based on", an aspect which may have to be made explicit in the TL, above all in cases of high sentential complexity, and which is reflected in the translation solutions given below.

The distribution of translation solutions is as follows:

i) Prepositions or word groups in prepositional function (see f.n. 45) 70%

Example:
Based on these results, there does not seem to be any need for concern about [...]

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[56] According to Baakes (1994:63), the (reduced) sentential relative clause "refers back to the predicate or predication of a clause or to a whole clause or sentence [...]". This is normally an -*ing* clause (3.3.1.2), but as this research shows, the past participle, too, may assume such a function.

Anhand dieser Ergebnisse braucht man sich [...] über [...] keine Gedanken zu machen.

ii) Subordinate clause introduced by pronominal adverb *wobei*   12%

Example:
As part of the initial baseline operation of the PDU with the X-Y combination, the effects of low [...] versus high [...] feed coal concentrations were reported *based on* equivalent pitch conversion levels for both cases.

Im Rahmen der Inbetriebnahmephase der PDU unter Verwendung der Kombination X-Y wurden die Auswirkungen der geringen [...] gegenüber der hohen [...] Kohle-konzentration im Einsatzmaterial ermittelt, *wobei* äquivalente Pechumsätze für beide Fälle *zugrunde gelegt wurden*.

iii) Others   18%

Example:
However, *based on* preliminary work done at X University for Y, about x% removal of solids should be possible.

Allerdings *geht aus* Voruntersuchungen der X University im Auftrag von Y *hervor*, daß eine Feststoffentfernung von x % möglich sein müßte.

As the results show, there is a very clear trend towards a prepositional solution in the TL. However, repetition is avoided in the TT for register reasons by using synonyms or near-synonyms. These are chosen by taking due account of the semantics of the sentential co-text, as is reflected in the listing of potential equivalents below.

It is interesting to note that subordination with the pronominal adverb *wobei* (Duden vol. 4, [5]1995:626 ff.) was used in several ST instances (12%) which are all characterized by a high informational density reflected in sentential complexity and in which "based on" introduces a clause in final position in the ST sentence. Like the English "based on" in the example under ii), *wobei* refers to the content of the main clause (Duden vol. 9, [4]1997:825) and, by making this relationship explicit, helps avoid excessive sentential complexity in the TT, an aspect which is required for register reasons. In all translation solutions with *wobei*, there is a requisite grammatical shift of the English past participle to a finite verb. The translation solutions here reflect more explicitly the sentential character of the participle, i.e., its reference to the main clause which is made somewhat more explicit in the translation by introducing *wobei*. It should, however be stressed that content-wise "wobei...zugrunde gelegt wurde" is no more explicit than "based on".

In the example under 'Others' the past participle is shifted to a finite verb above all for semantic reasons. On the basis of all translation solutions the following potential equivalents can be ascertained in their order of frequency of occurrence:

based on (at the beginning of the sentence):

preposition	anhand	(in particular in concatenation with *data* and/or *results*, e.g., "Based on this data/these results"
prepositional word group		bei/unter Zugrundelegung auf der Grundlage unter Berücksichtigung
present participle in prepositional function		basierend auf

finite verb

based on (introducing a clause in final sentential position)

subordination with *wobei* plus finite verb
preposition or word group in prepositional function
present participle in prepositional function *basierend auf*
explanatory expression, viz., *und zwar*[57] plus prepositional word group.

3.2.1.3.2   *Compared with* as a prepositional past participle

This accounts for 38% (15 occurrences) of all participles in this category. The excessive use of this prepositional past participle again suggests a somewhat monotonous and repetitive style which may have to be compensated for in translation to achieve overall textual equivalence. Although it may rightly be assumed that equivalence can straightforwardly be achieved by deploying a prepositional word group in German, e.g., *im Vergleich zu*, the semantics of the sentential co-text in the ST as well as TL register requirements give rise to different translation solutions with the following distribution:

i) Word group in prepositional function   47%
        (*im Vergleich zu*)
Example:
However, the X economic analysis indicated that such a Y process would be uneconomical *compared with* a Z process [...]

Der Wirtschaftlichkeitsanalyse von X zufolge ist jedoch ein derartiges Y-Verfahren *im Vergleich zu* einem Z-Verfahren [...] unwirtschaftlich.

ii) Comparative particle *als*   47%

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[57]   "In der Verbindung *und zwar* wirkt *zwar* erläuternd und steht ohne korrespondierendes Glied: [...]" (Duden vol. 9, [4]1997:853)

Example:
The LGO and heavier fractions from coprocessing are less stable *compared with* similar hydrocracking fractions.

Leichtgasöl-Fraktionen und schwerere Fraktionen aus dem Coprocessing weisen eine geringere Stabilität auf *als* die entsprechenden Fraktionen aus dem Hydrokracken.

iii) Others   6%

Example:
While the [...] blend is slightly inferior in overall performance *compared with* the hydrotreated coprocessing VGO, it is almost equivalent to [...]

Zwar *liegen* die Gesamtergebnisse dieses Gemischs geringfügig *unter* denen des durch Hydrotreating behandelten Coprocessing-VGOs, aber sie entsprechen fast [...]

As the results show, equivalence is achieved by an equal distribution of prepositional word group *im Vergleich zu* and comparative particle *als*. The latter was opted for in all cases in which the main verb in the sentence is *be* followed by a comparative (see example under ii)). This shows how the semantics of the sentential co-text comes into play and influences the selection of a potential equivalent in the TL. Moreover, the change between preposition and comparative particle also helps fulfil the register requirements of the TL, since this change counteracts monotony of expression in the TT on an overall textual basis. Both semantic and register aspects have also come to bear in the example under 'Others', in which equivalence is achieved by a 1:0-correspondence for *compared with*, with the comparison being expressed in German by the finite verb plus respective preposition, i.e., *liegen unter*.

3.2.1.3.3   *Followed by* as a sentential past participle

This accounts for 13% (5 occurrences) in the category under investigation. Since this past participle occurs with a low frequency, only slight signs of trends can be ascertained and will be discussed in the following. It usually expresses succession and refers back to something that was said before in the sentence. It can be paraphrased by "this being followed by". In the case of a listing of successive events, equivalence may be achieved by a 1:1-correspondence in German, a translation solution which accounts for 40%, e.g.:

[...], the best coke suppression was obtained for Fe (X ppm) loaded on coal agglomerates *followed* closely *by* Mo (X ppm) [...]

[...] wurde die stärkste Minimierung der Koksbildung mit Fe (X ppm) auf Kohleagglomeraten erzielt, dicht *gefolgt von* Mo (Y ppm) [...]

However, depending on the semantics of the sentential co-text, domain knowledge may come into play and modify syntax, as in the following example:

> Two-stage process studies were undertaken to evaluate the combination of a X type tubular reactor for the first stage *followed by* a Y type [...] reactor using a [...]

> Die Untersuchungen zum zweistufigen Verfahren wurden durchgeführt, um die Kombination aus einem X-Rohrreaktor für die erste Stufe *und einem nachgeschalteten* [...] Reaktor von Y unter Einsatz eines [...] zu bewerten.

In the above example, the requirements of a higher degree of phraseological-terminological specificity in the TL which is informed by knowledge of domain have come into play and modified syntax in the search for equivalence in another 40% of the translation solutions. The remaining 20% of translation solutions are accounted for by prepositions plus adjectives to achieve equivalence.

As regards the remaining 5% (2 occurrences) in 3.2.1.3, equivalence in the case of an apposition, for example, was achieved by inserting the relational relative pronoun *was*[58] and by transposing the past participle into a finite passive verb, e.g., "(discussed later)" - "(was später erörtert wird)" or by splitting a very complex sentence into two and starting the new sentence with the pronominal adverb *dabei* (Duden vol. 4, [5]1995:626 ff.) plus transposition of the past participle into a finite verb.

It is worth mentioning that of all the translation solutions for all the past participles in category 3.2.1.3, subordination was avoided in 95% of all cases. As regards the remaining 5%, subordination has become necessary above all for register reasons to avoid excessive sentential complexity in the TT. This result shows that 'equivalent' sentence-reducing linguistic means have been employed in the TT to achieve overall textual equivalence. On an overall textual basis it should also be noted that the repetitive and highly condensed style reflected in the use of the past participles investigated, was compensated for in translation in the search for equivalence. This avoidance of repetition and the improvement of a somewhat

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[58]   The relative pronoun *was* refers to the content of the main clause. (Duden vol. 9, [4]1997:619)

carelessly repetitive style is by no means an instance of "normalization" (Laviosa 2002:54), but fulfils the TL register requiring a reduction of monotonous expression in the TT. Improving on a tedious style may become necessary in scientific and technical translation which, as Schröter (³1990:9) points out, is "highly target language oriented" (my translation), so that it has to be carried out in compliance with the "usage norms" ("Gebrauchsnormen") (Wilss 1977:209, 1982:169) as reflected in its register.

3.2.4 Summary of this section

The results for the individual categories investigated in this section are summarized below:

Table 6   Distribution of translation solutions for the expanded postmodifying past participle as reduced relative clause (category 3.2.1.1.1)

Trend towards lengthy premodification/prenominal attribute (44%), followed by a 1:0-correspondence (29%), relative clause (6%), prepositional word group (5%) and Others (16%).[59] subordination: 8%, no subordination: 92%

As the results show, there is a trend towards lengthy premodification in the search for equivalence in the TL. Lengthy premodification (prenominal attributes) or "anteponierte Attributkette" (Kretzenbacher 1991:129) is a frequent feature characteristic of German scientific and technical syntax. However, depending on the semantics of the underlying verb, the past participle may assume a more structural binding function which can lead to a 1:0-correspondence in the TT. The relative clause solution may also be a potential equivalent for syntactic, semantic and, above all, for register reasons to avoid excessive sentential complexity in the TT.

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[59]   The occurrence of several different translation options which may be considered potential equivalents under certain circumstances correlates with findings from contrastive special languages research (Göpferich 1995a) where it has been shown that the 'adnominal participle construction' is more frequent in English scientific and technical discourse than the 'prenominal attribute' in the respective German discourse type, because the 'adnominal participle construction' is considered a 'progressive' construction and the 'prenominal attribute' a 'regressive' construction (the terms go back to Bally (1950) quoted in Göpferich 1995a:427). Since the latter is said to put more strain on the receptive capacity of the reader, its frequency must be lower than that of the less strenuous 'adnominal participle construction' (Göpferich 1995a:427). However, since there is no translational link between the texts investigated in contrastive special languages research, this type of research does not take account of other potentially equivalent translation solutions and the circumstances in which they may be chosen.

The result for the 'Others' category (16%) illustrates how further terminological and register aspects come into play and modify syntax.

It is interesting to note that in 92% of all translation solutions subordination was avoided, which can be viewed as a clear trend towards using 'equivalent' sentence-reducing devices in the TL - where this is feasible for pragmatic considerations - to achieve overall textual equivalence.

When this category is compared with the appropriate category for the present participle, it can be noted that subordination in the TL is avoided in the case of the past participle to a higher degree than in the case of the present participle.

For sub-category 3.2.1.1.1.1, i.e., 'detached' reduced relative clause, the figures shifted in favour of a relative clause solution in the TT (60%) which correlates nicely with the results for the 'detached' present participle in this function (3.3.1.1.1.1). However, due to the very low frequency of the two features in question, the respective results would have to be corroborated on the basis of a more comprehensive corpus. Subordination was avoided in 40% of all translation solutions.

Table 7   Distribution of translation solutions for the unexpanded postmodifying past participle (category 3.2.1.1.2)

Trend towards premodification (63%), Others (37%), e.g., participle to noun class shifts, 1:0-correspondence and other. no subordination

As the results show, premodification of the past participle as a participial adjective is the key to equivalence in most cases. Still, the 37% for the 'Others' category is quite substantial, and the translation solutions chosen show how terminological considerations, i.e., a higher noun-based terminological specificity in the TL leading to participle to noun class shifts, and further register aspects come into play and modify the unexpanded past participle in translation.

It should be noted that the expanded postmodifying past and present participle in 'adnominal relative clause' function is also a typical feature in the Romance languages, so that it may be assumed that, for translations from these

languages into German and vice versa, similar conclusions can be drawn.[60] It may also be assumed that adjectives used in similar function will give rise to similar translation solutions, e.g., "heavy metals *present* in the feed" - "*im Einsatzmaterial enthaltene* Schwermetalle" (premodification) or "Schwermetalle *im* Einsatzmaterial" (1:0-correspondence).

It should also be stressed that for the purposes of translation didactics, the relative clause solution may be considered a first step to be taken by trainee translators and translation novices alike in the case of the past and the present participle used as adnominal relative clause in their progressive approximation to equivalence in "multiple-stage translation"[61] (Wilss 1977:268), i.e., proceeding from grammatical correctness to equivalence at the syntactic level.

Table 8   Distribution of translation solutions for the related past participle (category 3.2.1.2.1)

Trend towards prepositional phrasing (75%), Others (25%). subordination 25%, no subordination: 75%

There is a clear trend towards a prepositional phrasing in the TL in the search for equivalence. However, due to the very low frequency of this feature in the present text, the results would have to be corroborated on the basis of a more comprehensive corpus.

Table 9   Distribution of translation solutions for "linking *as*-clauses" (Swales 1971:153) (category 3.2.1.2.2)

Trend towards a subjectless adverbial phrase introduced by *wie* (59%), Adverbial clause introduced by *wie* plus insertion of the neuter demonstrative pronoun *dies* (14%) and Others (27%).
full subordinate clause 14%, no subordination: 86%

Although there is an obvious trend towards structural near-1:1-correspondence in translation, the TT structure is subject to further register

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[60]   Of course, this assumption would have to be verified on the basis of a suitable corpus.

[61]   The term goes back to Voegelin (1954) who used it in a linguistic context. The term was then taken up by Wilss (1977) in a translation context and is similarly used here to refer to different stages in solving transfer problems in the translation process that translators go through on their way to equivalence.

considerations in the TL, above all the requirement of a reduction of "monotony of expression" (Reinhardt et al. [3]1992).

Table 10 Distribution of translation solutions for *based on* as a prepositional and/or sentential past participle (category 3.2.1.3.1)

Trend towards prepositions or prepositional word groups (70%), Subordinate clause introduced by pronominal adverb *wobei* (12%), Others (18%).

Despite the definite preference for a prepositional solution in the TT, it is important to note that the necessity to comply with a higher versatility of expression in the TL involves the use of synonyms or near-synonyms - with due account being taken of the semantic co-text - to achieve equivalence in the TL on an overall textual basis.

Table 11 Distribution of translation solutions for *compared with* as a prepositional past participle (category 3.2.1.3.2)

Trend towards a word group in prepositional function *im Vergleich zu* (47%) and comparative particle *als* (47%), Others (6%).

As the results show, equivalence is achieved by an equal distribution of the prepositional word group *im Vergleich zu* and the comparative particle *als*. The latter was opted for in all cases in which the main verb in the sentence is *be* followed by a comparative. This shows how the semantics of the sentential co-text of the ST comes into play and influences the selection of a potential equivalent in the TL. Again inappropriate repetition of the feature under investigation was avoided in the TT for register reasons.

As regards the two above categories, it is interesting to note that translators of technical discourse improve on a repetitive and occasionally somewhat careless style in their search for overall textual equivalence to comply with the register requirements of the specific TL type of discourse. As discussed in the various sections, this should not be considered an instance of translator-induced "normalization" (Laviosa 2002:54), and is strictly due to TL register constraints.

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Table 12   Distribution of translation solutions for *followed by* as a sentential past participle (category 3.2.1.3.3)

The following signs of a trend can be established: 1:1-correspondence in case of a listing of successive events (40%), domain knowledge-induced solutions (40%) and Others (20%).

The results for all categories investigated here show a clear trend towards employing 'equivalent' sentence-reducing devices in the TL for the ST features analyzed. The translation solutions for all past participles yield subordination in only 9% of the cases, whereas in 91% subordination was avoided. The most common solutions involve lengthy premodification/prenominal attributes or 1:0-correspondences in the case of the expanded postmodifying past participle, premodification in the case of the unexpanded past participle, prepositional phrasing and subjectless adverbial phrases in the case the related past participle and 'linking *as*-clauses', respectively, and prepositions or word groups in prepositional function, comparative particle *als* and others in the case of prepositional and sentential past participles. They and most of the other translation solutions contribute to syntactic compression and condensation of meaning in the TT, e.g., participle to noun shifts contributing to the higher noun-based terminological specificity of the TL.

Of course, the potential equivalents involving subordination may become operative for grammatical-syntactic, semantic and pragmatic reasons, i.e., above all on register grounds. The investigation has also shown how translators improve on a repetitive style induced by a certain degree of carelessness on the part of the author, as reflected by the features in categories 3.2.1.3.1 and 3.2.1.3.2.

Viewed as a whole, all the above translation solutions may be considered to contribute to "equivalence in difference" (Jakobson [1959]1992) at overall textual level. This investigation has also demonstrated how semantic and pragmatic aspects, such as register considerations, but also domain knowledge-induced considerations, may come into play and modify the syntactic level to achieve overall textual equivalence.

3.3 English -*ing* form constructions and their German potential equivalents

The -*ing* form is the most flexible and versatile and, hence, the most common non-finite verb form in scientific and technical discourse, accounting for 48% (379 occurrences) of all non-finite verb forms in the corpus. Its high versatility can be attributed to its twofold grammatical nature, i.e., it may occur as a present participle, which can be described as an adjectival verb form, or as a gerund, which can be described as a nominal or nominalized -*ing* form (cf. also Weise 1980:86).[62]

Although it would go beyond the scope of this thesis to enter into an in-depth discussion of the highly controversial and much debated issue of the abandoning of the traditional distinction between 'gerund' and 'present participle',[63] it should be said that the basic decision to maintain this distinction in the present work was guided by the fact that - as Weise (1980:86) rightly claims - there are differences in the syntactic use of the two forms, i.e., the gerund can fill syntactic positions which the participle cannot take up, e.g., only the gerund can be used as subject or as a supplement to an adjective. The instances encountered in the corpus illustrate the structural and functional differences in the use of the two forms. Therefore - and despite certain structural and functional overlaps which may arise - a sensible equivalence-relevant categorization of -*ing* forms should take account of such differences, since this will help facilitate not only the replication of results, but also their use in translation practice and teaching.

The categorization and description of the -*ing* forms found in the corpus, some of which are investigated here, is based on the following counting mode: All -*ing* forms contained in the corpus were counted. Of these, 73% are gerunds (including verbal nouns, see f.n. 62), 22% present participles and 5% Others. The following terminological/syntactic uses of the gerund in descending order of frequency were encountered in the corpus: gerund as terminological unit (as individual term or as constituent part of compounds, see Chapter 5), gerund after preposition, i.e., used as adverbial phrase, gerund as subject, as part of a nominal

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[62] Within the scope of this investigation, no distinction is made between a gerund and a verbal noun (*Verbalsubstantiv*). Although Weise (1980:86) distinguishes between the two, Gerbert (1970:71 ff.) in the same context concludes that, from a synchronic and diachronic point of view, a clear-cut distinction between the two no longer seems possible.

[63] For an interesting discussion of the various approaches to this issue, see Baakes (1994:9-13) who argues in favour of a distinction. Cf. also the relevant section in Quirk et al. ([13]1995:17.54).

group (e.g., *methods of drying*), as prepositional object (e.g., *The programme focussed on gaining*), as direct object (e.g., *x has the potential to allow processing*), and as supplement to an adjective (e.g., *x was unsuccessful in reducing y*) (see f.n. 77 for precentages).

It is important to note that the gerund as a terminological unit accounts for 79% of all gerunds and for 57% of all the *-ing* forms counted. These figures underpin Gerbert's (1970:70) statement that the nominal *-ing* form accounts for the lion's share of the non-finite verb forms in technical English and that the *-ing* suffix is an important component of terminological systematics. The different structures of the gerund in terminological compounding, i.e., two-element compounds, such as, V_{ing}+noun, e.g., *coking propensity*, or noun+V_{ing}, e.g., *vacuum drying*, will be investigated in 5.2.1.3, 5.2.1.6, 5.2.2.3.

The present participles encountered in the corpus are used as sentence reducing devices (22%) and have the following syntactic functions: reduction of relative clauses (including sentential relative clauses) and reduction of adverbial clauses (unrelated, related,[64] and absolute clauses).[65]

The 'Others' category (5%) includes present participles functioning as prepositions, e.g., *concerning, regarding* and *during*, as unspecific adjectives (e.g., *interesting*) and some *-ing* forms which are used somewhat vaguely instead of nominal phrasing for brevity's sake, e.g., *using* instead of *the use of.*

For statistical reasons based on the frequency of occurrence in the corpus and for reasons of equivalence, the focus is on the investigation of the present participle

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[64]   Under 'related' present particples we also subsume paratactically used present participles whose implied subject is identical with that of the paratactically connected clause. Their very low frequency did not justify the establishment of a separate category. As has been discussed in the previous section, the implied subject of the 'related' past participle clause may have different antecedents (see 3.2.1.2.1).

[65]   The categories 'related' ("the implied subject is identical with that of the main clause"), 'unrelated' ("the participle has neither its own subject nor does it provide a link with that of the main clause") and 'absolute' clause ("the participle has its own overt subject that is different from that of the main clause") are taken from Baakes (1994:64 ff.), but - as has been shown in the investigation of the past participles (3.2.1 ff.) - may have to be modified to take account of the factual reality of the ST. It should be noted that terminology is by no means uniform in this context, e.g., what Baakes (1994:70 ff.) calls an "absolute present participle clause", Weise (1980:86) calls an 'unrelated clause' and Sager et al. (1980:218) "detached non-finite clauses", whereas Gerbert uses 'absolute' and 'unrelated' clauses synonymously (1970:79).

(3.3.1) as a sentence reducing syntactic feature. However, for the same reasons one gerundial category (3.3.2.), i.e., gerunds used as adverbial phrases, will be examined.

The following sections discuss the categorization, description and investigation of equivalence-relevant -*ing* forms.

3.3.1 The present participle used in clause reduction and its German potential equivalents

Like the past participle (3.2.1 ff.), the present participle is widely used in clause reduction in scientific and technical discourse (Gerbert 1970:76-81; Huddleston 1971:249 ff.; Sager et al. 1980:215-218; Weise 1980:84-86; Baakes 1994:61-76), because it contributes to conciseness of expression and syntactic compression. It accounts for 22% (86 occurrences) of all -*ing* forms counted (as against 33% for the past participle in the same function, see 3.2.1). Of all present participles counted in the corpus, 40% (34 occurrences) reduce relative clauses, 14% (12 occurrences) sentential relative clauses and 46% (40 occurrences) adverbial clauses. Of the latter the unrelated present participle clauses account for 40% (34 occurrences) and the remaining 6% (6 occurrences) include, for example, reduced absolute and related present participle clauses.

3.3.1.1 The postmodifying present participle as reduced relative clause

Like the postmodifying past participle (3.2.1.1), the postmodifying present participle may appear at the head of a reduced relative clause. Unlike the past participle, which reduces a passive relative clause, the present participle reduces an active clause, an aspect which, in tandem with the semantics of the underlying verb, may influence translation procedures in the search for equivalence - as the results of the investigation will show. As mentioned earlier, the present participle reducing a relative clause accounts for 40% (34 occurrences) of all present participles counted. In this category, 85% (29 occurrences) reduce restrictive and 15% (5 occurrences) non-restrictive relative clauses. The fact that the present participle in this function - like the past participle (3.2.1.1.1.1) - does not always follow directly the antecedent noun to which it refers, but can be 'detached' from it, gave rise to a sub-category called the 'detached relative clause'. Whereas adnominal relative clauses account for

33% (28 occurrences) (3.3.1.1.1), the 'detached' relative clauses account for 7% (6 occurrences) (3.3.1.1.1.1). The findings for these two categories are presented and discussed below.

3.3.1.1.1 The expanded postmodifying present participle as reduced relative clause

This accounts for 33% (28 occurrences) of all present participles counted (as against 51% for the past participle in the same function, 3.2.1.1.1). Of these, 93% (26 occurrences) reduce restrictive and 7% (2 occurrences) non-restrictive relative clauses. The distribution of translation solutions for this category is as follows:

i) Preposition* (prepositional attribute)   **50%**
(*one instance was a word group in prepositional function)[66]

Example:
The X unit is suited to first-stage operation due to the disposable additive which avoids problems with normal heterogeneous catalysts that tend to deactivate rapidly when exposed to feeds *containing high solid and heavy metal contents* like in coprocessing.

Die X-Anlage ist für einen einstufigen Betrieb geeignet, da mit dem Einwegadditiv Probleme mit herkömmlichen Kontaktkatalysatoren verhindert werden können. Derartige Katalysatoren neigen zu einer raschen Desaktivierung, wenn sie Einsatzmaterialien *mit hohen Feststoff- und Schwermetallanteilen*, wie beim Coprocessing, ausgesetzt sind.

ii) Relative clause introduced by a relative pronoun[67]   **25%**
(der, die, das)

Example:
Table 1 summarizes the operating conditions *resulting in the highest pitch and coal conversions.*

In Tabelle 1 sind die Betriebsbedingungen, *die zu den höchsten Pech- und Kohleumsätzen führen*, zusammenfassend dargestellt.

iii) Others   **25%**

Example:
Similar to centrifugation, a commercial plant *processing X million t/a of feed slurry* [...] would require about 20 large filters which [...]

Ähnlich wie bei der Zentrifugierung wären für eine großtechnische Anlage *mit einem Durchsatz von X Mio. t/a Einsatzslurry* [...] etwa 20 Großfilter erforderlich, wodurch [...]

n.b.: Of all translation solutions only 29% involve a relative/subordinate clause, whereas in 71% of all cases subordination was avoided.

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[66] See f.n. 45.

[67] According to Duden vol. 4 (^{5}1995:1279), relative pronouns include "*der, die, das; welcher, welche, welches; wer, was.*"

As the results show, the use of prepositions is the most common translation solution used in the search for equivalence to accommodate the feature under investigation. Prepositional constructions (*Präpositionalgefüge*) are a very frequent feature in German technical discourse, because they can denote various different circumstances in a concise and distinct way (Fluck [2]1997:109 ff.). As prepositional attributes (*Präpositionalattribute*),[68] they can be used instead of relative clauses in German.

Certainly, this result is also a function of the semantics of the underlying English verbs (both dynamic and stative verbs, see Quirk et al. [13]1995:4.28) within their specific sentential co-texts. The present participles *containing*, *using*, *resulting in*, and *employing* - listed here in their order of frequency of occurrence - were translated with the German preposition *mit*,[69] and the present participle *allowing* with the preposition *für*.

It is also interesting to note that the relative clause solution is used more frequently than the results show for the postmodifying past participle (3.2.1.1.1). One reason for this may be the aspect of 'secondary subjectification' (4.3), which may occur with 'subject+active transitive verb structures' in their reduced form as well, i.e., in present participle constructions, e.g.:

> [...] two-stage studies *linking* a[n] X reactor with an ebullated bed unit.
> [...] Studien zum zweistufigen Verfahren [...], *bei denen* ein X-Reaktor mit nachgeschaltetem Wirbelbettreaktor *eingesetzt wurde*.

In the above example, a lengthy premodification in the TL would not have been possible for grammatical-syntactic reasons. In fact, the complexity of the English reduced active relative clause itself and its embedding in a likewise complex main clause along with the semantics of the underlying verb (plus the aspect of 'secondary subjectification', 4.3) and the sentential co-text may be the main reasons for the relative clause solution in the cases investigated.

Of all the relative clause solutions in the TL examined in the category under investigation, lengthy premodification would have been syntactically possible only in

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[68] For a definition of *Präpositionalattribut* and *Präpositionalgefüge* see Duden vol. 9 ([4]1997:593).

[69] There was one instance in which a word group in prepositional function, viz., *unter Einsatz von*, was used.

a limited number of cases, such as in the relative clause example under ii), but was obviously avoided for register reasons to prevent excessive sentential complexity in the TL (see f.n. 48).

As far as the 'Others' category is concerned, most of the translation solutions reveal the influence of higher-ranking register and terminological considerations, such as the requirement of high noun-based terminological specificity in the TL, as in the example quoted under iii) 'Others', or as in the following example:

material *boiling* below 300°C   Material *mit einem Siedepunkt* unter 300°C

In this context, the verb *contain* is noteworthy, because it is often put into terminological use in English to link very long multiple compound nouns, with equivalence being achieved in German either by a relative clause with the verb *enthalten* or by a preposition (*mit*). However, it can also lead to a quite different solution pointing to the influence of further terminological and register aspects in the TL, such as a premodified attribute (adjective), e.g.:

molecules containing nitrogen   stickstoffhaltige Moleküle

The 'Others' category also contains a few instances of the present participle *including* which generally belongs to the "explicit indicators of apposition" (Quirk et al. [13]1995:17.73), and which are the only non-restrictive non-finite relative clauses[70] in the category analyzed (they account for 7% of all the relative clauses in this category), e.g.:

X was shown to have some advantages *including* the ability to scavenge heavy metals present in the feed.

X hatte einige Vorteile, *wie z. B.* einen Fängereffekt für im Einsatzmaterial vorliegende Schwermetalle.

Equivalence is achieved by *wie* or *wie z. B.* introducing an explanatory apposition in German and shows how register aspects come into play and modify syntax.

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[70]   "[...], postmodifying -*ed* and -*ing* participle clauses are both usually restrictive (but *cf* 17.34 *f*)." (Quirk et al. [13]1995:17.29)
        For a discussion of restrictive/non-restrictive non-finite relatives in scientific and technical discourse see Huddleston (1971:249-255).

It is interesting to note that of all translation solutions in the TL, subordination was avoided in 71% of all cases, which underpins a tendency to achieve condensation of meaning and syntactic compression by the various linguistic means available in the TL, e.g., prepositional solutions, to achieve "equivalence in difference" (Jakobson [1959]1992) at overall textual level. Of course, this should not be taken to mean that the subordinated solutions (29%) cannot be considered equivalent. As was discussed above, further semantic and pragmatic aspects, above all register aspects, may come to bear and modify syntax in the search for overall textual equivalence. Again, it should be pointed out that some present participles in this category have been shifted to prepositions plus nouns, i.e., terms, due to the high noun-based terminological specificity of the TL, see example under iii) 'Others'.

3.3.1.1.1.1 The expanded postmodifying present participle as 'detached' reduced relative clause

This accounts for 18% (6 occurrences) of the present participles reducing a relative clause (cf. 6% for the past participle in this function, 3.2.1.1.1.1). Unlike the corresponding past participle category, which contains only restrictive relatives, the present participle category contains 50% (3 occurrences) restrictive and 50% (3 occurrences) non-restrictive relatives. The distribution of translation solutions for this sub-category is as follows:

i) **Relative clause introduced by a relative pronoun or pronominal adverb**[71]   **50%**

Example:
Twenty seven projects were selected by the Management Committee *covering* four major areas of investigation: [...]

Das Management Committee [...] wählte 27 Projekte aus, *die* sich schwerpunktmäßig auf die folgenden vier Arbeitsbereiche *bezogen*: [...]

ii) **Preposition or word group in prepositional function**[72]   **33%**

Example:
The objectives and major accomplishments of each project are highlighted *including* the impact on processing economics when possible.

[...],wobei die Zielsetzungen und die wesentlichen Ergebnisse jedes Projekts ggf. *unter Einbeziehung* entsprechender verfahrensbezogener Wirtschaftlichkeitsbetrachtungen im

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[71]   In one instance the pronominal adverb *wobei* was used.
[72]   See f.n. 45.

Vordergrund stehen.

iii) Others   17%

The figures tend to favour a relative clause solution in the TL. In the example shown, more than one shift is required to achieve equivalence. The English passive voice is rendered with an active voice in the TL in order to avoid a detachment of the relative clause in German, and the English present participle is modulated in translation, this being an instance of 'secondary subjectification' (*projects...covering*) (4.3). The relative clause solution in German in tandem with other translational shifts contributes to clarity of expression in the TL by making the relationship between relative pronoun and antecedent noun of reference explicit, a relationship which in the ST may occasionally be ambiguous owing to the detachment of the present and/or past participles used to reduce relative clauses.

In this category, too, preposition and prepositional word groups are a common translation solution (33%). It is interesting to note that all instances which gave rise to this translation solution are non-restrictive relatives and again that the present participle *including* is among those instances. Depending on the sentential co-text, it is translated with *unter Einbeziehung von*, which is a word group in prepositional function, so that an entry for *including* in a translation-geared dictionary should contain the potential equivalents: *wie, wie z. B.* (in case of an appositive exemplification) and *unter Einbeziehung von*.

As to the 'Others' category, higher-ranking aspects of semantics and cohesion and coherence come into play and modify syntax.

It is worth noting that half of all 'detached' present participles reduce non-restrictive relatives, as against only 7% in category 3.3.1.1.1. However, since the 'detached' present participle only accounts for 18% of all present participles reducing a relative clause, the results obtained for this category would have to be underpinned by a more comprehensive corpus. This is also true of restrictiveness/non-restrictiveness of relatives and its potential equivalence-relevant consequences. However, the results correlate with those for the respective past participle category (3.2.1.1.1.1).

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An overview of the distribution of all translation solutions for categories 3.3.1.1.1 and 3.3.1.1.1.1 is given below for quick reference:

Table 13 **Distribution of translation solutions for the expanded postmodifying present participle as reduced relative clause and the expanded postmodifying present participle as 'detached' reduced relative clause (categories 3.3.1.1.1 and 3.3.1.1.1.1)**

Preposition or prepositional word group	47%
Relative clause	29%
Others (such as preposition plus participle to noun class shifts)	24%
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subordination: 32% no subordination: 68%	

For a comparison between the results for the above categories and those for the corresponding past participle categories see 3.4.

3.3.1.2 The postmodifying present participle as reduced sentential relative clause

Unlike the adnominal relative clauses discussed above, the sentential relative clause which does not postmodify a noun "refers back to the predicate or predication of a clause [...] or to a whole clause or sentence [...] or even to a series of sentences [...]" (Quirk et al. [13]1995:15.57) and is always non-restrictive. It frequently occurs in scientific and technical discourse specifically in its reduced form (Baakes 1994:63) to contribute to syntactic compression and condensation of meaning. According to Sager et al. (1980:218), the -*ing* clause in final position expresses result by denoting the outcome of the action expressed by the main clause. The most common present participles in this category are *indicating* plus *that*-clause (58%) and *suggesting* plus *that*-clause (17%).

The present participle used for reducing a sentential relative clause accounts for 14% (12 occurrences) of all present participles counted in the corpus. It may be followed by both a *that*-clause or a direct object. The distribution of translation solutions for this category is as follows:

i) Subordinate clause introduced by relative pronoun *was*   **92%**
(Duden vol. 4, [5]1995:1279) **or pronominal adverbs, e.g.,**
woraus, wobei, wodurch (Duden vol. 4, [5]1995:626 ff.)

-

Example:
However, more Ni and V was deposited on the X ebullated bed catalyst when the additive was not present, *indicating* that the additive acts as a good metal scavenger for heavy metals present in the feed.

Ohne Additiv lagerte sich jedoch mehr Ni und V auf dem Wirbelbettkatalysator von X ab, *was darauf hindeutet*, daß das Additiv einen positiven Fängereffekt für im Einsatzmaterial enthaltene Schwermetalle hat.

ii) Others   8%

Example:
To produce this amount of SCO, each process required a different amount of [...] *depending on* its pitch conversion level, the cut point of the Y vacuum bottoms fed to the [...] reactor [...] and the coal concentration in the feed [...]

Zur Produktion dieser Menge synthetischen Rohöls war für jedes Verfahren eine andere Menge [...] erforderlich, *und zwar in Abhängigkeit vom* Pechumsatz, von der Schnittemperatur der dem [...] Reaktor zugeführten Y-Vakuumrückstände [...] und der Kohlekonzentration im Einsatzmaterial [...]

As the results show, there is a very clear lead for subordinate clauses (92%) introduced by a relative pronoun (*was*) or pronominal adverb (*woraus, wodurch, wobei*) in the TL to accommodate the feature under investigation. Of these, 73% are very short subordinate clauses involving a shift from present participle to finite verb and reflecting the repetitive use of *indicating* and *suggesting* plus *that*-clause, which has certainly influenced this result. For these the following potential equivalents can be listed:

indicating+*that*-clause	woraus hervorgeht, daß
	was darauf hindeutet/hinweist, daß
suggesting+*that*-clause	was vermuten läßt, daß
	was darauf schließen läßt, daß

The variety in the potential equivalents is due to register requirements, i.e., a reduced monotony of expression. The remaining 27% reflect the present participle plus direct object constructions, which have given rise to full and more complex subordinate clauses introduced by pronominal adverbs and involving a shift from present participle to finite passive verb, and in one case by the relative pronoun *was* involving a shift from present participle to finite active verb, e.g.:

indicating+direct object	was auf...hindeutet

The grammatical function of the German relative pronoun *was* and of pronominal adverbs, such as *woraus, wobei* and *wodurch*, is very similar to that of the

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English present participle in this context, because neither refers to an antecedent noun but to the contents of the main clause.[73]

As for the 'Others' category, equivalence is achieved by a word group in prepositional function (Beneš 1976:93) plus the explanatory expression *und zwar* which is used in the TL without unequivocally referring to a particular part of the sentence (Duden vol. 9, [4]1997:853). The *und zwar* solution is a very helpful translational tool in this context, since the use of a preposition or word group in prepositional function alone would fall short of providing the required syntactic - though semantically unspecific - link with the main clause.

As mentioned in Krein-Kühle (1995a:66-67), equivalence in the case of the sentential relative clause can also be achieved by parataxis and by adding a causal adverb *(und daher/deshalb/aus diesem Grunde/so)* which functions as a semantic marker. The fact that this translation solution is not found in the corpus is due to the very low frequency of occurrence of participles plus direct object and the very high frequency of the participles *indicating* and *suggesting* plus *that*-clause and their grammatical-syntactic implications in the TL.

The results for this feature are another good example of what Wandruszka (1969:528) calls the "asystematische Disponibilität" or "non-systematic availability" of languages. What is expressed in the ST by grammatical means is expressed in the TT by lexical means, so that a cross-rank equivalence or "equivalence in difference" (Jakobson [1959]1992) is achieved at the syntactic and overall textual levels. The fact that equivalence in the TL is obtained here by lexical means ("more words") and subordination should not be mistaken for an instance of "explicitation" (Baker 1996; Laviosa 2002). Although grammatical means may be considered to be more implicit than lexical means, so that the latter is more explicit (Beneš 1976: 94), this is a strictly language-bound explicitness, since the above discussion highlighting the grammatical-syntactic functions of the SL and TL structures has shown that both

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[73]   "Das Relativpronomen *was* muss immer gesetzt werden, wenn es sich nicht auf ein einzelnes Bezugswort im übergeordneten Satz, sondern auf dessen Inhalt insgesamt bezieht: [...]" (Duden vol. 9, [4]1997:619)
     "Durch das Pronominaladverb kann der Relativsatz nicht nur auf ein einzelnes Wort, sondern auch auf den Gesamtinhalt des übergeordneten Satzes bezogen werden: [...]". (Duden vol. 9, [4]1997:825)

structures serve the same syntactic and textual functions and have the same effect on the SL and TL expert readers.

3.3.1.3 The unrelated present participle used in adverbial clause reduction

As mentioned earlier, the unrelated or "unattached" (Quirk et al. [13]1995:15.59) present participle accounts for 40% (34 occurrences) of all present participles counted in the corpus, whereas absolute and related participles account for only 6%. Neither has this participle construction its own subject, nor is the understood subject identifiable with the subject of the main clause. Although this construction "is considered to be an error" in LGP (Quirk et al. [13]1995:15.59), "in formal scientific writing, the construction has become institutionalized where the implied subject is to be identified with the *I*, *we*, and *you* of the writer(s) or reader(s)" (Quirk et al. [13]1995:15.59 (d))[74] (cf. also Baakes 1994:74).

The high frequency of this construction in our corpus is certainly due to the excessive use of the participle *using*, which accounts for 82% of all the unrelated participles in this construction. Among the remaining 18% we find above all the participles *assuming* and *considering*. Baakes (1994:74), too, found that these three participles are very frequently used in this construction. The unrelated present participle can also be introduced by subordinating conjunctions, such as *when*, e.g.:

AT WHSV = X, the bench-scale unit resulted in lower pitch conversions for
all temperatures investigated as expected *when comparing* a CSTR with a tubular reactor.

However, the unrelated participle is generally not introduced by a conjunction. This may sometimes make it difficult to identify its antecedents - e.g., it may refer back to the content of a stretch of language - and the translator has to have recourse to supra-sentential and textual co-texts and the context in the search for equivalence. Although the participle *using*, for example, has assumed a prepositional function in the ST in most instances (i.e., there is a cline from participle (form) to preposition (function)), this in no way implies that equivalence can be achieved by choosing just one correspondent preposition in the TT, as the results will show.

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[74] "The error of unattached clauses has traditionally been discussed in connection with participle clauses, particularly -*ing* clauses. Other traditional terms for the error are 'unattached', 'unrelated', 'pendant', and 'dangling' participle." (Quirk et al. [13]1995:15.59 Note [a])

Moreover, while an instrumental meaning can often be inferred from the participle *using*, the translator has to be aware of those cases in which a different semantic relationship is present, an aspect which is also reflected in the results mentioned below.

The distribution of translation solutions for this category is as follows:

i) Preposition, secondary preposition[75] and word group in   64% prepositional function

Example:
Experiments were also carried out *using* [...] coprocessing VGO blended with
X to investigate whether such blends would provide a viable FCC option.

Ferner wurden Versuche *mit* einem Gemisch aus [...] Coprocessing-VGO und X gefahren,
um zu untersuchen, ob derartige Gemische eine wirtschaftliche Alternative beim FCC
darstellen.

ii) Adverbial phrase (preposition+noun)   18%

Example:
Using a heavy gas oil feedstock, it was not possible to reduce the nitrogen content in the
product from the second stage below X to Y ppm.

Bei Einsatz von schwerem Gasöl war es nicht möglich, den Stickstoffgehalt im Produkt der
zweiten Stufe unter X bis Y ppm zu senken.

iii) Others   18%

Example:
Based on the data for the two X runs, an activation energy of Y kcal/mole was
estimated *assuming* pitch conversion is a first order reaction and that the PDU operated
in classical plug flow.

Anhand der Daten für die beiden X-Versuchsläufe wurde eine Aktivierungsenergie
von Y kcal/mol geschätzt, *wobei unterstellt wird, daß* es sich bei der Pechumsetzung um
eine Reaktion erster Ordnung handelt und daß die Technikumsanlage in der klassischen
Pfropfenströmung arbeitet.

**n.b.: Of all translation solutions only 9% are accounted for by a subordinate clause,
whereas in 91% of all cases subordination was avoided.**

As the results show, there is a very clear lead for a prepositional solution in the TL to accommodate the feature analyzed. This can be attributed to the very high frequency of the participle *using* (82%) in the corpus which leads to the following potential equivalents in the TL, listed here in their order of frequency of occurrence:

using   *unter Verwendung von, mit, mit Hilfe, unter Einsatz, in, mittels, durch* (in the
         sense of *mittels*)

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[75]   According to Beneš (1976:93), secondary prepositions are, e.g., *mittels, hinsichtlich*, etc.
       For prepositional word groups see f.n. 45.

Of the above German prepositions roughly 40% are 'primary' prepositions, e.g., *mit, in, durch,* and 60% 'secondary' prepositions and word groups in prepositional function (Beneš 1976:93-94), e.g., *mittels, unter Verwendung, unter Einsatz,* etc.

The use of prepositions, secondary prepositions and word groups in prepositional function fully complies with TL register requirements. As Beneš (1976:93-94) rightly claims, the use of various prepositional groups is a frequent feature in German scientific and technical discourse, because these prepositional groups establish closer intra-sentential relations than the corresponding facultative clause variants. The various different conceptual relations can be more precisely designated and differentiated by these secondary prepositions and prepositional groups (i.e., by lexical means) (Beneš 1976:93-94). This may also be the reason for the variety of potential equivalents found. Although they are synonyms or near-synonyms, one may be preferred to the other, for example, to avoid tedious repetition on an overall textual basis for register reasons or to make a specific conceptual relation clear. Hence, the selection of the above potential equivalents in the TT reflects consideration not only of the sentential co-text but of pragmatic requirements as well, i.e., the overall domain knowledge-bound context and register. An interesting case in point is the use of the German preposition *in* for the English participle *using* in the following example, because it shows that the means by which something is done may coincide with the place where this is done in scientific and technical discourse, e.g.:

> Comparison of the two X Y runs shows the degree of reproducibility obtainable with hydrogen quenching *using* the PDU.

> Ein Vergleich der beiden X-Y-Versuchsläufe zeigt den Grad der Reproduzierbarkeit, der durch Quenchen mit Wasserstoff *in* der Technikumsanlage erzielt werden kann.

Whereas the above prepositional translation solutions (64%) reflect the more instrumental meaning of *using* (i.e., *by using*), the adverbial phrase solution, which accounts for 18% of all solutions, reflects the 'contingency' or temporal aspect of *using* (i.e., *when using* or *if/when we use*) (see example under ii) above) (cf. clauses of time and contingency, Quirk et al. [13]1995:15.25-29, 15.30). Therefore, an adverbial phrase in the TL, i.e., preposition plus noun, may be the key to equivalence if the subordinating conjunction *when* is used, e.g., *when comparing - beim*

Vergleich, or, if it is not used, but can be inferred from the sentential co-text and the context. In fact, preposition *bei* or preposition+article *beim* plus nominalization of the present participle in the TL was used with 100% regularity for the English conjunction *when*+present participle or when this preposition had to be inferred from the context.

In the 'Others' category, use of subordinate clauses, most of which are introduced by the pronominal adverb *wobei*, and 1:0-correspondences for the English participle demonstrates how further semantic and pragmatic aspects come into play and modify syntax.

On the basis of the above results, the following potential equivalents for the following unrelated participles can be ascertained:

using instrumental meaning	*mit*, (less frequent also: *durch, in*)
	unter Verwendung, mit Hilfe, unter Einsatz, mittels
temporal/contingency aspect,	
i.e., implicit *when using*	*bei Verwendung, bei Einsatz*
assuming (that)	subordinate clause introduced by *wobei*
	wobei unterstellt wird, daß
	subordinate clause introduced by *falls*
considering	*bei Betrachtung, in Anbetracht* or *angesichts*

It is interesting to note that, in the context of the unrelated participle, Baakes (1994:74), who does not work with a translation corpus but nonetheless gives recommendations for translation, claims that "in this case the Ge [German] impersonal pronoun 'man' is the word to match." Although a construction with *man* may be a correspondence and in certain cases even a potential equivalent, not a single instance was found in the corpus under investigation. The problem with impersonal *man* is that it needs to be embedded in a subordinate clause. As the results show, however, subordinate clauses are avoided (they account for only 9%) in most cases, and there is a clear trend towards prepositions and word groups in prepositional function as well as adverbial phrases in this context. Since the English grammatical clause-reducing construction is not available in German, recourse is had to those syntactic means in the TL that enable the same function, i.e., syntactic compression and condensation of meaning, to be performed. Avoidance of subordination (in 91% of all translation solutions) and recourse to prepositions/prepositional groups and

adverbial phrases ensures "equivalence in difference" (Jakobson [1959]1992) at overall textual level. The few subordinate clause solutions, too, contribute to overall textual equivalence in that they have become operative for grammatical-syntactic and register reasons.

3.3.2 The gerund used as an adverbial phrase[76] and its German potential equivalents

As mentioned in the introduction to the investigation of the -*ing* form, the gerund as a terminological item or constituent part of terminological compounding accounts for 79%, whereas the remaining gerundial constructions account for 21%. Of the latter, the gerund used as an adverbial phrase is the most frequent feature and accounts for 32% (19 occurrences).[77] As Weise (1980:88) rightly claims, the gerundial constructions contribute significantly to compression and the logical structuring of texts. The adverbial phrase (*adverbiale Bestimmung*), introduced by a preposition, is a very common feature, because the preposition helps integrate the adverbial phrase into the main clause and denotes the semantic relationship between main clause and adverbial phrase by at the same time allowing a high degree of syntactic compression.

The following adverbial phrases, which are the subject of this investigation, are encountered in the corpus: phrases of means and instrument (Quirk et al. [13]1995:9.49), i.e., *by*+gerund, (68%),[78] gerund as conditional clause (Quirk et al.

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[76] Gerunds equivalent to an adverbial clause will be called 'adverbial phrase' here. Since this gerundial form is not always the reduced form of a subordinate adverbial clause in English, the term 'adverbial phrase' is used as a generic term here to refer to adverbial gerund constructions introduced by a preposition. For example, there is, strictly speaking, no instrumental subordinate clause category in English, since such a relationship is expressed by the preposition *by* + gerund (especially in scientific and technical discourse) (cf. Göpferich 1995a:433). Thus, we cannot speak of an adverbial clause reducing device, because this construction is itself the reduced form, i.e., an adverbial phrase (*adverbiale Bestimmung*).

[77] This finding correlates with Weise's figure (1980:87); he, too, established a percentage of 32 for this construction. The percentages of the other gerundial constructions encountered in the present corpus are as follows: gerund as subject (18%) (11 occurrences), gerund as part of a nominal group (18%) (11 occurrences), as prepositional object (18%) (11 occurrences), as direct object (7%) (4 occurrences), as supplement to an adjective (5%) (3 occurrences) and others (2%) (1 occurrence). It should be noted that the gerund as subject and part of a nominal group may often also be terminologically 'laden', an aspect which becomes relevant in the context of equivalence at the terminological-phraseological level (5.2.1.3, 5.2.1.6, 5.2.2.3).

[78] This finding correlates with Weise's (1980:87) finding; he claims that the construction *by* + gerund is by far the most frequent. For an overview of the gerundial constructions found in his corpus, see Weise (1980); cf. also Baakes (1994:17-48).

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[13]1995:15.33-34) replacement, e.g., expressing exclusion by *without*+gerund, (21%), and as clause of concession (Quirk et al. [13]1995:15.39 ff.) and clause of time (Quirk et al. [13]1995:15.25-29) replacement, e.g., *before*+gerund, (11%).

Since German has no counterpart for this English construction, equivalence may be more difficult to achieve and, although recourse to a subordinate clause plus the appropriate conjunction is possible, the results of this investigation presented and discussed below show that this solution is a mere correspondence rather than a potential equivalent in the discourse type/genre under analysis.

The distribution of translation solutions for the above category is as follows:

i) Adverbial phrase (preposition+noun*)   53%
(*The most common nouns are abstract nouns with *-ung* suffix; others are,
e.g., substantivated infinitives, borrowed English nouns, etc.)

Example:
The analysis was simplified *by converting* WHSV and X into one independent variable[...] which is [...]

Diese Analyse wurde *durch Umrechnung* der WHSV-Werte und X in eine unabhängige Variable [...] vereinfacht, bei der es sich um [...] handelt.

ii) Others   47%

With the following breakdown:

Elimination of adverbial phrase (gerund becomes passive or active verb)	16%
1:0-correspondence for the gerund or prepositional solution	16%
New sentence	5%
Shift due to terminological considerations	5%
Subordinate clause	5%

Example:
The reader may select any project or research element for more detailed review *by referring* to the appropriate consortium reports.

Für eingehendere Erläuterungen zu bestimmten Projekten und Forschungselementen *wird* auf die entsprechenden Konsortiumsberichte *verwiesen*.

n.b.: Of all translation solutions only 5% involved a subordinate clause, whereas in 95% of all cases subordination was avoided.

As the results show, the search for equivalence in the construction investigated here tends to favour an adverbial phrase (preposition+noun) in the TL. This is in compliance with German register requirements, since the technical sentence in German is often extended by adverbial qualifications which are formed by prepositions plus nouns - i.e., nominal groups - which replace the respective

subordinate clauses (Fluck [2]1997:104-106). Nominal forms of expression, in fact, comply with LSP function (Beneš 1976:92-93; Göpferich 1995a:420 ff.).

The high percentage for the 'Others' category is interesting, since it shows how other higher-ranking text levels, e.g., the terminological level, and, above all, register considerations come into play and modify syntax. A case in point illustrating the latter aspect is the sentence quoted in this category in which the gerund is transformed and modulated into a passive verb with the adverbial phrase completely disappearing, because the establishment of direct contact with the reader in the English sentence (*The reader may select*)[79] is neutralized in German for reasons of coherence, since the English habit of "information packaging" would counteract the depersonalized author-oriented German register requirements (Gerzymisch-Arbogast 1993).

The adverbial phrase may also disappear in the TL with the gerunds becoming passive or active verbs/predicates due to the transformation of an instance of 'secondary subjectification' (4.3) into prepositional phrasing in the TL. Moreover, with gerunds whose underlying verbs are semantically weak equivalence may be achieved by a 1:0-correspondence or by a preposition, as is demonstrated in the following examples:

This was investigated *by carrying out some experiments* at [...]
Dieser Aspekt wurde *durch Experimente* bei [...] untersucht.

Despite having high volatile contents, both residues resulted [...]
Trotz eines hohen Gehalts an flüchtigen Bestandteilen ergaben sich bei beiden Rückständen [...]

With very long and complex sentences (> 60 words) containing several relative clauses, adnominal relative clauses, subordinate clauses and parantheses, the gerundial phrase may be removed from the sentence by making the logical-semantic subject of this phrase explicit in the TL and transforming the gerund itself into a finite verb to form a new sentence. This helps prevent excessive sentential complexity in the ST - which may occur for various reasons (see 1.4.3) - from being transferred into the TT, since this would counteract the pragmatic requirements (such as clarity of expression) of equivalence in the TL. While the thematic conceptual reality should

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[79]   It is interesting to note that this is the only instance where the reader is referred to
in the corpus under investigation. Thus, English research reports, too, generally seem to
refrain from direct reader contact. Of course, this would have to be corroborated by LSP
research on the basis of a more comprehensive corpus (see 2.2.2.1.1, e), iii) and 4.2.1.1.2).

be made as explicit as possible, linguistically this should be done as concisely as possible (cf. Beneš 1976:93).

As the results show, gerunds used in adverbial phrase function in English may have a host of potential equivalents in German. Although there is a tendency towards using an adverbial phrase in German, further semantic, terminological and above all pragmatic, i.e., register considerations, may come into play and modify syntax. However, all potential equivalents mentioned above can, in fact, become operative and contribute to overall textual equivalence, because they all serve the same syntactic and overall textual function as the English adverbial phrase, i.e., they contribute to syntactic compression and conciseness of expression in the TL by avoiding subordinate clauses. This can be statistically underpinned by the fact that, of all translation solutions, subordinate adverbial clauses only account for 5% (e.g., to avoid excessive sentential complexity owing to excessive use of prepositional phrases in one and the same sentence in the TL), whereas in 95% of all translation solutions, subordination was avoided by having recourse to the above linguistic means. Thus the English ST category of adverbial phrases and their German potential equivalents is yet another example of "equivalence in difference" (Jakobson [1959]1992) which is achieved at overall textual level.

3.3.3 Summary of this section

The results for the individual categories investigated in this section are summarized in the following:

Table 14   Distribution of translation solutions for the expanded postmodifying present participle as reduced relative clause (category 3.3.1.1.1)

Trend towards a prepositional solution/attribute (50%), Example: (E) *containing, using, resulting in, employing* - (G) *mit* relative clause (25%), Others (25%).
subordination: 29%; no subordination: 71%.

As the results show, there is a trend towards a prepositional solution (50%) in the TL which certainly correlates with the semantics of the underlying English verb.

Prepositional phrases (*Präpositionalgefüge*) are a common feature of German scientific and technical discourse, because they concisely and clearly denote the various different conceptual circumstances (Fluck [2]1997:109). As prepositional attributes they are a means of reducing relative clauses in German. The relatively high percentage for finite relative clauses in the translation solutions (25%) reflects the aspect of 'secondary subjectification' (4.3) which may occur with 'subject+active transitive verb structures' in their reduced form as well, and the aspect of complexity of this type of relative clause and its embedding in a likewise complex main clause. Neither aspect allows, e.g., a lengthy premodification in the TL.[80]

The results for the 'Others' category (25%) illustrates how further terminological and register aspects come into play and modify syntax.

It is interesting to note that in 71% of all translations solutions subordination was avoided, which can be seen as a clear trend towards using 'equivalent' sentence-reducing devices in the TL - where this is reasonably possible for pragmatic considerations - to achieve overall textual equivalence.

Although the figures shifted rather in favour of a relative clause solution in the TL (50%) for the 'detached' reduced relative clause (3.3.1.1.1.1), these results should be taken with caution due to the very low frequency of this feature and would have to be corroborated on the basis of a more comprehensive corpus. However, the aspect of detachment may be the decisive factor, since the main trends in translation for this category neatly correlate with those for the 'detached' past participle (3.2.1.1.1.1). Subordination was avoided in 50% of all translation solutions for the 'detached' present participle.

Table 15 **Distribution of translation solutions for the postmodifying present participle as reduced sentential relative clause (category 3.3.1.2)**

Trend towards a subordinate clause introduced by relative pronoun (*was*) or pronominal adverb (*woraus, wobei, wodurch*) (92%), e.g., *indicating that - was darauf hindeutet/hinweist, daß; woraus hervorgeht, daß* *suggesting that - was vermuten läßt, daß; was darauf schließen läßt, daß* Others (8%): e.g., explanatory expression (*und zwar*) [also possible: parataxis+causal adverb, e.g., *und daher/deshalb/aus diesem Grunde/so*]

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[80]   Certainly, lengthy premodification or a prenominal attribute may become a potential equivalent under certain syntactic-semantic circumstances, but is obviously much less common than in the case of the past participle in the same function (3.2.1.1.1) for the reasons discussed earlier.

As the results show, there is a very clear trend towards a subordinate clause solution in the TL which is introduced with a relative pronoun or pronominal adverb. The fact that the most common participles encountered in the English ST in this category are *indicating* (58%) and *suggesting* (16%) plus *that*-clause has clearly influenced this result. Explanatory expression *und zwar* and parataxis+causal adverb may also become potential equivalents depending on the semantics of the underlying verb and further register considerations (Krein-Kühle 1995a:66-67). As has been discussed in the relevant section, syntactic and textual functions and the effect on TT reader of the German relative pronoun *was* and of pronominal adverbs are equivalent to those of the English present participle analyzed.

Table 16   Distribution of translation solutions for the unrelated present participle used in adverbial clause reduction (category 3.3.1.3)

Trend towards prepositions/prepositional groups (64%), e.g., *using* instrumental meaning *mit*, (less frequent also: *durch, in*) *unter Verwendung, mit Hilfe, unter Einsatz, mittels* Adverbial phrase (18%), e.g., *using* (temporal and/or contingency aspect) - *bei Verwendung, bei Einsatz* Others (18%), e.g., subordinate clause: *assuming - wobei unterstellt wird, daß*
subordination: 9%; no subordination: 91%

Apparently, therefore, there is a very clear trend towards a prepositional solution in the TL which can be attributed to the excessive use of the participle *using* and leads to the above figures. All above potential equivalents can, in fact, become operative in the search for overall textual equivalence depending on register or domain knowledge-specific (i.e., conceptual) considerations. Together with the adverbial phrases, consisting of prepositions plus nouns, a very clear trend towards prepositional constructions can be ascertained which is in line with TL register requirements (Beneš 1976:93-94; Fluck [2]1997:104-106). Of all translation solutions subordination was avoided in 91% of the cases.

Table 17 Distribution of translation solutions for the gerund used as an adverbial phrase (category 3.3.2)

Trend towards an adverbial phrase (preposition+noun) (53%), Others (47%) With the following breakdown:	
Elimination of adverbial phrase (gerund becomes active/passive verb)	16%
1:0-correspondence for the gerund or prepositional solution	16%
New sentence	5%
Shift due to terminological considerations	5%
Subordinate clause	5%
subordination: 5%; no subordination: 95%	

As these results show, there is a trend towards an adverbial phrase (preposition+noun) in the TT for the ST construction under investigation. However, it should be noted that the 'Others' category, which is quite extensive, includes a variety of potential equivalents, especially for the construction *by*+gerund which accounts for 68% of all adverbial phrases in the ST. The fact that the implied logical-semantic subject of the gerundial phrase may be related (37%) to that of the main clause or may be unrelated (63%) along with the animateness or inanimateness of the subject in question and the semantics of the underlying verb, as well as TL register aspects, may have given rise to the various translation solutions in the 'Others' category.

On the basis of the above results, a tentative equivalence-relevant recommendation could run as follows: if the implied subject of the English adverbial phrase is the scientific author or a team of researchers and can be paraphrased by *I* or *we*, e.g., *This was done by loading* (i.e., *by our loading*) *Fe on coal*, i.e., if the adverbial phrase is 'unrelated', there is a high degree of probability that equivalence is achieved by an adverbial phrase, i.e., preposition+noun, or a preposition (e.g., *by using - mit*) in German. Of course, any further implications of this aspect would have to be investigated on the basis of a more comprehensive corpus.

Again, it is interesting to note that subordination was avoided in 95% of all translation solutions.

The results for all categories investigated here show that there is a clear trend towards employing 'equivalent' sentence-reducing devices in the TL for the ST features under investigation. These are mostly prepositional constructions, i.e.,

prepositions and prepositional groups functioning, i.a., as adverbial phrases, which are a common feature in German scientific and technical discourse, because they establish closer intra-sentential relations than their corresponding clause variants. Moreover, they help designate and differentiate more precisely the various different conceptual relations in the TL (cf. also Beneš 1976:93-94). The nominalized register is a typical characteristic of both English and German scientific and technical discourse (Sager et al. 1980:184; Gerbert 1970:61 ff.; and Jumpelt 1961:34-35; Beneš 1976:92; Göpferich 1995a:420 ff., respectively). One feature of this nominalized register is the non-finite verb form in English. For the -*ing* forms analyzed, the key to equivalence involves prepositional constructions, such as prepositional attributes and adverbial phrases, which are a typical feature of nominalized register in this type of discourse in German.

Of course, other potential equivalents involving subordination may become operative for grammatical-syntactic, semantic and pragmatic reasons, i.e., above all for register considerations. The subordinate or paratactic translation solutions for category 3.3.1.2., i.e., reduced sentential relative clauses, are due to the grammatical-syntactic and semantic constraints in the TL. However, the syntactic and textual function and reader effect of the English participle are equivalent to those of the German translation solution.

Here again, the fact that the grammatical, i.e., implicit, constructions in the English ST are rendered with lexical, i.e., explicit, constructions in the German TT certainly does not constitute a case of "explicitation" or "simplification" (Baker 1996), but of cross-rank equivalence or "equivalence in difference" (Jakobson [1959]1992) at both sentential and textual levels, as is shown by this investigation.

3.4   Summary of this chapter

The investigation of the non-finite verb forms, which - in their sentence/clause-reducing function, in particular - contribute to syntactic compression and condensation of meaning in scientific and technical discourse and are a typical feature of the nominalized register in the SL (see, e.g., Gerbert 1970:61 ff.; Weise 1980:79-89), shows that there is a clear translational trend towards employing 'equivalent' clause/sentence-reducing devices in the TT. These are mostly prepositional

constructions functioning, i.a., as adverbial phrases and as attributes in premodification or postmodification, which are a typical feature of the nominalized register in this type of discourse in German (cf. Göpferich 1995a:420-422) because they establish closer intra-sentential relations than their corresponding clause variants. Moreover, they help designate and differentiate more precisely the various different conceptual relations in the TL (see, e.g., Beneš 1976:93-94).

The translation trends for the main category of infinitive clauses of purpose (3.1.1.1 plus 3.1.1.1.1) suggest a register-induced sound balance in the distribution of prepositional/adverbial phrasing (41%) and infinitive conjunction *um - zu* plus its adverbial or modal extensions (38%). The infinitive construction *mit dem Ziel,... zu* (13%) is a specific feature of the genre investigated and the remaining translation solutions (8%) demonstrate how further semantic and pragmatic aspects, specifically other register aspects, come into play and modify syntax. As regards the main past participle category, i.e., the expanded postmodifying past participle as reduced relative clause (including the 'detached' past participle in the same function - 3.2.1.1.1 plus 3.2.1.1.1.1), the following breakdown in translation solutions can be established: lengthy premodification/prenominal attribute (41%), 1:0-correspondence (27%), relative clause (9%), prepositional word group 7%, Others (15%).[81] The breakdown in translation solutions for the corresponding present participle category (categories 3.3.1.1.1 plus 3.3.1.1.1.1) is as follows: preposition (prepositional attribute) or prepositional word group (47%), relative clause (29%) and Others (24%). The variety in the translation solutions points to the importance of a meaningful equivalence-relevant categorization. Although both past and present participle in the above categories have the same function, i.e., they reduce relative clauses, the fact that the present participle reduces an active relative clause which may involve instances of 'secondary subjectification' (4.3), together with further semantic considerations and aspects of sentential complexity, may have considerable implications for translation and may lead to a different distribution in the translation solutions. From an equivalence point of view, therefore, these two categories should not be treated together (as is done, e.g., in Königs (2000:186 ff.) and Göpferich (1995a:422 ff.)).[82] Detailed categorization has proved necessary for the other

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[81] Any discrepancy in the figures due to rounding off.

[82] Königs (2000:186 ff.) gives the impression that the TL correspondences mentioned occur equally for the two categories, which is due to the fact that she only looks - from a systemic point of view - at isolated sentences, for which she suggests correspondences, but

features investigated, too, not only to establish trends in translation, but also to demonstrate how semantic, terminological-phraseological and pragmatic considerations, both domain knowledge and register aspects, come into play and modify syntax. As this research has shown, syntactic equivalence in STT is dependent on and interwoven with register requirements, in particular. These requirements call for the use of a high degree of syntactic compression or condensation and conciseness of expression (see, e.g., Kretzenbacher 1991),[83] involving formality and abstraction, and a high noun-based lexical and terminological specificity in German which may be implemented, i.a., by nominalization (roughly one third of all infinitives are nominalized in translation, see 3.1.3; nominalization also occurs with some of the past and present participle constructions investigated) and prepositional constructions of different kind mostly functioning as sentence/clause-reducing devices. These requirements also call for a reduced monotony of expression in order to prevent the transfer of excessive and repetitive use of specific non-finite constructions (see, e.g., 3.2.1.3.1 and 3.2.1.3.2) - which may occur, e.g., due to a certain carelessness on the part of the author (1.4.3) - into the TT. This shows that technical translators do, in fact, correct defective STs in translation, as they are expected to do (Schmitt 1987b; Horn-Helf 1999). This procedure is by no means an instance of "normalization" (Baker 1996; Laviosa 2002), but contributes to "equivalence in difference" (Jakobson [1959]1992) at both syntactic and overall textual levels. The same is true of the instances of implicitness and, even more so, explicitness ascertained in the German TT. The fact that the grammatical, i.e., implicit, non-finite constructions in the English ST are rendered with lexical, i.e., explicit, means in the German TT is certainly not a case of "explicitation" or "simplification" (Baker 1996), but is a case of language-bound, i.e., systemic, explicitness. As this research shows, increases in

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not at complete LGP texts-in-contexts as *parole* events. Göpferich (1995a:422 ff.) contrasts, i.a., English adnominal participle constructions with German prenominal attributes in scientific and technical discourse on the basis of a parallel corpus, obviously tacitly presupposing that such adnominal participial constructions are the equivalents of prenominal attributes in German, which is by no means always the case, as this research shows. Since there is no translational link between the texts investigated in contrastive special languages research, any inferences drawn about translation should be considered with caution. From the point of view of translation, this type of research - though relevant in itself - too often ignores the important fact that there is always a certain tension between a translation, which is bound to an ST, and an original TL piece of writing.

[83]   As Kretzenbacher (1991:119) claims: "The central strategies of textual reduction in [German] scientific discourse are to be found, however, at the level of syntax." (my translation, brackets added)

the degree of explicitness may also and specifically occur on register grounds. From a translational point of view, the German TT is not more explicit than the English ST, so that "equivalence in difference" (Jakobson [1959]1992) can be deemed to have been achieved at syntactic and overall text-in-context levels. Apart from the translation trends established, the translation solutions subsumed under the 'Others' categories are highly interesting in that they show how further higher-ranking semantic, terminological-phraseological and pragmatic aspects involving aspects of cohesion and coherence (Chapter 6) may influence the syntactic level. So, whereas register is the main factor influencing equivalence at the syntactic level, the above aspects may additionally come into play and trigger specific translation solutions which also contribute to equivalence at both syntactic and overall-text-in context levels. Apart from a few 1:1 or near-1:1-correspondences which have become potential equivalents in the corpus analysed, the translation trends established are a good example of what Wandruszka (1969:528) calls "asystematische Disponibilität" (*non-systematic availability*) and what is referred to in the present work as the 'non-corresponding availability' of languages, a potential which should be fully exploited when it comes to achieving equivalence in translation. The findings also point to an interrelatedness of certain features investigated, e.g., certain infinitive (3.1.2.1.3, 3.1.2.1.5, structural verbs+infinitive) and present participle constructions (3.3.1.1.1, 3.3.1.1.1.1) and the inanimate subject, which share the aspect of 'secondary subjectification' (4.3), which implies the hierarchical interrelatedness of what may superficially be deemed isolated translation procedures. 'Secondary subjectification' (4.3) is an equivalence-relevant feature at the lexical-semantic level. How equivalence operates at this level will be investigated and demonstrated in the following Chapter 4.

4 Equivalence at the lexical-semantic level:
An investigation of *have* and *be* as main verbs, modal auxiliaries and instances of 'secondary subjectification' and their German potential equivalents

> Unter der Voraussetzung der grammatischen Korrektheit gründet sich die äquivalente Übersetzung in ihrer Semantik auf den Bedeutungen der lexikalischen Mittel der ZS. Semantische Äquivalenz ist eine Funktion der Formative im syntaktischen Kontext.
>
> (Neubert 1970:452)

> Im Hinblick auf die Kategorie der *denotativen Äquivalenz* stellt sich der Übersetzungswissenschaft die Aufgabe, sprachenpaarbezogen die potentiellen Äquivalenzbeziehungen zu beschreiben und anzugeben, welche Faktoren textueller Art die Wahl eines bestimmten Äquivalents im konkreten Übersetzungsfall bestimmen. Zentraler Gegenstandsbereich bei der Beschreibung denotativer Äquivalenzbeziehungen ist die *Lexik* [...], weil hier die Sprachen am produktivsten sind bzw. sein müssen [...]
>
> (Koller [4]1992:228)

Since presentation of information and the imparting of knowledge are the predominant aims in STT, complete and correct comprehension of ST meaning and its appropriate rendition in the TL are indispensable for achieving "equivalence at the content level" (Wilss 1979) or lexical-semantic equivalence. Although lexical features such as polysemy and semantic incongruence are normally discussed at this level (Krein-Kühle 1995a:79-90), these features are not particularly amenable to the establishment of trends in translation solutions due to their very complex and highly context-sensitive nature, and their investigation would require a much more comprehensive corpus to yield such trends.[1] Research in this direction would be highly welcome, though, with a view to establishing a translation-geared dictionary containing potential equivalents for polysemous and semantically incongruent lexemes, such as the German polysemous term *Leistung*,[2] because as Hann (1992:11) rightly criticizes: "Too many professional translators are blissfully unaware of the polysemous nature of these terms and make little attempt to determine the true English equivalent in the given context." This statement also applies to the 'true'

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[1] For example, an investigation of the semantic incongruence of certain verbs, such as the German verb *montieren* - which as an hyperonym has no equivalent in English at this abstraction level, so that the translator has to select from among hyponyms which refer to individual aspects at a concrete level (Krein-Kühle 1995a:80) - would require a comprehensive corpus to establish the various potential equivalents, e.g., in the present case: *assemble* (*zusammenbauen*), *instal* (*einbauen*), *fit* (*einpassen*), *mount* (*anbauen*), etc. (Franck 1980:125).

[2] Potential equivalents for *Leistung* are: *power* ("*Leistung* im technisch-physikalischen Sinne"), *capacity* ("*Leistungsvermögen*"), *output* ("*erbrachte Leistung*"), *efficiency*, *performance* [...] (Franck 1980:122).

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German equivalents of polysemous English terms, such as the empty word (*Hülsenwort*) *unit* (see Geißler 1972:143-144), the translation of which involves a need to determine the appropriate domain or sub-domain and a consideration of collocational aspects and/or contexts to monosemize the word, so that lexical-semantic equivalence can be established.[3]

This research will concentrate, therefore, on the investigation of features at the lexical-semantic level which are amenable to the establishment of trends in translation solutions, occur in the corpus with a high frequency and are typical of a wider range of scientific and technical genres. The features in question are: *have* and *be* used as main verbs, modality, viz., modal auxiliaries, and instances of 'secondary subjectification'. *Have* and *be* used as main verbs are very common in scientific and technical discourse (Swales 1971:2) (4.1). As early as 1961, Jumpelt (1961:73) remarked that these two verbs might have to be rendered *more specifically* in indicating content in German, but no research has been carried out so far into these equivalence-relevant features. The same is true of the modal auxiliaries (4.2). Despite their more or less extensive treatment in monolingual studies (such as Barber 1962; Huddleston 1971; Köhler 1981 or Meyer 1989), no comprehensive contrastive or translational studies are available in the STT field. And while instances of 'secondary subjectification' in LGP were the object of a comprehensive study by Rohdenburg (1974), this problem, too, has not been investigated so far in the field of technical translation, although it has been identified as a problem in Franck (1980:22-23), Schröter ([3]1990:28) and Gnutzmann (1991) (4.3). On the basis of the finite verb forms counted in the corpus, the percentage distribution of the above features is given in the table below.

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[3]   In Horn-Helf's (1999) approach, denotative equivalence is dismissed as an inadmissible requirement because of the frequent defectiveness of technical source texts (op. cit.:360). However, as has been discussed in 1.2.4 (see also Krein-Kühle 2001), the defectiveness of STs, though a familiar problem in technical translation, can hardly serve as a basis for a translation theory. Precisely because of their defectiveness, STs have to be repaired by the translator, so that, e.g., denotative equivalence can be achieved for the corrected ST lexeme. What counts in translation is not the lexeme itself, but its intended meaning in a specific co-text and context, also and even if the intended meaning may have to be established via ST correction.

Table 18 Distribution of the features (*have* and *be* used as main verbs, modal auxiliaries and instances of 'secondary subjectification') investigated at lexical-semantic level

(Percentages calculated on the basis of the finite verb forms (total: 663 occurrences)	Percentage Occurrences	
have and *be* used as main verbs	26%	174
modal auxiliaries	21%	138
instances of 'secondary subjectification'	22%	145

As these figures show, the above features occur with a high frequency and are, therefore, conducive to the establishment of trends in translation solutions. It is an empirical fact that these features not only appear in the genre under analysis, but also occur in a wider range of scientific and technical genres, so that the results established may be of a more general usefulness. How equivalence at the lexical-semantic level is established with these features, and how this level may govern and modify the syntactic level and may itself be governed and modified by terminological-phraseological and pragmatic considerations, specifically register aspects, will be demonstrated in the following sections.

4.1   *Have* and *be* used as main verbs and their potential equivalents

According to Swales (1971), *have* and *be* used as main verbs are very common in scientific statements:

> In fact, about a third of all scientific statements have *is* or *are* as the main verb. This causes difficulty for students who speak languages in which it is not always necessary to use a verb like *be* [...] The other very common verb in scientific statements is the main verb *have*. Again this can cause a problem because of the grammatical differences between English and many other languages.
>
> (Swales 1971:2) (emphasis added)

Although Swales looks at the problem from the point of view of foreign language teaching of technical English, his statement clearly points to an interlingual, and hence translational, problem which goes beyond merely grammatical aspects. However, except for an uncorroborated statement by Jumpelt (1961:73) that the two verbs have to be rendered more specifically in indicating content in German,[4] no

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[4]   Jumpelt (1961:73) talks of 'auxiliary verb constructions' in this context, although the two examples he mentions clearly indicate a main verb use, e.g., "flux distribution *is* fairly flat"

attention has been paid so far to this translation-relevant subject. Also, as regards LSP research, only Gerbert (1970:33-39), who discusses the verb *be* in the context of the nominal complex ("Nominalkomplex"), and Huddleston (1971:133-140), based on Huddleston et al. (1968:85-94), deal with *be* used as main verb. While Gerbert mentions only certain structures, e.g., "Subjekt+*to be+for*", most of which do not occur in the ST under investigation, Huddleston, whose analysis is based on the Chomskyan transformational and Hallidayan grammars, devotes an entire section to the analysis of the verb *be* and suggests three clausal categories, i.e., "intensive intransitive clauses", "extensive intransitive clauses" and "extensive transitive clauses" (Huddleston 1971:133-140). However, an equivalence-relevant categorization has to go beyond monolingual categories, and the difference between intensive and extensive constructions may, but need not, be relevant and may, in fact, become irrelevant on co-textual semantic and above all pragmatic grounds for the feature under investigation. Nonetheless, reference is made to Huddleston's categories in those cases where they are relevant to or coincide with the present categorization.

In the ST under investigation *have* and *be* used as main verbs account for 26%[5] (174 occurrences) of all finite verbs. Of these 26%, 12% are accounted for by *have* (20 occurrences) and 88% (154 occurrences) by *be*. The high frequency of *be* can be explained by its high versatility in usage. As a main verb with copular function it can have different types of complementation (Quirk et al. [13]1995:16.20 ff.) and occurs in our corpus in the following structures: with adjectival subject complement (41%) (4.1.2.1), nominal subject complement (30%) (4.1.2.2) and adverbial complementation (7%) (4.1.2.3). It also occurs with "existential *there*" (Quirk et al. [13]1995:18.45, 46) (4%) (4.1.2.4), in 'functional verb structures'[6] (2%) (4.1.2.5), with

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("die Flußverteilung *verläuft* ziemlich flach") and "engine which *has* a seven stage compressor" ("Triebwerk, das einen siebenstufigen Verdichter *aufweist*"). "Bei der Übersetzung En/De sind die im Englischen häufigen Hilfsverbkonstruktionen im Deutschen inhaltlich spezieller zu fassen: [...]"

[5] Cf. Barber (1962:28) who states in his investigation of tenses in his corpus: "There are two interesting points about the Present Simple Active, the predominant tense. First, no less than 45% of the examples are parts of the verb *to be* (nearly all *is* and *are*); no other tense is dominated in this way by one verb; and no other verb, not even *have* is outstandingly frequent."

[6] In this context *be* is the functional, i.e., semantically weak, verb in a nominal structure, e.g., *to be a reflection of*. Cf. Gerbert (1970:39), who speaks of a "nominales Gefüge" and Fluck ([2]1997:97-98), who talks of "Funktionsverbgefüge", which often serve as passive

"pseudo-subject *it*" (5%) (4.1.2.6), as part of stock phrases, e.g., *to be due to* (6%) (4.1.2.7), and in a category (5%) (4.1.2.8), in which *subject+be* is followed by an explicit indicator of apposition (Quirk et al. [13]1995:17.73), e.g., *X is as follows*, or just a colon, e.g., *Major conclusions are*: [...] (for occurrences see individual categories).

Have as a main verb occurs in two equivalence-relevant categories, i.e., in the SP$_{(have)}$O$_d$ structure, in which a characteristic or quantity is allocated to the subject (60%) (12 occurrences) and as part of a 'functional verb structure' (40%) (8 occurrences), e.g., *to have the potential to*. The categorization, description and investigation of equivalence-relevant *have* and *be* constructions are dealt with in greater detail in what follows.

4.1.1 *Have* and its potential equivalents

As mentioned earlier, *have* accounts for 12% (20 occurrences) of the *have* and *be* category established on the basis of the finite verb forms. The *have* category is divided into two sub-categories, 4.1.1.1, i.e., *have* in SP$_{(have)}$O$_d$ structure, in which a characteristic or quantity is allocated to the subject (60%), and 4.1.1.2, i.e., *have* as part of a functional verb structure (40%).

4.1.1.1 *Have* in SP$_{(have)}$O$_d$ structure, in which a characteristic or quantity is allocated to the subject

Have in the above structure has a possessive, stative meaning (cf. Quirk et al. [13]1995:3.33-35),[7] with the object characterizing the subject. It accounts for 60% (12 occurrences) of all instances of *have* used as main verb in the corpus. The distribution of translation solutions for this category is as follows:

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variants and may have modal meaning. 'Functional verb structure' is to be understood here in a broader sense as referring to all instances in which a nominal structure can be paraphrased either by a full verb (see 4.1.2.5), an auxiliary or *be*+adverb+adjective (see category 4.1.1.2). For a discussion of the use of functional verb structures in German LSP see Reinhardt et al. ([3]1992:156).

[7]   There are no instances in this category in which *have* is used in the dynamic (e.g., "have breakfast") or causative sense (e.g., "have him clean the window"). The fact that German *haben* can only be used in the stative possessive sense, whereas English *have* can be used in the stative, dynamic and causative sense is, of course, relevant to semantic aspects of equivalence in translation (cf. also Jumpelt 1961:69).

i) Other more specific German verbs, e.g., *aufweisen, enthalten*   58%

Example:
[...], the naphtha fractions from coprocessing and hydrocracking *have* similar instabilities while the heavier distillate fractions [...]

[...] *weisen* die Naphthafraktionen aus dem Coprocessing und dem Hydrokracken ähnliche Instabilitäten *auf*, während die schwereren Destillatfraktionen [...]

ii) *haben* used as main verb in German   25%

Example:
X Y vacuum bottoms *has* [sic!] ≈ 1.5 to 2.0% more sulphur than Z.

X-Y-Vakuumrückstände *haben* im Vergleich zu Z einen um ca. 1,5 bis 2,0 % höheren Schwefelgehalt.

iii) Others   17%
e.g. *sein* or domain knowledge-induced shifts.

n.b.: *haben* is avoided in 75% of all cases.

As the results show, there is a clear trend in German towards verbs which are more specific in indicating content for English *have*. These are selected on the basis of the semantic clausal and/or sentential co-text in the ST and collocational considerations in the TL. Although these verbs are more specific than German *haben*, they still belong to what Pörksen calls 'pallid' verbs with a sentence structuring function, such as "'teilnehmen', 'aufweisen', 'bilden'", which are a typical characteristic of German scientific texts (Pörksen 1986:188). The variety in the German verbs, which are *haben*, *aufweisen* and *enthalten* in the TT under investigation, with *aufweisen* having the highest frequency, is also in line with TL register aspects requiring a reduced "monotony of expression" (Reinhardt et al. [3]1992)[8] in the TT and does not constitute an instance of "normalization" (Baker 1996).

It is interesting to note that in the example under ii), register requirements, which here involve the aspect of a high noun-based terminological specificity in the TT - *sulphur* is shifted to the compound *Schwefelgehalt* (*sulphur content*) - come into play and make the use of *haben* possible. Although it would have been

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[8]   ˜See f.n. 52, Chapter 3.

grammatically, syntactically and semantically 'correct' to translate "to have more sulphur than" by "mehr Schwefel haben als", this translation ignores the pragmatic aspect in that it counteracts TL register requirements as regards level of formality and terminological specificity and, therefore, would have failed to achieve equivalence at the terminological-phraseological and overall textual levels (see Chapters 5 and 6, respectively). As regards the translation solutions under 'Others', *sein+preposition*, too, may be the key to equivalence for semantic reasons, e.g., "*to have* a reasonable economic value" - "*von* ausreichendem wirtschaftlichen Wert *sein*", as may domain knowledge-induced shifts in perspective.

4.1.1.2 *Have* as part of a 'functional verb structure'

Have in the above structure is the functional verb, with the following noun carrying the semantic weight. Such structures can be paraphrased either by other verbs, both full verbs and auxiliaries, or by *be*+adverb+adjective and can be followed by prepositions plus non-finite verb forms. This structure accounts for 40% (8 occurrences) of all instances of *have*. The distribution of translation solutions for this category is as follows:

i) English structure shifted to verbs, both main verbs and   **62%**
    auxiliary verbs, and also *sein* plus class shifts in German

Example:
These results indicated that the agglomerated coal *has the potential to allow* processing at higher severity to increase pitch conversion and distillables yield.

Diesen Ergebnissen zufolge *kann* mit agglomerierter Kohle eine Verarbeitung bei schärferen Bedingungen zur Erzielung höherer Pechumsätze und destillierbarer Ausbeuten *erfolgen*.

ii) *haben* as part of a 'functional verb structure' in German   **38%**

Example:
Coal concentration *had* little *impact on* the other variables.

Auf die anderen Variablen *hatte* die Kohlekonzentration kaum *Einfluß*.

n.b.: *haben* is avoided in 62% of all cases.

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As the results show, there is a clear trend towards the use of other verbs, both main and auxiliary verbs, in German, and *haben* is avoided in 62% of all cases. Certainly, the selection of the respective verbs depends on the semantic clausal or sentential co-text. In this context, 'secondary subjectification' (of which there are two instances) (4.3) has a decisive impact on translation solutions and results in considerable structural shifts at the syntactic level, as in the example under i). It is interesting to note that there is a certain redundancy in the structure, *to have the potential to allow*, which may be paraphrased by *can allow*, because *allow* already contains the meaning of 'enablement', so that it may also be argued that equivalence for the structure *has the potential to* has been achieved by a 1:0-correspondence in the TT.

German *sein* involving further class shifts (e.g., noun to adjective) may also be the key to equivalence, e.g., "X can have an economic advantage" - "X kann wirtschaftlich vorteilhaft sein". The repetitively used expression *to have an effect/impact on*, was alternately rendered by *Auswirkungen/Einfluß haben auf* and by the reflexive verb *sich auswirken auf*. This shows how register aspects, viz., avoidance of tedious repetition, in the TL come into play and govern the selection of lexical-semantic units to achieve both semantic and overall textual equivalence.

For the final presentation of the findings, the above two categories and the relevant percentages have been combined. This has not been done for statistical reasons alone, but also for the sake of obtaining an overview of the general textual distribution of *haben* and the other solutions in the TT. Taken together, the figures for 4.1.1.1 and 4.1.1.2 are as follows:

Table 19   Distribution of translation solutions for *have* in SP(have) O_d structure and *have* as part of a 'functional verb structure' (categories 4.1.1.1 and 4.1.1.2)

Haben	**30%**
Others	**70%**

for category 4.1.1.1: e.g., *aufweisen, enthalten* and *sein* and domain knowledge-induced solutions.
for category 4.1.1.2: e.g., other verbs, both main and auxiliary verbs, *sein* involving class shifts

As regards the overall textual distribution of *haben* and the other forms, it can be said that the respective translation solutions have obviously been selected on the basis of both the semantic co-text of the ST and register aspects in the TL. Although

the German TT also shows some degree of repetition as regards the verb *aufweisen*, the register demand for a reduced "monotony of expression" (Reinhardt et al. [3]1992:134) and a higher degree of verbal specificity and versatility, which is brought about by verbs and structures other than *haben*, can be deemed fulfilled.

The above trend is also reflected in the translation solutions for NcI constructions, where the *have* infinitive is preceded by the verbs of assumption *expect* and *project* and which can be paraphrased in such a way that the infinitive *have* becomes a main/finite verb (see Infinitives, 3.1.2.1.4), e.g.:

> [...], coprocessing *is projected to have* a product cost advantage of about $ x/bbl.
> [...] *bietet* Coprocessing *voraussichtlich* einen Herstellungskostenvorteil von ca. $ x/bbl.

This points to the interrelatedness of certain features investigated and aptly corroborates the validity of the translation trend established above.

4.1.2 *Be* and its potential equivalents

As mentioned earlier, *be* accounts for 88% (154 occurrences) of the *have* and *be* category established on the basis of the finite verb forms. The *be* category is divided into several equivalence-relevant sub-categories established on the occurrence of *be* in the corpus. These sub-categories are described and discussed in the following.

4.1.2.1 *Be* with adjectival C_s[9]

This is the largest sub-category and accounts for 41% (63 occurrences) of all *be* counted in the corpus. In 36% of all cases in this category, the adjective is modified by an adverb, e.g., *almost, slightly, significantly*, or comparative, e.g., *less* and *more*, which may lead to considerable shifts in the TT, as the results will show.

The distribution of translation solutions for this category is as follows:

i) *sein* used as main verb in German   **54%**

n.b.: 59% of the translation solutions for the structure investigated
are accounted for by 1:1-correspondences, whereas 41% are accounted for by
additional syntactic and semantic shifts of the structure, e.g., class shifts,
modal-to-nonmodal shifts, 0:1-correspondence to compensate for an
ellipsis in the ST, negated antonyms, etc.

Example:
However, the nitrogen and oxygen results *are more ambiguous* partly due to [...]

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[9] C_s = subject complement

Die Stickstoff- und Sauerstoffergebnisse *sind* jedoch aufgrund ihrer [...] zum Teil *weniger eindeutig*.

ii) Other more specific German verbs   40%

n.b.: 72% of all translation solutions exhibit further
syntactic and semantic shifts.

Example:
While the [...] blend *is slightly inferior* in overall performance compared with the
hydrotreated coprocessing VGO, [...]

Zwar *liegen* die Gesamtergebnisse dieses Gemischs *geringfügig unter* denen des durch
Hydrotreating behandelten Coprocessing-VGOs, [...]

iii) Others   6%

These are 1:0-correspondences for *be* for reasons of cohesion and coherence.

Example:
However, more Ni and V was deposited on the X ebullated bed catalyst when the additive
was not present, indicating that [...]

Ohne Additiv lagerte sich jedoch mehr Ni und V auf dem Wirbelbettkatalysator von X ab,
was darauf hindeutet, daß [...]

n.b.: *sein* **is avoided in 46% of all cases.**

The results show that there is an almost equal share of translation solutions
with German *sein* and other solutions, such as more specific verbs as in the example
under ii) or 1:0-correspondences as in iii) in the search for equivalence at the lexical-
semantic and overall textual levels. Depending on the clausal and sentential semantic
co-text of the ST, the more specific German verbs occurring in the TT are *aufweisen*,
liegen in/unter, *zeigen*, *erzielen*, etc. It is highly interesting to note that 41% of all
translation solutions under i) and 72% of those under ii) exhibit additional syntactic
and semantic shifts in the structure investigated, such as:

be+adv/comp+adj	a) more specific verb+adj+noun
e.g., "fractions are less stable"	"die Fraktionen weisen eine geringere Stabilität auf"
	b) adv+(reflexive)verb
e.g., "to be quite different"	"sich deutlich unterscheiden"
	or negated antonyms see example under i).
be+adj	a) verb
e.g., "to be ready for"	"bereitstehen"
	b) noun+functional verb
e.g., "to be available"	"zur Verfügung stehen"
be+modal adjective	modal auxiliary+verb
e.g., "the use of x is possible"	"x kann verwendet werden"

modal auxiliary+be+adj	*sein* or more specific verb in the indicative
e.g., "X will be proportional to"	"X verhält sich proportional zu"
(see 'regularity' *will* 4.2.5.1.1)	

Most of the above class shifts, e.g., the shift to noun+functional verb in the TL, are due to TL register requirements. As regards the translation solutions under ii), the aspect of 'secondary subjectification' (4.3) came into play in 20% of the cases and led to considerable syntactic and semantic shifts in the TT.

In all cases in the 'Others' category ST redundancy not only led to a 1:0-correspondence for the main verb *be*, but to transposition and modulation involving the elimination of entire subordinate clauses (contingency or relative clauses). In the above example (iii)), the semantics of the contingency clause in the ST is rendered by a preposition+noun in the TT to achieve equivalence. In the following example the semantics of the relative clause is rendered by an adjective, e.g., "molecules that are rich in nitrogen" - "stickstoffreiche Moleküle". All examples in this category show how pragmatic considerations come into play and modify lexical-semantic and syntactic aspects of equivalence. These examples also cast some doubt on the contention that translators *per se* "explicitate" (Baker 1996). On the contrary, they may be fully aware of the need to eliminate ST redundancy in the TL for pragmatic reasons to contribute to cohesion and coherence to achieve overall textual equivalence.

4.1.2.2 *Be* with nominal C₅

This sub-category accounts for 30% (47 occurrences) of all *be* counted in the corpus. In the structure under investigation a state of equality in the mathematical sense may be expressed and/or a definition given. The structure occurs here in what Huddleston (1971:133-140) describes as "intensive intransitive clauses" and "extensive transitive clauses", viz., "equative *be*". While "the intensive construction characterizes the subject", the extensive construction "involves the identification of one term by another" (Huddleston 1971:134). However, as mentioned earlier, this difference in meaning may, but need not, be relevant from the point of view of equivalence for the feature under investigation owing to further co-textual semantic and pragmatic

considerations.[10] Also included in this sub-category are two *that*-clause complements which are treated as nominal complementation.

The distribution of translation solutions for this category is as follows:

i) More specific German verbs   49%
Such as *darstellen, sich handeln um, sich ergeben aus, ausmachen, betragen, liegen bei/auf,* etc. depending on the ST co-textual semantics.

Example:
Based on the data for the two X Y runs, an activation energy of Z kcal/mole was estimated assuming pitch conversion *is* a first order reaction [...]

Anhand der Daten für die beiden X-Y-Versuchsläufe wurde eine Aktivierungsenergie von X kcal/mol geschätzt, wobei unterstellt wird, daß es *sich* bei der Pechumsetzung *um* eine Reaktion erster Ordnung *handelt* [...]

ii) *sein* used as main verb in German   36%
n.b.: 41% of the translation solutions for the structure investigated are accounted for by 1:1-correspondences, whereas 59% are accounted for by additional syntactic and semantic shifts.

Example:
Coprocessing *is* a more expensive upgrading option compared with bitumen upgrading unless bitumen prices exceed $x/bbl.

Coprocessing *ist* als Verarbeitungsweg teurer als die Bitumenveredelung, sofern die Bitumenpreise $ x/bbl nicht übersteigen.

iii) Others   15%
These are 1:0-correspondences for *be* for pragmatic reasons, except for one instance where *be* was rendered by *haben.*

Example:
In this case it was possible to produce a product *which is ≈80% naphtha* from the light gas oil starting material, but [...]

In diesem Fall konnte aus dem leichten Gasöl ein Produkt *mit einem Naphthagehalt von ca. 80%* erzeugt werden, aber [...]

n.b.: *sein* is avoided in 64% of all cases.

As the results show, German *sein* is avoided in 64% of all cases for the structure investigated. 59% of the translation solutions with *sein* exhibit transposition and modulation in producing lexical-semantic equivalence. It is very interesting to note that - as with adjectival complementation - the translation solutions for instances of 'secondary subjectification' (4.3), which account for 22% in this sub-category,

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[10]   Certainly, on the basis of a larger corpus, the categories proposed by Huddleston (1971:133-140) could be investigated separately from an equivalence point of view to establish more precisely potentially different trends in translation solutions.

appear under i), suggesting that this feature gives rise to more specific verbs for the predicate *be* and may involve further transposition and/or modulation in the TL, as in the following example:

The X-Y combination *was the worst performer* because [...]
Die Kombination aus X und Y *schnitt am schlechtesten ab*, da [...]

This instance of personification requires modulation to arrive at a more abstract wording in the TL to achieve equivalence at the lexical-semantic level.

Depending on the sentential co-text, the following more specific German verbs commonly appear in the TT:

darstellen	In those cases in which the subject is identified/explained by something else. E.g., "[...] that x *are* somewhat of a compromise." "[...], daß x eine Art Kompromiß *darstellen*."
sich handeln um	In those cases in which the subject is more specifically defined by the nominal complement, e.g., "It should be noted that these *were* raw samples from the PDU and not [...]" "Dabei ist zu beachten, daß es *sich* um Rohproben aus der PDU und nicht *um* [...] *handelte*."
betragen, ausmachen	in the context of percentages and costs
liegen bei	in the context of prices

As regards the 'Others' category, all examples show how register considerations, such as the requirement of a high noun-based terminological specificity and the trend towards a prepositional solution, here instead of a relative clause (see example under iii)), come into play and modify lexical-semantic and syntactic aspects of equivalence. For reasons of cohesion and coherence, there are further shifts in this category, e.g., supra-sentential solutions in the case of *this*-subjects, which contribute to overall textual equivalence in the TL (see 6.1.2).

The above trend is also reflected in the translation solutions for NcI constructions, where the *be* infinitive is preceded by the verbs of assumption *expect* and *project* and which can be paraphrased in such a way that the infinitive *be* becomes a main/finite verb (for an example see Infinitives, 3.1.2.1.4). This certainly does not exclude solutions with *sein*, although these exhibit additional semantic shifts, as in the following example:

X *are expected to be* acceptable FCC feedstocks.
X *sind voraussichtlich* als Einsatzstoffe für das FCC *geeignet*.

Semantic aspects also govern the selection of a more specific verb in the following example where *be* is the infinitive preceded by the catenative verb *seem* (see Infinitives, 3.1.2.1.1):

> The role of the catalyst *seems to be* predominantly one of coke prevention, [...]
> Der Katalysator *dient offensichtlich* im wesentlichen der Minimierung der Koksbildung, [...]

Similar to the results for category 4.1.1 (*have*), this points to the interrelatedness of certain features investigated and corroborates the validity of the translation trend established above.

4.1.2.3 *Be* with adverbial complementation

This sub-category accounts for 7% (11 occurrences) of all *be* counted in the corpus. In our corpus, the complementing adverbials are predication adjuncts (Quirk et al. [13]1995:16.21, 24), viz., means adjuncts and, most commonly, place adjuncts[11]. The structure under investigation occurs in what Huddleston (1971:133-140) describes as "extensive intransitive clauses". In this context, he claims that "*be* is here replaceable by such clearly extensive verbs as *exist, take place, be situated* and so" (1971:133), an aspect which is reflected in the translation solutions below. He also includes some instances of what Quirk et al. ([13]1995:18.44 ff.) call "existential *there*" in this category.[12] However, since different trends in translation solutions can be expected on syntactic, in particular, and lexical-semantic grounds, "existential *there*" is given separate consideration in this investigation (see 4.1.2.4).

The distribution of translation solutions for the above category is as follows:

i) Other more specific German verbs   82%

Example:
No conclusions could be drawn regarding [...] because the operating conditions selected
were not in the exponential rise portion of the coke yield curve [...]

In bezug auf [...] ließ sich keine Aussage treffen, da die gewählten Betriebsbedingungen
nicht [...] *im exponentiell ansteigenden Bereich der Koksausbeutekurve lagen.*

ii) Others   18%

Example:
Figure 5 compares the results for each of the above catalyst types at high severity operation
[...] except for the molybdenum naphthenate case *which was at 450°C.*

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[11]   "Place" here refers to a "mathematical place", e.g., "X was at or near its upper coking
         propensity temperature limit", "Run [...] is within this allowable operating region", etc.
[12]   For an investigation of *there* see Huddleston (1971:321-326).

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Bild 5 zeigt die mit den o.g. Katalysatortypen unter den folgenden verschärften Betriebsbedingungen erzielten Ergebnisse im Vergleich: [...]mit Ausnahme des Molybdännaphthenats, *das bei 450 °C eingesetzt wurde.*

n.b.: *sein* is avoided in 100% of all cases.

The results show that in 100% of the cases *sein* is avoided and more specific verbs (in the 'Others' category, too) are used in the search for equivalence at the lexical-semantic level. Since place adjuncts of the type mentioned in the example under i) are very commonly used in the corpus, the more specific German verbs are *liegen (in/innerhalb, unter, bei)* and *sich befinden.*

In the 'Others' category, a 1:0-correspondence for *be* may be the key to equivalence in those cases in which the structure under investigation occurs twice in the sentence, but repetition is considered redundant in the TL. In the above example the aspect of 'secondary subjectification' (4.3) led to further modulation, i.e., the shift from abstract to concrete (e.g., 1:0-correspondence for *case*) and the use of a more specific verb in the passive voice.

4.1.2.4 *Be* with "existential *there*" (Quirk et al. [13]1995: 18.44 ff.)

This sub-category accounts for 4% (6 occurrences) of all *be* counted in the corpus. In the structure analyzed, i.e., "there+be+subject(noun)", *there* is the 'grammatical subject' or "dummy mood-subject" in the terminology of Huddleston et al. (1968:85), and the subject of the original clause is the "notional subject" (Quirk et al. [13]1995:18.45) of the *there*-sentence. Unstressed *there* is used by the writer to provide "some kind of dummy theme" which enables the writer "to indicate the 'new' status of a whole clause, including its subject" (Quirk et al. [13]1995:18.44). Since a 1:1-correspondence, viz., *es gibt, es ist*, may sound awkward in most cases, "existential *there*" is often left untranslated. This may, however, lead to considerable shifts to achieve equivalence at the syntactic and lexical-semantic levels, as the results will show.

The distribution of translation solutions for the above category is as follows:

i) 1:0-correspondence for *there+be* 50%
   and shift of 'notional' subject to subject+more specific verb in the TT.

Example:
[...], but *there was some improvement* in terms of decreased Coke Reactivity Index (CRI) and increased X.

Allerdings *wurden gewisse Verbesserungen* in Form eines abnehmenden Koksreaktivitäts-
indexes (CRI) und einer zunehmenden X *verzeichnet.*

ii) 1:0-correspondence for *there+be*   33%
   and shift of 'notional' subject to finite verb in the TT
   and of English object to German subject.

Example:
There is no explanation at this time for the higher coke yields for these two catalyst
precursors compared with [...]

Zur Zeit *lassen sich* die höheren Koksausbeuten bei diesen beiden Vorkatalysatoren
im Vergleich zu [...] noch *nicht erklären.*

iii) Others   17%

Example:
There were several conclusions of interest.

Hieraus konnte man mehrere interessante Schlüsse *ziehen.*

n.b.: *sein* is avoided in 100% of all cases.

All translation solutions exhibit a 1:0-correspondence for the "existential
there+be structure" under investigation as well as considerable shifts at the syntactic
and lexical-semantic levels which shows that the TT does not exhibit any need for this
kind of "dummy theme" to achieve equivalence at the lexical-semantic and overall
textual levels. In fact, retention of this "dummy subject" would counteract
equivalence at these levels. It is very interesting to note that in 66% of all translation
solutions, the more specific German verbs are passives or passive variants, which
shows that register reasons have come to the fore, the passive and its variants being a
typical feature of German scientific and technical discourse (e.g., Reinhardt et al.
[3]1992:128 ff.; Göpferich 1995a:409 ff.).

The example under iii) exhibits not only a 1:0-correspondence for *there+be*,
but introduction of a pronominal adverb (Duden 4, [5]1995:626 ff.), viz., *hieraus*, for
supra-sentential aspects of cohesion and the introduction of impersonal German *man*
as subject, which is a means of 'depersonalization' and a common feature in German
technical discourse (Fluck [2]1997:97).[13]

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[13]   Fluck ([2]1997:97) considers German *man* to be almost a passive variant and explains the
change between *man* and passive constructions as a means of avoiding a too frequent and
stylistically 'unpleasant' repetition.

In 50% of all translation solutions, an implicit modality of the English structure in its sentential co-text - which can be ascertained by verbal paraphrasation in those cases in which the verb has a procedural meaning, as in ii) which can be paraphrased by *x cannot be explained* - is made somewhat more explicit in German by the introduction of passive variants and modal auxiliary *können*. The passive variants in question are *sein+zu*+infinitive and *lassen+sich*+infinitive, which are a frequent feature of German scientific and technical discourse (Fluck [2]1997:98). These passive variants have a modal note in that they can be paraphrased by the modal auxiliary *können* (Duden vol. 9, [4]1997:559-566). All the same, this is not an instance of "explicitation" (Baker 1996), but a good example of the 'non-corresponding availability' of the feature of modality (4.2) in the two languages, translationally informed consideration of which may lead to "equivalence in difference" (Jakobson [1959]1992) at the lexical-semantic level.

The translation trend established above is also reflected in the following example where *be* is the infinitive preceded by the catenative verb *seem* (see Infinitives, 3.1.2.1.1):

Based on these results, *there does not seem to be any need for concern* about how [...]
Anhand dieser Ergebnisse *braucht man sich offensichtlich über [...] keine Gedanken zu machen.*

This example aptly demonstrates the interrelatedness of different translation procedures based on the trends so far established, i.e., class shift of the catenative verb *seem* to an adverb (3.1.2.1.1), 1:0-correspondence for *there+be* and further modulation (viz., introduction of impersonal *man* as subject and German verb *brauchen*) which together contribute to equivalence at the lexical-semantic level.

As regards the results of categories 4.1.2.3 and 4.1.2.4 above, which taken together coincide with what Huddleston (1971:133-140) describes as "extensive intransitive clauses", it is interesting to note that *sein* is completely avoided in the search for equivalence at the lexical-semantic level.

4.1.2.5 *Be* as part of a 'functional verb structure'

Although this sub-category accounts for only 2% (3 occurrences) of all *be* counted in the corpus, it is relevant from an equivalence point of view, as the results will show. The structure under investigation can be paraphrased by a full verb which can be arrived_at by noun-to-verb shifts, e.g., *to be in agreement with - to agree with.*

The distribution of translation solutions for the above category is as follows:

i) Shift of 'functional verb structure' to full verb in German   66%

Example:
The significantly lower sulphur conversion for the X-Y combination *is a reflection of* the higher initial sulphur content of the Z feedstock since [...]

Der deutlich geringere Schwefelumsatz bei der X-Y-Kombination *spiegelt* den höheren Ausgangsschwefelgehalt des Z-Einsatzmaterials *wider*, da [...]

ii) Others   34%

As the figures show, there is a clear trend towards a verbal shift in the TL. As regards the 'Others' category, *be* is rendered in all instances by a more specific verb in German involving maintenance of the structure itself, e.g., *to be in good agreement - eine gute Übereinstimmung zeigen.*

The investigation of similar functional verb structures including other semantically weak verbs, e.g., *to make* as in *to make a good fit* for *to fit tightly*, on the basis of a very large corpus would be an interesting aspect of further research to underpin the unsystematicness established above in the search for equivalence at the lexical-semantic level.

4.1.2.6 *Be* after pseudo-subject *it*

This accounts for 5% (8 occurrences) of all *be* counted in the corpus. Of this, pseudo-subject *it*+be+adjective(possible)+infinitive accounts for 75% of all pseudo-subject *it*+be* cases in the corpus. The translation trend established for these instances is discussed under 3.1.2.1.2. The remaining 25% are accounted for by adverbial or *that*-clause complementation after the adjective (see examples below). Only in 12% of all pseudo-subject *it*+be* cases was the structure maintained in translation involving the use of *sein*, whereas in 88% of the cases pseudo-subject *it*+be* was eliminated in translation and the complement was class-shifted involving further shifts at the syntactic and lexical-semantic levels. As discussed under Infinitives, 3.1.2.1.2, pseudo-subject *it*+be+modal adj. *(possible)* was rendered by modal auxiliary *können*, and in the following examples the structure is either shifted to a verb, example a), or rendered by an adverb, example b):

a)   It is clear from Fig. 13 [...]   Aus Bild 13 geht hervor [...]
b)   it is possible that   möglicherweise

-

The result shows a clear trend (88%) to avoid pseudo-subject *it+be* to achieve equivalence at the lexical-semantic level.

4.1.2.7 Stock phrases with *be*

Stock phrases are understood here to mean expressions which are more or less stereotypes in certain types of scientific and technical discourse, such as *to be due to*, which do not offer much choice as regards their translation. These stock phrases account for 6% (9 occurrences) of all *be* in the corpus. Translation solutions with *sein* account for 78% of all cases and other solutions for 22%. The expression *to be due to* which is the most frequent form of the stock phrases counted in the corpus was commonly translated by the infinitival constructions *zurückzuführen sein auf* or *sich zurückführen lassen auf*, with both TL forms being passive variants with a modal note (Fluck [2]1997:98).

> Example:
> The same results were duplicated using another X catalyst and *may be due to* the transition from one type of catalytic site to another.
>
> Die gleichen Ergebnisse wurden mit einem anderen X-Katalysator wiederholt und *lassen sich möglicherweise* auf den Übergang von einer katalytisch aktiven Stelle auf eine andere *zurückführen*.

The implicit modality of *to be due to* is rendered by two infinitival constructions with a modal note in the TL. The fact that two different infinitive constructions are used is due to the TL register aspect requiring avoidance of tedious repetition in the TL. Both constructions contribute to TL lexical-semantic and textual equivalence. The explicit modality in the above example expressed by 'uncertainty' *may* is rendered by a modal adverb in the TT (see 4.2.1.1.1).

4.1.2.8 Subject+*be*+explicit indicator of apposition (Quirk et al. [13]1995: 17.73) or colon

In this category, which accounts for 5% (7 occurrences) of all *be* in the corpus, *subject+be* is followed by an explicit indicator of apposition (Quirk et al. [13]1995:17.73), e.g., *X is as follows*, or just a colon, e.g., *Major conclusions are:*. In 100% of the cases, equivalence is achieved by more specific, and for register reasons, different verbs in German plus the occasional 0:1-correspondence, viz., introduction

of an indicator of apposition, which is required in German, because it contributes to cohesion and hence to overall textual equivalence, e.g.:

Major conclusions *are*:   Die Hauptergebnisse *lauten wie folgt/sehen wie folgt aus*: another potential equivalent could be *sich darstellen*

The category under investigation aptly demonstrates how lexical-semantic and pragmatic aspects coincide to achieve equivalence at the lexical-semantic and overall textual levels.

For a final presentation of the findings, the above categories and percentages for *be* used as main verb with copular function have been combined. The statistical overview for category 4.1.2, viz., *be* and its potential equivalents, is as follows:

Table 20   Distribution of translation solutions for *be* used as main verb (category 4.1.2)

Sein	**38%**
Others	**62%**

4.1.3   Summary of this section

The results for the individual *have* and *be* categories investigated in this section are summarized in the following:

Table 21   Distribution of translation solutions for *have* in SP$_{(have)}$O$_d$ structure (category 4.1.1.1)

Trend towards more specific verbs, e.g., *aufweisen, enthalten*, etc.   58%
(*haben* 25% and 'Others', e.g., *sein* or domain knowledge-induced shifts, 17%)

Table 22   Distribution of translation solutions for *have* as part of a 'functional verb structure' (category 4.1.1.2)

Trend towards 'functional verb structure' to verb shifts, both full and auxiliary verbs, and also *sein* involving class shifts   62%
(*haben* 38%)

Table 23   Distribution of translation solutions for *have* used as main verb (category 4.1.1)

haben 30%   Others 70%

The above results show a clear trend towards the use of other verbs in the TL. Although these verbs still belong to what Pörksen (1986:188) calls 'pallid' verbs, which are a typical feature of German scientific and technical discourse, they are more specific in denoting content (Jumpelt 1961:73) than German *haben*, so that they contribute to equivalence at the lexical-semantic level. The fact that the use of more specific German verbs at the same time involves different verbs also fulfils the register aspect requiring avoidance of monotonous repetition of one and the same verb in the TL, so that it also contributes to overall textual equivalence.

Table 24 Distribution of translation solutions for *be* with adjectival C,
(category 4.1.2.1)

Trend towards an almost equal share of German *sein*, 54%, and more specific verbs, 40%, and other solutions, 6%.

n.b.: 41% of the translation solutions with *sein* exhibit additional
transposition and modulation, as do 72% in the case of more specific verbs. 100% of the cases in the 'Others' category exhibit 1:0-correspondence for *be* involving considerable unit shifts.

Table 25 Distribution of translation solutions for *be* with nominal C,
(category 4.1.2.2)

Trend towards more specific German verbs, 49%, e.g., *darstellen*, *sich handeln um*, *sich ergeben aus*, *ausmachen*, etc. Other solutions, e.g., 1:0-correspondence plus considerable structure and unit shifts, 15%. *Sein* 36%. n.b.: 59% of the solutions with *sein* exhibit additional transposition and modulation.

The results for categories 4.1.2.1 and 4.1.2.2 point to a higher verbal versatility and specificity at the TT lexical-semantic level which is in line with TL register requirements. It should be noted that the translation solutions in both categories frequently exhibit further transposition and modulation, e.g., in the case of 'secondary subjectification' (4.3), but also register-induced shifts, as in the case of a ST relative clause with predicate *be*+noun, which is shifted to a TT prepositional phrase with a 1:0-correspondence for *be* (see example iii) under 4.1.2.2 and the trends established for reduced relative clauses in 3.2.1.1.1 and 3.3.1.1.1) to contribute to TT cohesion and coherence and to achieve overall textual equivalence.

Table 26 Distribution of translation solutions for *be* with adverbial complementation (category 4.1.2.3)

Trend towards more specific German verbs   82%

('Others': 18%, e.g., 1:0-correspondence for *be* or more specific verb+modulation) n.b.: *sein* is avoided in 100% of all cases.

Table 27   Distribution of translation solutions for *be* with "existential *there*"
(category 4.1.2.4)

Trend towards 1:0-correspondence for *there+be* and shift of 'notional' subject to subject+more specific verb in the TT, 50%, or shift of 'notional subject' to finite verb in the TT and of E object to G subject, 33%, ('Others': 17%). n.b.: *sein* is avoided in 100% of all cases.

As regards the results of categories 4.1.2.3 and 4.1.2.4 above, which taken together coincide with what Huddleston (1971:133-140) describes as "extensive intransitive clauses", it is interesting to note that *sein* is avoided in 100% of all cases, but more specific verbs are used in the search for equivalence at the lexical-semantic level. In the case of category 4.1.2.4, there is a clear trend (100%) towards a 1:0-correspondence for "existential *there*"+*be* involving more specific verbs in German and further shifts to achieve equivalence at the syntactic and lexical-semantic levels.

Table 28   Distribution of translation solutions for *be* as part of a 'functional verb structure' (category 4.1.2.5)

Trend towards shift of 'functional verb structure' to full verb   66% ('Others' 34%, *be* is rendered by more specific verbs)

The results show a clear trend towards a full verb in German (66%) for this kind of English 'functional verb structure'. However, due to the very low frequency of *be* in this structure in the corpus, further research into this highly equivalence relevant aspect would have to be carried out on the basis of a much larger corpus including other neutral verbs occurring in similar structures, such as *make*, to underpin this trend.

Table 29   Distribution of translation solutions for *be* after pseudo-subject *it* (category 4.1.2.6)

Trend towards 1:0-correspondence for pseudo-subject *it+be*, 88%, and class shift of the adjectival complement to verb or adverb ('Others' 12%)

As mentioned already under Infinitives (3.1.2.1.2), considerable structure and class shifts occur in translation involving 1:0-correspondence for pseudo-subject *it+be* (88%) to achieve equivalence at the syntactic and lexical-semantic levels.

**Table 30   Distribution of translation solutions for stock phrases with *be*
(category 4.1.2.7)**

Trend towards translation solutions with *sein* ('Others' 22%)	78%

With stock phrases, here especially *to be due to*, there is a clear trend towards translation solutions with *sein* (78%). However, for semantic and register reasons other verbs may contribute to lexical-semantic and overall textual equivalence (22%).

Table 31   Distribution of translation solutions for subject+*be*+explicit indicator of apposition or colon (category 4.1.2.8)

Trend towards more specific verbs and 0:1-correspondence, 100%, viz., introduction of an indicator of apposition in German.

The result for this category shows that *sein* is avoided in 100% of all cases and how more specific verbs and the introduction of an indicator of apposition in German contribute to lexical-semantic and overall textual equivalence.

The investigation shows a clear trend towards more specific German verbs and other translation solutions in the search for equivalence in translating English *have* and *be* used as main verbs. As regards *have*, more specific verbs and other solutions account for 70%, whereas *haben* only accounts for 30%. As regards *be*, which is the most frequent of the two verbs, there is also a clear trend towards more specific verbs (46%) and other translation solutions (16%) which account for 62%, whereas *sein* accounts for 38%. Since *be* is not only the "most central" and the "most common" copular verb, but also the "most neutral" one in meaning (Quirk et al. [13]1995:16.23), consideration of the semantics of the complement and of the clausal and sentential co-text plays a pivotal role in achieving lexical-semantic equivalence in translation, as has been shown in the discussion of the above categories. The above categorization shows the importance of structural aspects, too, in the investigation of *be* as main verb suggesting that specific structures lead to specific trends in translation solutions, e.g., the unequivocal translation trends established with *be* after pseudo-subject *it* (4.1.2.6) or *be* with "existential *there*" (4.1.2.4).

Although syntactic and semantic aspects of equivalence may coincide, the above discussion has also shown how the latter take priority over the former in the search for equivalence. Both aspects may be governed and modified by pragmatic considerations, here above all register aspects, which may, for example, lead to 1:0-correspondences for *be* and further shifts, e.g., to eliminate redundancy, for reasons of cohesion and coherence to achieve overall textual equivalence.

The findings also point to an interrelatedness of certain features investigated, e.g., certain infinitive constructions (3.1.2.1.1, 3.1.2.1.4), which can be paraphrased in such a way that *have* and *be* infinitives become main/finite verbs, so that the translation trends established above may be applicable in these instances, too. This also implies the interrelatedness of what superficially may be deemed isolated translation procedures.

Jumpelt's statement (1961:73) that the two verbs *have* and *be* have to be rendered more specifically in indicating content in German has now been underpinned on a corpus basis. Moreover, the methodological framework applied enables us not only to establish what these specific verbs are, but also to bring to light the nature and extent of transposition and modulation required to achieve equivalence at the lexical-semantic level for the relevant structure analyzed, and to establish how this level may be influenced and modified by pragmatic aspects, as reflected in most of the other translation solutions. The verbs in question - though more specific than German *haben* oder *sein* - still belong to what Pörksen calls 'pallid' verbs, which are a typical feature of German scientific discourse (Pörksen 1986:188). The established textual distribution of *haben* and *sein*, more specific verbs and expressions as well as other translation solutions discussed in the respective categories also fulfils the TL register requirement of a higher degree of verbal specificity, versatility and formality and hence contributes to overall textual equivalence.

The investigation of *have* and *be* on the basis of a very large corpus and involving further equivalence-relevant sub-categorization would be a fruitful area of further research.

4.2 English modal auxiliaries and their German potential equivalents

Although there have been many studies of German and English modal auxiliaries, most of them have been monolingual and LGP related.[14] More recently, Gutknecht and Rölle (1996) undertook a "contrastive or translational study of the modals" (1996:6), which provides enlightening insights into their semantic dimensions in an LGP setting. However, their study involves only isolated sentences and is not based on an ST-TT pair in context. For a study to be truly translational and above all equivalence-relevant, a text-in-context-based investigation is an indispensable prerequisite (see Introduction) for an account of the semantic and pragmatic aspects of modality in translation.[15] Even more recently, further monolingual research into modality in LSP texts has been carried out (Gotti and Dossena 2001), concentrating on legal, economic, academic and medical discourse.[16]

Although the term 'modality' may be defined in different ways, i.e., in a narrower or wider sense (see, e.g., McArthur 1992:664-665), the present study concentrates on 'modal auxiliaries', because they are a common feature of scientific discourse (see the studies quoted below) and because they are of particular importance for equivalence in translation due to their intricacies from a semantic and pragmatic point of view. Certainly, a more comprehensive corpus-based study covering, e.g., modal expressions such as modal adjectives or adverbs, would be a fruitful area for further research, but such an investigation would go beyond the scope of this thesis.[17] However, due to their frequency of occurrence in the corpus and their relevance to translation, some modal infinitive constructions have been investigated under 3.1.2.1.

Although some monolingual English and German studies exist in the scientific and technical language field, such as Barber (1962), Huddleston (1971), Gerbert (1970), Beier (1977), Sager et al. (1980), Meyer (1989) and more recently Hyland

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[14]   Cf. Gutknecht and Rölle (1996) for a comprehensive bibliographical overview.

[15]   We think that in monolingual research, too, modals should be investigated on the basis of complete texts-in-contexts which should represent one specific genre and subject field, rather than isolating sentences from text fragments (as, e.g., in Meyer 1989:128) or looking at different genres and fields, to take account of their *parole* setting.

[16]   Two articles in the book cited also include technical discourse. Heller (2001) investigates modality in DIN standards and Hyland (2001) 'hedges' and 'boosters' in academic argument. However, since the corpora used by these authors either include DIN standards only (Heller 2001) or texts from various disciplines (Hyland 2001) and since their counting modes are not based on a finite verb count, their figures cannot be used for any comparison.

[17]   For an investigation of hedging in LSP discourse see Hyland (1998). For a more recent discussion of the concept of hedging see Schröder (1998).

(1998)[18] for English, with Huddleston offering the most detailed study, and, e.g., Beneš (1981), Köhler (1981), and Fluck ([2]1997) for German, no comprehensive contrastive or translational studies are available on this subject. The monolingual studies in question show that the restrictive character of LSP also manifests itself in the area of the modal auxiliaries in terms of, e.g., frequency of occurrence or kinds of modality, and these findings are, of course, relevant from an equivalence point of view. It should be pointed out that, especially in the context of the modal auxiliaries in scientific discourse, "there are no generally accepted criteria or common terminology for defining their use" (Sager et al. 1980:210). Definitions and labels also vary widely on the subject of modality in general language discourse (cf. Gutknecht and Rölle 1996). For the purpose of this examination, recourse is had to generally accepted terminology (Quirk et al. [13]1995:4.49 ff.), although for text typological reasons, the terms 'objective and subjective modality' as proposed by Rathay (1984), who investigates some pragmatic aspects in the use of English modals, and as used by Meyer (1989) in an investigation of modals in scientific discourse, will be employed, even if a clear-cut distinction between the two is not always feasible or necessary from an equivalence point of view (see 'past tense' modals, e.g., 4.2.3). According to Rathay (1984:113), "objective modality" refers to the "propositional content" (i.e., it specifies the way entities and phenomena exist), while "subjective modality" refers to the speaker's attitude to the propositional content. Thirdly, the modal may also be used to refer to the speaker-addressee relation, i.e., to convey the intentions of the speaker. In this case, the modal has a "specific illocutionary function". Meyer (1989:127) hypothesizes "that in scientific discourse objective modality may play a more important role than is observed in the general use of language". While this hypothesis may certainly prove true for some genres, there may be others in which more intensive use is made of "subjective modality" for various reasons, as we will see in the following examination.

In our ST, as many as 21% of the finite verbs (138 occurrences) are accompanied by a modal auxiliary[19] (cf. 17% in Huddleston's corpus 1971:297 and

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[18] Hyland (1998) is a monolingual corpus-based study of hedging in scientific research articles "in the field of cell and molecular biology [...] consisting of 75,000 words" (op. cit.:96), the modal auxiliaries being one of several hedging devices examined (op. cit.:105-119).

[19] The counting mode includes one elliptic use of *can*, two elliptic uses of *could*, and one

16% in Barber's corpus 1962:29). The distribution of the modals found is shown in the following table:

Table 32   Distribution of modal auxiliaries in the English ST

(Percentages calculated on the basis of the finite verb forms)	percentage	occurrences
may	4%	5
might	4%	5
can	15%	21
could	17%	23
will	4%	5
would	38%	53
should	5%	7
must (+ have to/had to), need	4%	6
be	9%	13
	100%	138

The figures show that the "central modals" (Quirk et al. [13]1995:3.39 ff.), *can/could, may/might, will/would, should*[20] and *must* are much more frequent in this type of discourse than "marginal modals" - of these only *need* occurs - or "semi-auxiliaries", such as *have to* (cf. also Barber 1962:29; Beier 1977:83 and Huddleston 1971:297). However, a comparison of the figures for these "central modals" with other LSP studies does reveal a very significant distinguishing feature of difference. Whereas *may* and *can* are the most frequent modals in the studies by Barber (1962:29) and Huddleston (1977:297),[21] there is a very clear lead for *would* (38%) in our corpus. Although this aspect will be discussed in greater detail in the relevant section on *will/would* (see 4.2.5 ff.), it is worth mentioning here that the high frequency of *would* in the hypothetical mode can be attributed to the fact that the experimental runs described in the research report under analysis were carried out with a view to establishing the technical and economic feasibility of a particular process on a commercial scale. Since the report analyzed is the final report on a 3-year R&D programme, which is expected to provide some basic data serving to evaluate with confidence the suitability of the process for a further scale-up, the author uses hypothetical *would* as a built-in safety margin to tone down the absoluteness of

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elliptic use of *would*. These elliptic uses are reflected in corresponding elliptic uses in the TT.

[20]   *shall* does not occur in the corpus investigated.

[21]   Barber (1962:29) mentions 38% for *can*, 35% for *may*, 1.7% for *could*, 0.7% for *might* and 3.5% for *would*. Huddleston (1971:297) furnishes the following figures: 27% for *may/might*, 36% for *can/could* and 22% for *will/would*.

statements and conclusions. This is certainly also true of some of the other "surface past tense" (Huddleston 1971:294-314) modals in the corpus, i.e., *might*, *could* and *should*. The uses of these modals, which will be discussed in the relevant sections, differ from their nonpast counterparts, the modal-temporal ambiguity being one of the most intricate problems in the search for equivalence. However, for easy reference, they will be grouped in pairs in what follows:

4.2.1 *May* and *might* and their German potential equivalents

In the ST analyzed, *may* and *might* account for only 8% (10 occurrences) of all modals, i.e., *may* for 4% (5 occurrences) and *might* for 4% (5 occurrences), (as against, e.g., *may* for 35% and *might* for 0.7% in Barber 1962: 29, and 27% (*may* for 24% plus *might* for 3%) in Huddleston 1971:297).

4.2.1.1 *May* and its potential equivalents

As Huddleston (1971:297-305) and Meyer (1989) have shown, *may* is often used in scientific discourse in its "objective" or "root possibility" sense and in some of its uses is replaceable by *can* (cf. also Quirk [13]1995:4.53), e.g.:

> Energy *may* be defined as the capacity for performing work. (Meyer 1989:130)

This situation is somewhat different in our corpus, as the following investigation will show.

4.2.1.1.1   'Uncertainty' *may*

80% of all instances of *may* express a certain degree of uncertainty both on the part of the author and in the nature of scientific and technical processes and events, etc. A clear-cut distinction between author-inherent and process-inherent uncertainty is not always feasible, nor necessary from an equivalence point of view, because it is hypothesized on an empirical basis that all instances of *may* that cannot be replaced by *can* yield similar translation solutions (i.e., modal adverbs) in the TL. For the purpose of this investigation, this category, therefore, is called 'uncertainty' *may* (cf. "epistemic possibility" *may* (Quirk et al. [13]1995:4.53) in LGP use, and "subjective modality" *may* (Meyer 1989:132) and "Uncertainty (possibility)" *may* (Huddleston 1971:300) in LSP use). According to Swales (1971:34), *may* has a probability of 20-

40%. The distribution of translation solutions for 'uncertainty' *may* in the present corpus is as follows:

i) Modal-to-adverb class shift   100%

Example:
At present, this *may* be the most economical route for their disposal assuming that landfilling is not available for environmental or other reasons.

Zur Zeit ist dieses Verfahren *vermutlich* der wirtschaftlichste Weg für eine Rückstandsentsorgung, falls eine Deponierung aus umweltschutztechnischen oder anderen Gründen nicht in Betracht kommt.

As the result shows, modal adverbs are the key to equivalence at the semantic level in the TL for the modals analyzed. These "modal particles" (Beneš 1981:198), e.g., "*angeblich, anscheinend, vermutlich, offensichtlich* [...]", are typical representatives of modality in German scientific discourse. They denote the author's attitude towards the statements made (Fluck [2]1997:103), e.g., possibility, supposition, doubt, etc. The result also correlates with LGP findings on epistemic modality, suggesting that this kind of modality which is preferably expressed by modals in English, is expressed by modal adverbs in German (Gutknecht and Rölle (1996) quoting Edmondson et al. 1977). The modal adverbs found in the TT are *möglicherweise* to express possibility/probability and *vermutlich* to express supposition, with the former being more frequent.

It should be noted in this context that in two instances *may* occurs in subordinate clauses, with the main clause containing a verb or an impersonal construction expressing an uncertainty, e.g., *suppose, it is possible that*, which may have triggered the use of *may*. In these instances, it can be argued that *may* is rendered by a 1:0-correspondence in translation, however, with the modal element of the proposition being maintained, e.g., by rendering the above impersonal modal construction by a modal adverb in the TL, as in the following example:

Since the amount of insoluble matter increased with coal concentration, *it is possible that* some of the residuum molecules that are rich in nitrogen *may have been included* with the insoluble material.

Da die Menge unlöslicher Bestandteile mit der Kohlekonzentration zunahm, *wurden möglicherweise* einige der stickstoffreichen Moleküle des Rückstands im unlöslichen Material *eingeschlossen*.

Here, the adverb *möglicherweise* is the potential equivalent of *it is possible* rather than the modal *may* in its perfective form.

4.2.1.1.2   'Rhetorical' *may*

The remaining 20% of *may* denote a special rhetorical function within the context of the author-reader relation, i.e., that of a "representative speech act" (Rathay 1984:114),[22] implying a polite request/information by mentioning in a more formal way what the reader *can* do, e.g.:

i) Nonmodal impersonal construction   **100%**

Example:
The reader *may* select any project or research element for more detailed review by referring to the appropriate consortium reports.

Für eingehendere Erläuterungen zu bestimmten Projekten und Forschungselementen *wird* auf die entsprechenden Konsortiumsberichte *verwiesen*.

In this case, equivalence at the semantic level is governed and modified by pragmatic aspects, i.e., register considerations, which have led to an impersonal sentence construction with a nonmodal passive predicate, involving considerable transposition and modulation. German scientific and technical discourse, which - certainly in the case of the genre investigated - is characterized by an "impersonal style" (cf. Göpferich 1995a:371-380), would avoid any such reference to the reader.[23]

Table 33   Distribution of translation solutions for 'uncertainty' *may* and 'rhetorical' may (categories 4.2.1.1.1 and 4.2.1.1.2)

E: 'uncertainty' *may*	G: modal adverbs, e.g., *möglicherweise*, *vermutlich* (100%)
E: 'rhetorical' *may* (e.g., The reader may select [...])	G: nonmodal impersonal construction (100%)

The investigation of *may* on the basis of a larger corpus involving further contextually informed sub-categorization would be a particularly promising area for

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[22]   According to Rathay (1984:114) "representative speech acts" convey permission, request or recommendation.

[23]   "Personen-Einbezug", i.e., reference to/inclusion of author or reader, may, of course, be genre-dependent in both English and German technical discourse (cf. Göpferich 1995a:371-380).

further research to investigate its semantic complexities and uses in scientific and technical texts from an equivalence point of view.

4.2.1.2 *Might* and its potential equivalents

Might accounts for 4% (5 occurrences) of all modals in the corpus. As Quirk et al. ([13]1995:4.61) rightly claim, "on the whole, *might* and *should* do not act as the 'past time' equivalents of *may* and *shall*". Like 'hypothetical' *could* (4.2.4.2.3), *might* expresses a low degree of certainty or probability ("5-20% probability" according to Swales 1971:34) or supposition. However, *might*, when used in subordinate clauses, may also express "present relative to a past axis" (Huddleston 1971:302) and has to be distinguished from 'hypothetical' *might* on equivalence grounds - although it must be stressed that a clear-cut distinction is not always feasible due to modal-temporal ambiguity. However, contextual inference may help determine the aspect which is to be given priority in translation.

'Present relative to past axis' *might* accounts for 40% and 'hypothetical' *might* for 60% of all instances of *might* in the corpus. The results for the two categories are given in the following:

4.2.1.2.1   'Present relative to past axis' *might*

This *might* accounts for 40% of all instances of *might* in the corpus. In these instances, the use of *might* in the subordinate clause is triggered by the past tense use in the main clause (sequence of tenses in English). It can be said in this context that *might* is the past tense form of 'uncertainty' *may* (see 4.2.1.1.1 above). The distribution of translation solutions for *might* is as follows:

i) **German modal adjective, e.g., *möglich*** 50%

Example:
The mode of coal drying was studied to determine how it *might* influence process performance, particularly process operability.

Das Kohletrocknungsverfahren wurde mit dem Ziel untersucht, seinen *möglichen* Einfluß auf das Leistungsverhalten des Verfahrens, insbesondere seine betriebstechnische Einsetzbarkeit, zu ermitteln.

ii) **German modal *können*** 50%

Example:
Finally, a fundamental investigation of X showed how a greater understanding of Y
might lead to better processing concepts [...]

Zu guter Letzt ging aus einer grundlegenden Untersuchung der X hervor, wie durch eine
bessere Kenntnis der Y die Verfahrenskonzepte verbessert werden *können*.

The results show an even distribution between modal adjective, e.g., *möglich*, and modal *können*. In one instance the adverbial expression *u. U. (unter Umständen)* was added. In view of the somewhat 'noncommittal' tone of this report as regards the comments on the findings, the translator obviously considered it necessary to stress the modal component of a supposition with lower probability inherent in a particular case of *might*, when viewed against the background of the entire text-in-context, by adding the modal adverbial expression *u. U.* as another "hedging device" (Clyne 1991) to achieve equivalence at the overall textual level. It is interesting to note that German here favours the present tense in the subordinate clause.

4.2.1.2.2 'Hypothetical' *might*

This *might* accounts for 60% of all instances of *might* in the corpus. In all instances, *might* expresses supposition as regards an 'unreal' world (see f.n. 29). The distribution of translation solutions for 'hypothetical' *might* is as follows:

i) Past subjunctive (with or without *u.U.*)   67%

Example:
Where the pitch product has an inherent economic value or alternatively, where it can be
disposed of very cheaply, operation at high reactor throughputs *might* make
economic sense.

In den Fällen, wo das Pechprodukt einen inhärenten wirtschaftlichen Wert aufweist
oder wo es sich sehr kostengünstig entsorgen läßt, *dürfte* ein Betrieb bei
hohen Reaktordurchsätzen, wirtschaftlich gesehen, sinnvoll sein.

ii) Others, e.g., adjective   33%

Example:
A separate economic analysis would clearly show *how much might be saved*.

Aus einer separaten Wirtschaftlichkeitsanalyse dürfte *der Betrag der möglichen
Einsparungen* eindeutig hervorgehen, [...]

There is a trend towards past subjunctive in German to achieve equivalence at the lexical-semantic level. German past subjunctive is used to express irreality and potentiality with regard to 'unreal' worlds (Duden vol. 4, [5]1995:280 ff.). The German adjective *möglich* for *might* in the example under ii) is the result of transposition to achieve the nominalization required for TL register reasons, which shows how pragmatic aspects come into play and modify both the syntactic and lexical aspects of equivalence.

For ease of reference, the results for *might* will be summarized as follows:

Table 34   Distribution of translation solutions for 'present relative to past axis' *might* and 'hypothetical' *might* (categories 4.2.1.2.1 and 4.2.1.2.2)

E:	'present relative to past axis' *might*	G: modal adjective (50%) modal *können* (50%) (present tense/plus the occasional *u.U.*)
E:	'hypothetical' *might*	G: past subjunctive (with or without *u.U.*) (67%) Others, e.g., adjective (33%)

Due to the low frequency of *may* and *might* in the ST investigated, more research would be desirable on the basis of a larger corpus to establish further potential equivalents and underpin the above findings.

4.2.2   The modals of necessity *must* (*have to/had to*) and *need*,[24] and their potential equivalents

From an equivalence point of view and due to their very close semantic relationship (cf. also Quirk et al. [13]1995:4.55), these modals of necessity have been categorized together. In the ST analyzed, *must* (*have to/had to*) accounts for 3% (5 occurrences) and *need* for 1% (1 occurrence) (as against, e.g., 16% (*must* only) in Barber 1962:29, and 7% (*must* only) in Huddleston 1971:297). All of these modals express a "ROOT NECESSITY meaning" (Quirk et al. [13]1995:4.54) or an "objective necessity which either is inherent in the object of research itself or leads to a specific kind of action" (Meyer 1989:131). According to Beier (1977:87), *must* refers to "unabdingbare

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[24]   Although *need* and *have to* are - strictly speaking - "quasi-modals" (Quirk et al. [13]1995:4.55), they will be subsumed under 'modals' in this category for the purpose of this investigation.

Notwendigkeiten" ("indispensable necessities"). In terms of Huddleston's terminology, the above modals express a "logical necessity, conclusion" (Huddleston 1971:311-313), with some of them involving a conditional element in the sentential co-text in which they occur ("conditional *must*") (Huddleston 1971:312).

The distribution of translation solutions for the above modals of necessity is as follows:

i) German modal *müssen* (present tense, past tense, past subjunctive) 100%

Example:
To achieve equivalent pitch conversion levels the bench-scale CSTR unit *must* be operated at about a 5°C higher reactor temperature.

Um gleichwertige Pechumsätze zu erzielen, *muß* die CSTR-Laboranlage bei einer um etwa 5 °C höheren Reaktortemperatur betrieben werden.

As the result shows, German modal *müssen* is the key to equivalence at the semantic level for the modals of necessity under analysis. *Müssen* is the second most frequent modal (after *können*) in German scientific and technical discourse (e.g., Köhler 1981), with its main meaning being "necessity" (Duden vol. 4, [5]1995:161). The modal construction *sein+zu+*infinitive, which can denote a possibility or necessity, i.e., it may be a *müssen* variant (Duden 4, [5]1995:187), is not used. This may be due to the fact that it mainly expresses the modality of *können* (possibility) and, in a less frequent use, simultaneously implies both *müssen* and *sollen* and is therefore used for directives in German scientific and technical discourse (Beneš 1981:199).

The translation trend for the modals of necessity can be summarized as follows:

Table 35 Distribution of translation solutions for modals of necessity (category 4.2.2)

E: modals of necessity, i.e., *must* (*have to*/*had to*), *need*
G: modal of necessity, i.e., *müssen*   (100%)

There were no instances of 'rhetorical' *must* in the corpus.[25]

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[25]   The following is an example of 'rhetorical' *must* taken from Meyer (1989:133): "It *must* be remembered that the materials of highest permeability [...] saturate in quite weak fields."

4.2.3 *Should* and its potential equivalents

In our corpus, *should* accounts for 5% (7 occurrences) of all modals (as against, e.g., 4.5% in Barber 1962: 29, and 6% (*should* 4% plus *shall* 2%) in Huddleston 1971:297). *Shall* does not occur in the present corpus. From a semantic point of view it is important to note that "on the whole, *might* and *should* do not act as the 'past time' equivalents of *may* and *shall*" (Quirk et al. [13]1995:4.61) (see *might* 4.2.1.2). *Should* can have different meanings in different uses in scientific and technical discourse which may be relevant from an equivalence point of view. It can express "obligation" and "logical expectation", with *should* expressing "a weaker element of compulsion/necessity than *must*" (Huddleston 1971:310), as well as "recommendations or specifications", "instruction or stipulation", and can be used instead of the subjunctive (Sager et al. 1980:211-212) and instead of "tentative *would*" in the first person form (Huddleston 1971:310). Meyer (1989:131-132) defines two uses of *should* in his corpus, i.e., "a necessity which is expected to exist according to logic or in terms of a theoretical model" and an "ethical necessity in terms of generally accepted principles and standards of scientific work which the author refers to in order to motivate a certain mode of action", e.g., "It *should* be noted that [...]". Meyer (1989:131-132) classifies *should*, though not without hesitation, as "objective modality",[26] which is open to debate, but in the case of equivalence is less relevant than the individual use of *should* in its specific co-text and context.

In the ST analyzed there are three uses of *should*, i.e., 'logical expectation', 'recommendation/advisability' and 'rhetorical' *should*, which lead to different translation options, as the results will show. 'Logical expectation' and 'recommendation/advisability'[27] can be regarded as the result of a "tentative inference", i.e., "the speaker does not know if his statement is true, but tentatively concludes that it is true, on the basis of whatever he knows" (Quirk et al. [13]1995:4.56). In the context of the present corpus this means that an inference is

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[26] "It is difficult to decide whether also the two kinds of necessity expressed by *should* belong to the realm of objective modality. Both of them appear to be closely connected with human thinking and human attitude. However, in order to evaluate a certain conclusion as logical and convincing or a certain mode of action as compelling and unavoidable, the author appeals to a body of logical or ethical principles which are looked upon as a kind of objective authority [...]" (Meyer 1989:132).

[27] Gutknecht and Rölle (1996:70) refer to advisability as "tentative necessity in the root sense".

made on the basis of the findings obtained on an experimental scale with regard to the applicability of the process under investigation on a commercial scale. This inference translates into an hypothesis, which has not yet been confirmed, but can be modified or rejected.

4.2.3.1 *Should* expressing 'logical expectation'

This use accounts for 43% of all *should* instances. The distribution of translation solutions for *should* is as follows:

i) Past subjunctive of German modal *müssen*   **67%**

Example:
However, based on preliminary work done at X University for Y, about 50-75% removal of solids *should* be possible.

Allerdings geht aus Voruntersuchungen der X University im Auftrag von Y hervor, daß eine Feststoffentfernung von 50 - 75 % möglich sein *müßte*.

ii) Past subjunctive of German modal *dürfen*   **33%**

The result shows that the past subjunctive of *müssen* and to a lesser extent *dürfen* is the key to equivalence at the lexical-semantic level. These past subjunctive forms are used in German, i.a., to express supposition or assumption within a hypothetical setting (Duden, vol 4, [5]1995:283).

4.2.3.2 *Should* expressing recommendation/advisability

This use accounts for 29% of all instances of *should*. It refers to hypothetical circumstances for which a recommendation/advice is given on the basis of state-of-the-art knowledge or nature of things. The distribution of translation solutions for *should* is as follows:

i) Past subjunctive of German modal *sollen*   **100%**

Example:
Due to the nature and low melting point of the low coal residue, it *should* be fed as a liquid rather than a solid to prevent excessive bed elutriation.

Aufgrund der Beschaffenheit und des niedrigen Schmelzpunkts des Rückstands aus dem Einsatzmaterial mit geringer Kohlekonzentration *sollte* dieser in flüssiger und nicht in fester Form zugeführt werden, um ein übermäßiges Austragen aus der Wirbelschicht zu vermeiden.

The result shows that in 100% of the cases, equivalence at the lexical-semantic level is achieved by using the past subjunctive of the German modal *sollen*. Meyer's remark (1989:f.n. 7) that "the apparantly [sic!] equivalent German modal verb [i.e., *sollen, sollte*] would only express moral obligation", cannot be left unchallenged, because German *sollen* has a much wider semantic range (cf. Duden vol. 4, [5]1995:165-175), including the semantic variant of "advice/recommendation", in particular in its past subjunctive form (op. cit.:172). Moreover, it is the third most frequent German modal in scientific and technical discourse (Beneš 1981:197; Fluck [2]1997:101).

4.2.3.3 'Rhetorical' *should*

'Rhetorical' *should*, which according to Meyer (1989:133) expresses "ethical necessity", involves impersonal constructions with an *it* subject. These account for 28% of the *should* under analysis. In these constructions the modal verbs are used to establish an author-reader relation (see 'rhetorical' *may*, 4.2.1.1.2)

to direct the attention of the latter to special arguments or findings which the writer considered as important or which were presented in a special form (e.g. in a table) or in one of the following sections. This is a rhetoric function which cuts across the distinction between objective and subjective modality but requires that the modal verb is used in combination with a predicate verb denoting human activity. (Meyer 1989:133)

The distribution of translation solutions for 'rhetorical' *should* is as follows:

i) Past subjunctive of German modal *sollen*   **50%**

Example:
It *should* therefore be recognized that [...]

Es *sollte* daher darauf hingewiesen werden, daß [...]

ii) Modal construction *sein+zu*+infinitive   **50%**

Example:
It *should be noted that* these were raw samples from the PDU and not hydrotreated samples or [...]

> *Dabei ist zu beachten*, daß es sich um Rohproben aus der PDU und nicht um durch Hydrotreating behandeltes Material oder [...] handelte.

The results show equal shares for German modal *sollen* and modal construction *sein+zu+*infinitive. In addition to the meanings discussed under *must* (4.2.2), the latter translation solution characteristic of scientific and technical discourse is used as a neutral variant in those cases in which the meaning of *müssen* or *sollen* would be too strict and the meaning of *können* too non-committal (Beneš 1981:199).

The example under ii) demonstrates how pragmatic aspects, i.e., register considerations (introduction of a pronominal adverb with cohesive function, viz., *dabei*), come into play and modify syntactic and semantic aspects of equivalence.

In addition to the uses found in the corpus, *should* can be used to express a directive, e.g., in different kinds of technical instructions. In German, modal construction *sein+zu+*infinitve is frequently used in these directive contexts (Beneš 1981:199), e.g.:

> The oil seals *should be stored* with great care.
> Die Wellendichtringe *sind* sorgfältig *zu lagern*. (Krein-Kühle 1995a:72)

On the basis of the above findings, the following translation trends can be summarized for *should*:

Table 36 Distribution of translation solutions for *should* of logical expectation, *should* of recommendation/advisability, 'rhetorical' *should* (categories 4.2.3.1, 4.2.3.2, 4.2.3.3) and *should* of instruction (not in the corpus)

E: *should* of logical expectation	G: past subj. of modals *müssen* (67%), *dürfen* (33%)
E: *should* of recom./advisability	G: past subj. of modal *sollen* (100%)
E: 'rhetorical' *should*	G: past subj. of modal *sollen* (50%),
	modal construction *sein+zu+*infinitive (50%)
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E: *should* of instruction* *(not in the corpus)	G: modal construction *sein+zu+*infinitive

An investigation of *should* on the basis of a much larger corpus with a view to underpinning the above results, would be a fruitful area of further research.

4.2.4 *Can* and *could* and their German potential equivalents

In our corpus, *can* and *could* account for 32% (44 occurrences) , viz., 15% (21 occurrences) and 17% (23 occurrences) respectively, of all modals (cf., e.g., *can* and *could* for 39.7%, viz., 38% and 1.7% respectively, in Barber 1962:29, and 36%, viz., 29% and 7% respectively, in Huddleston 1971:297). As regards these two modals, the figures roughly correlate with other LSP findings. However, their distribution differs distinctly in favour of a much higher percentage for *could*.

4.2.4.1 *Can* and its potential equivalents

Can accounts for 15% (21 occurrences) of all modals in the ST investigated. The three main meaning variants of *can* in an LGP context are "possibility", "ability" and "permission" (Quirk et al [13]1995:4.52), with "possibility" or rather "root possibility" being the most frequent variant (Coates 1980/1983 quoted in Gutknecht and Rölle 1996:37). From an LSP point of view, the problem of categorizing "possibility" is, as Huddleston (1971:297) rightly claims, "that *possible* and its derivatives have themselves quite a wide range of meaning". He distinguishes between five categories for *can*, i.e., "qualified generalization", "exhaustive disjunction", "uncertainty/possibility", "legitimacy" and "ability" (op. cit.:302-305). In Meyer's (1989:133) corpus *can* is mainly used to express "objective availability (of approaches, methods, techniques, etc.)" and "objective possibility (of entities or processes and their qualitative and quantitative parameters)".

According to Swales (1971:34), *can* points to a "40-70% probability" (cf. 4.2.1 *may* and *might*). It is, indeed, a very good example of 'objective modality' in scientific and technical discourse.

In the corpus analysed there are two categories which may be relevant from an equivalence point of view, i.e., 'rhetorical' *can*, which refers to the author-reader relation, e.g., "One can also see that", "It can be seen that", "no better results can be expected",[28] and 'objective' *can* which expresses an "objective possibility", "objective availability" (Meyer 1989:133), "qualified generalization" or "ability" (Huddleston 1971:303). The most frequent meanings are "objective possibility", i.e.,

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[28] In Huddleston (1971:304) some instances of what is called here 'rhetorical' *can* are categorized under "legitimacy" and "ability".

under a given set of circumstances, and 'ability'/'capability' of processes, substances, etc. How closely these meanings may be interrelated will be demonstrated on the basis of an example:

> Previous experiments [...] indicated that the mode of coal drying *can* affect its behaviour in coal liquefaction or coprocessing.

Although it can be argued that this is an instance of "objective possibility", the aspect of "ability" (if we consider the coal drying process agentive) comes semantically into play. However, these differences are less relevant from an equivalence point of view, as the results will show.

4.2.4.1.1   'Objective' *can*

This category accounts for 76% of all instances of *can* in the corpus. The reason for the possibility expressed by *can* often lies in a cause-effect relationship. Sentences denoting this type of relationship are a typical characteristic of this kind of discourse (Sager et al. 1980:190 ff.).

The distribution of translation solutions for 'objective' *can* is as follows:

i) German modal *können*   63%

Example:
For all [...] processes, the residue stream presents problems in terms of either further utilization or disposal, and in some cases, *can* greatly influence the overall economics of the process.

Bei allen [...] Verfahren stellt der Rückstandsanteil im Hinblick auf Aufarbeitung oder Entsorgung Probleme dar und *kann* in einigen Fällen großen Einfluß auf die Gesamtwirt-schaftlichkeit des Verfahrens haben.

ii) German modal construction *sich lassen*+infinitive   37%

Example:
The results indicated that both residues are more reactive than most coals tested in the same unit under similar conditions and *can* be burnt with low carbon residence times.

Aus den Ergebnissen ging hervor, daß beide Rückstände eine höhere Reaktivität aufweisen als die meisten unter ähnlichen Bedingungen in der gleichen Anlage erprobten Kohlen und *sich* mit niedrigen Kohlenstoffverweilzeiten *verbrennen lassen*.

The results indicate a trend towards German modal *können* in the search for equivalence at the lexical-semantic level, which is not surprising, because *können* is the most common German modal in this type of discourse (Beneš 1981:197; Fluck

[2]1997:101) and covers the entire semantic range of possibility and availability (and, of course, permission and supposition) (Duden vol. 4, [5]1995:154; Gutknecht and Rölle 1996). The construction *sich lassen*+infinitive, which is both a modal construction and a passive variant (Duden vol. 4, [5]1995:317.3), can be considered a straightforward synonym of *können*. As a passive construction and only in tandem with inanimate subjects it expresses the modality of *können* (Beneš 1981:200). The use of *sich lassen*+infinitive shows how pragmatic aspects, i.e., register considerations, come into play and modify the lexical-semantic level to achieve overall textual equivalence by avoiding "monotony of expression" (Reinhardt et al. [3]1992:134 ff.).

4.2.4.1.2   'Rhetorical' *can*

This category accounts for 24% of all instances of *can* in the corpus. The distribution of translation solutions for 'rhetorical' *can* is as follows:

i) German modal construction *sich lassen*+infinitive   80%

Example:
One can also see that the slightly larger distillables yield for the X combination compared with the Y pair is mostly due to an increase in the light gas oil yield.

Ebenso läßt sich ersehen, daß die etwas höhere destillierbare Ausbeute bei der Kombination X im Vergleich zur Kombination Y hauptsächlich auf eine erhöhte Ausbeute an Leichtgasöl zurückzuführen ist.

ii) Nonmodal reflexive verb construction   20%

Example:
It can be seen that the rate of increase of X with increasing WHSV is greater than that of Y.

Es zeigt sich, daß X mit steigendem WHSV-Wert stärker ansteigt als Y.

As the results show, there is a lead for modal construction *sich lassen*+infinitive. Although *können* could also have been used in some of the cases, this was not done, obviously to avoid repetitive use of this modal for TL register reasons. In 20% of the cases, equivalence is achieved by a nonmodal reflexive verb construction, which also fulfils the TL requirement of a more varied register. Other potential equivalents not found in the corpus may be impersonal constructions with *ersichtlich sein* or *man+können*.

The investigation of 'rhetorical' *can*, on the basis of a larger corpus, is certainly a promising area of further research, because this rhetorical aspect seems to be an important feature in research reports (cf. also Meyer 1989:133).

On the basis of the above findings, the following translation trends can be summarized for *can*:

**Table 37   Distribution of translation solutions for 'objective' *can*
and 'rhetorical' *can* (categories 4.2.4.1.1 and 4.2.4.1.2)**

E:	'objective' *can*	G: *können* (63%), *sich lassen* (37%)
E:	'rhetorical' *can*	G: *sich lassen* (80%), nonmodal reflexive verb construction (20%)

Table 38   Total percentage distribution of translation solutions for *can*:

modal *können*	48%
reflexive modal construction *sich lassen*+infinitive	47%
nonmodal construction	5%

The results for *can* show how pragmatic aspects, i.e., register constraints of a reduced "monotony of expression" (Reinhardt et al. [3]1992:134 ff.), come into play and modify the lexical-semantic level of equivalence. The even distribution of *sich lassen* and *können* ascertained throughout the text is not so much a reflection of the "natural tendency for variation of expression" (Gutknecht and Rölle 1996:104, emphasis added) but rather a register constraint, as the results have shown. Clyne's remark that "*sich lassen* is a typically German construction with no equivalent in English" (1991:58) cannot be left unchallenged, because - although there is no strictly linguistic TL correspondence - from a translation point of view, English modal *can* is a serviceable potential equivalent, and not only in scientific and technical discourse.

4.2.4.2 *Could* and its potential equivalents

In the ST under investigation *could* accounts for 17% (23 occurrences) (cf., e.g., 1.7 % in Barber 1962:29, and 7% in Huddleston 1971:297). As mentioned earlier, the 'past tense' modals are extremely intricate both from a translation and categorization

point of view due to their temporal-modal ambiguity. In this context, Huddleston (1971:303) suggests three categories, which may be translation relevant, viz., "deep past tense", "present relative to past axis" and "unreal". Both the "deep past tense" and "present relative to past axis" of *could* express the 'objective' or 'root' possibility meaning of *can* (4.2.4.1). For the purpose of this investigation the 'unreal' category will be denoted 'hypothetical' which includes conditional past (e.g., in *if-*clause constructions) and is used to make predictions about unreal worlds.[29] Like *might* (4.2.1.2.2) in the same context, *could* here has a ca. "5-20% probability" (Swales 1971:34). The other two categories which Huddleston (1971:305) subsumes under "'real' *could*" are dealt with separately for equivalence-relevant reasons. 'Rhetorical' *could* will be dealt with under each of the three categories.

The percentages for the three categories are as follows: 'deep past tense' use 26%, 'present relative to past axis' 30% and 'hypothetical' use 44% (as against 56% for 'unreal' mode and 44% for 'real' mode in Huddleston 1971:304).

4.2.4.2.1 'Deep past tense' *could*

This accounts for 26% of all instances of *could* in the corpus. Except for two affirmative instances, in which the use of *could* is somewhat debatable, *could* occurred in negation. The distribution of translation solutions for 'deep past tense' *could* is as follows:

i) German past tense of *können* 50%

Example:
Due to a limited amount of coprocessing residue, not enough experiments *could* be performed [...]

Aufgrund der begrenzten Menge zur Verfügung stehender Coprocessing-Rückstände *konnten* nicht genügend Versuche durchgeführt werden, [...]

ii) German past tense of *sich lassen* 33%

Example:
No conclusions *could* be drawn regarding [...]

In bezug auf [...] *ließ sich* keine Aussage treffen [...]

iii) Others 17%
Such as full verb with modal meaning, e.g., *ermöglichen*.

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[29] 'Unreal' here refers to a world of still potential reality.

As the results show, the trend in translation solutions is similar to that for 'objective' *can* (4.2.4.1.1). The above examples neatly illustrate how pragmatic aspects come into play and trigger a requisite variation in expression to achieve equivalence at the overall textual level. In 33% of the cases in this category we can argue that *could* has a rhetorical function. In these cases there is an equal share of the past tense form of modal *können* and *sich lassen* in the TL (see example ii)).

4.2.4.2.2 'Present relative to past axis' *could*

This accounts for 30% of all instances of *could* in the corpus and its use is generally triggered by a past tense use in the main clause (sequence of tenses in English). This certainly does not mean that every *could* in subordinate clauses is automatically 'present relative to past axis' from a translation point of view. The distribution of translation solutions for *could* is as follows:

i) Present tense of *können*   **57%**

Example:
Previous work at X showed that coprocessing feed coal *could* be beneficiated using [...]

Aus früheren bei X durchgeführten Arbeiten ging hervor, daß die Einsatzkohle für das Coprocessing mit Hilfe von [...] aufbereitet werden *kann.*

ii) Present tense of *sich lassen*   **14%**

iii) Others   **29%**
Such as nonmodal or modal construction *sein+zu+*infinitive.

As the results show there is a definite lead for the present tense modal *können* in the search for equivalence at the lexical-semantic level. The temporal aspect, which is also dependent on the semantics of the co-text, is of importance here because German, which is less bound to a particular sequence of tenses, obviously uses the present tense in scientific discourse in those circumstances where results or findings are still facts and are replicable by tests. The present tense is also used in the translation of *wh*-clauses of the following type:

The objectives of the current study were to determine whether process derived light oils *could* be used in small quantities [...]

Mit dieser Untersuchung sollte herausgefunden werden, ob prozeßstämmige Leichtöle in kleinen Mengen [...] eingesetzt werden *können* [...]

-

These results can be underpinned by a German parallel text with similar syntactic-semantic constructions (Lenz et al. 1988).

In 29% of all cases *could* is put into a rhetorical use and equivalence in translation is achieved by an equal share of nonmodal constructions (due to modulation) and *sich lassen*.

4.2.4.2.3 'Hypothetical' *could*

This *could* accounts for 44% of all cases of *could* in the corpus. In two instances *could* occurs in 'modal perfective active' and in one instance in 'modal perfective passive' construction. The distribution of translation solutions for 'hypothetical' *could* is as follows:

i) Past subjunctive of modal *können*[30]   60%

Example:
However, if the reactor temperature *could* be increased sufficiently at higher WHSV such that higher pitch conversion values are obtained, this would significantly decrease pitch production levels and result in more economical operation.

Falls jedoch die Reaktortemperatur bei höherem WHSV-Wert zur Erzielung höherer Pechumsätze erhöht werden *könnte*, ergäben sich daraus eine deutlich reduzierte Pechmenge sowie ein wirtschaftlicherer Betrieb.

ii) Past subjunctive of *sich lassen*   10%

Example:
This would depend on the value added selling price that *could* be obtained for a solids free product [...]

Diese dürfte von dem Verkaufsmehrerlös abhängen, der *sich* für ein feststofffreies Produkt erzielen *ließe*, [...]

iii) Others   30%
Such as nonmodal or modal construction *sein+zu+*infinitive.

There is a definite lead for the past subjunctive of modal *können* and - to a much lesser extent *sich lassen* - in the search for equivalence at the lexical-semantic level. The fact that the past subjunctive has a high frequency is not surprising, because it is used in the TL to express irreality and potentiality (Duden vol. 4,

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[30]   In the case of the modal perfective passive the verb in the past subjunctive is *haben*, e.g.:
"If these molecules could have been hydrogenated [...]" - "Wenn diese Moleküle [...] hätten ¬hydriert werden können [...]"

[5]1995:280), i.e., to make statements about 'unreal' worlds. However, it is noteworthy that in 30% of the cases other translation solutions have come into play due to modulation at the lexical-semantic level or to pragmatic considerations in the TL. In 10% of the cases, 'hypothetical' *could* has a rhetorical function. In the following example, the translation solution with modal construction *sein+zu*+infinitive in an impersonal construction has a somewhat higher degree of certainty than the construction with *could*:

> Coprocessing residues *could* be expected to perform [...]
> *Es ist zu erwarten*, daß Coprocessing-Rückstände [...] geeignet sind [...]

Table 39 Distribution of translation solutions for 'deep past tense' *could*, 'present relative to past axis' *could* and 'hypothetical' *could* (categories 4.2.4.2.1, 4.2.4.2.2 and 4.2.4.2.3)

E: 'Deep past tense' *could*	G: past tense of *können* (50%) past tense of *sich lassen* (33%) Others, e.g., modal full verb (17%)
E: 'Present relative to past axis' *could*	G: present tense of *können* (57%) present tense of *sich lassen* (14%) Others, e.g., nonmodal or modal *sein+zu*+infinitive (29%)
E: 'Hypothetical' *could*	G: past subjunctive of *können* (60%) Past subjunctive of *sich lassen* (10%) Others, e.g., nonmodal or modal *sein+zu*+infinitive (30%)

Table 40 Total percentage distribution of translation solutions for *could*

E: *could*	
G: Past tense, present tense or past subj. of modal *können*	57%
Past tense, present tense or past subj. of *sich lassen*	17%
Others, e.g., modal *sein+zu*+inf., modal full verb, nonmodal	26%

Compared with the overall results for *can* (4.2.4.1), the low percentage for *sich lassen* and the higher one for *können*, may be attributed to the grammatical fact that the past tense and past subjunctive forms of *sich lassen* are identical in German. Since the forms must be unequivocally distinguishable in certain contexts, *können* is more often used, because it has separate past tense and past subjunctive forms. Other

translation solutions may also come into play for semantic (e.g., modulation) or pragmatic reasons, e.g., register considerations.

Table 41 **Total percentage distribution of translation solutions for** *can* **and** *could* **on a textual basis**

E: *can* and *could*	
G: *können* (present and past tense, past subj.)	52%
sich lassen (present and past tense, past subj.)	32%
Others, e.g., modal *sein+zu+*inf., nonmodal etc.	16%

The overall result for *can* and *could* shows the distribution of *können* and *sich lassen* plus other solutions. It indicates how pragmatic considerations, i.e., register aspects, come into play and influence and modify the lexical-semantic level. An even distribution of the above forms on a textual basis helps reduce "monotony of expression" (Reinhardt et al. [3]1992:134 ff.) with a view to achieving equivalence at the overall textual level.

4.2.5 *Will* and *would* and their potential equivalents

In the corpus analyzed, *will* and *would* account for 42% (58 occurrences), viz., 4% (5 occurrences) and 38% (53 occurrences) respectively, of all modals (cf. *would* for 3.5% in Barber 1962:29, with no instances of *will*, and 22%, viz., 12% and 10% respectively, in Huddleston 1971:297). As already stated in the introduction, the high percentage of *would*, which is mainly used in the hypothetical mode, can be attributed to the very specific character of the research report under analysis. Since further scale up to commercialisation of the process will be based on the findings of this report, the author uses "'non-committal' *would*" as a "hedging device" (Clyne 1991:61).

4.2.5.1 *Will* and its potential equivalents

Will accounts for 4% (5 occurrences) in our corpus. In scientific and technical discourse *will* may occur in three main uses: a) as a marker of futurity, i.e., "Futurity, relative to present" (Huddleston 1971:305); b) as a marker of "inherent 'regularity'" (Meyer 1989:131) or "prediction", "i.e. to indicate that an action always or typically takes place under normal circumstances" (Sager et al. 1980:210) (cf. also Quirk et al.

[13]1995:4.57 (a3) who talk of "HABITUAL predictive meaning" and "timeless statements of 'predictability'").[31] Huddleston (1971:306-307) distinguishes in this context "induction" as referring to a timeless truth or "deduction" expressing an "'it follows that' relation". Both Sager et al. (1980:210) and Huddleston (1971:306-307) note that *will* in this use can be replaced by a nonmodal form. c) According to Sager et al. (1980:211) there is a third use of *will* expressing "ability".

The 'futurity' use of *will* can also have an "intentional" element (cf. "intention" as a subcategory of 'volition' in Quirk et al. ([13]1995:4.57 (b1) in LGP use). In this context, Huddleston (1971:305) claims that the "fact that the infinitive [in the following example] expresses an agentive process does not necessarily make the *will* volitional," and therefore categorizes the following example under "Futurity, relative to present":

> These granules will be discussed in more detail later. (Huddleston 1971:305)

However, in the above example we can well argue that this 'futurity" *will* also has an 'intentional' element, which may be given semantic priority and may trigger a different potential equivalent (see 4.2.5.1.2 below) in the TT.

Of the above uses, two occur in the ST under analysis, i.e., "futurity, relative to present", here called 'futurity' *will*, which accounts for 20% and "inherent regularity", here called 'regularity' *will*, which accounts for 80%. The results for these two categories are as follows:

4.2.5.1.1   'Regularity' *will*

This *will* accounts for 80% of all instances of *will* in the corpus. The distribution of translation solutions for 'regularity' *will* is as follows:

i) Nonmodal solution by use of the present tense in German   100%

Example:
The production rate of a given product per X *will* be proportional to the product's yield and the feedstock WHSV, that is: [...]

Die Produktionsrate für ein bestimmtes Produkt pro X *verhält sich* proportional zur Produktausbeute und zum WHSV-Wert, d.h.: [...]

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[31]   Meyer (1989:131) mentions that he does not use the term "predictability" in this context, "because it may blur the distinction between "someone who predicts something" and "something which is predictable."

As the results show, a nonmodal verb form is the key to equivalence at the lexical-semantic level in all cases. 'Regularity' *will* is not only "another difficulty for German learners of English" (Meyer 1989:131), but a 'popular' source of translation errors in the two translation directions, especially among trainee translators. Gerbert's (1970:96) early recommendation that these instances be translated into German "without consideration of *will*" (my translation), can now be verified on a corpus basis.

4.2.5.1.2   'Futurity' *will*

This *will* accounts for 20% of all instances of *will* in the corpus. The distribution of translation solutions for 'futurity' *will* is as follows:

i) Present tense in German   **100%**

Example:
Each of the projects is reviewed in terms of objectives and achievements, how it interrelates to other topics investigated and where possible, the effect of significant developments or results on overall process economics *will be highlighted*.

Die Zielsetzungen und Ergebnisse jedes Projekts werden beschrieben, und es wird dargelegt, wie die einzelnen untersuchten Projekte zusammenhängen.
Falls möglich, *wird* auf die Auswirkungen der wesentlichen Entwicklungen und Ergebnisse auf die Gesamtwirtschaftlichkeit des Verfahrens näher *eingegangen*.

As the result shows, the present tense solution is the key to equivalence at the lexical-semantic level. German simple present tense can also refer to future events (Duden vol. 4, [5]1995:251) and indeed is often used instead of the simple future not only in LGP, but in LSP discourse, in particular, above all with longer texts, because the future tense is neither an "Erzähltempus" ("narration tense") nor an "Abhandlungstempus" ("tense for treatises, essays or scientific articles") (Duden vol. 4, [5]1995:256). It is a known grammatical fact that English is more precise in denoting future events than German (and, moreover, has a more varied grammatical repertoire of expressing these events), which in similar contexts often uses simple present tense (Duden vol. 4, [5]1995:251, 256; Quirk et al. [13]1995:4.41 ff.).

As mentioned earlier, 'futurity' *will* can have an 'intentional' element as well, which may be given priority in translation. Although no examples occurred in the ST under analysis, a '*will*-directed' look at the "project definitions" preceding previous

progress reports and the present final research report,[32] brought forward another potential equivalent for *will*. In the nature of things, "project definitions" have a high frequency of *will* by describing the work to be done, e.g.:

Scope/Description/Statement of Work
Coprocessing residues *will be ground* at low temperatures and agglomerated using X.
Following parameters *will be investigated*;

Umfang/Beschreibung/Angaben zu den Arbeiten
Coprocessing-Rückstände *werden* bei niedrigen Temperaturen *vermahlen* und mit X agglomeriert. Folgende Parameter *sollen* untersucht werden:

Whereas the first *will* in the above example is translated by a present tense passive form, the second *will* is translated by modal *sollen*, which, i.a., expresses task, purpose, or function (Duden vol. 4, [5]1995:165). It seems that *sollen* has a rhetorical function here and is chosen, therefore, for register reasons. It is used in those instances in which the description of, e.g., processes, findings, etc. is given "in the following" or "in what follows", as in the example below, which is taken from a TL original text:

Außer einigen rekordverdächtigen Fällen von Stereoselektivität mit Fernwirkung [...] und von spektakulären Fluoreffekten [...] führte die Beschäftigung mit der nucleophilen, radikalischen und elektrophilen Reaktivität der zur Realisierung des SRS-Prinzips hergestellten Heterocyclen zu einigen Erkenntnissen, welche sich - über dieses Gebiet hinaus - als allgemein bedeutsam erwiesen haben. Diese *sollen* im folgenden kurz behandelt werden.   (Seebach et al. 1996)

Table 42 **Distribution of translation solutions for 'regularity' *will* and 'futurity' *will* (categories 4.2.5.1.1 and 4.2.5.1.2) and 'intentional' *will* (not in the corpus)**

E: 'regularity' *will*	G: nonmodal solution, i.e., present tense (100%)
E: 'futurity' *will*	G: present tense (100%)
E: 'Intentional' *will** * (not in the corpus)	G: German modal *sollen*

As the overall result shows, there is a very clear translation trend towards a present tense use for both 'regularity' *will* and 'futurity' *will* to achieve equivalence at both the lexical-semantic and overall textual levels. The investigation of *will* on the basis of a larger corpus to underpin these findings and to investigate the conditions of 'intentional' *will*, will be a fruitful area of further research.

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[32]   For confidentiality reasons, the source of these project definitions cannot be disclosed.

4.2.5.2 *Would* **and its potential equivalents**

Would is the most common modal in the ST, i.e., it accounts for 38% (53 occurrences) of all modals in the corpus (as against 10% in Huddleston 1971:297 and 3.5% in Barber 1962:29). In 74% of all cases, *would* is used in the hypothetical mode, i.e., it is used to make "predictions about 'unreal worlds'" (Huddleston 1971:308). These 'unreal worlds' are established by the use of *would* in *if*-clauses denoting an unreal condition or by contextual inference (see f.n. 29). The predictive statements in the ST refer to the technical and economic feasibility of the processes under investigation on a commercial scale and the implicit context-based unreal condition which surrounds them, is "if the processes were applied on a commercial scale". In most cases, hypothetical *would* has a "non-committal" function (Clyne 1991:61) and points to a certain degree of caution on the part of the author as regards the certainty of his propositions. "'Non-committal' *would*" (Clyne 1991:61) is to relieve the author to a certain extent of the responsibility for his statements. The background is that the findings of this final research report are expected to serve as a basis for a decision on whether a scale-up to commercialisation would be sensible from a technical and economic point of view. Such decisions are even more difficult to make, if not only corporate but also governmental funding is involved.

The remaining 26% are 'real world' instances of *would*. In those instances, the use of *would* in a subordinate clause is triggered by the past tense in the main clause. Although *would* like *could* (4.2.4.2) "act as the 'past time' equivalents" of *will* and *can* (Quirk et al. [13]1995:4.61) and although we may have the same categories as under *could* (4.2.4.2.1-3), a difficulty in categorization (and translation) is that the author was by no means consistent in his use of *would*. In the conclusions at the end of the report, the writer sometimes uses *would* in the hypothetical mode, whereas in the introduction he always uses 'present relative to past axis' *would* in dependent subordinate clauses with semantically similar statements, e.g.:

Introduction:
It was shown that fluid catalytic cracking *would* be the preferred route to produce specification products from coprocessing vacuum gas oils rather than two-stage hydrotreating due to [...]

Conclusions:
Major conclusions are as follows:
Fluid catalytic cracking *would* be a better choice than two-stage hydrotreating to produce specification products from raw coprocessing vacuum gas oil [...]

The above examples show how difficult it may be to distinguish between the modal-temporal ambiguity of *would* due to the lack of consistency on the author's part. However, there are also some unequivocal cases of *would* in subordinate clauses, in which *would* expresses 'deep past tense' (one instance only) or 'present relative to past axis'. Since both the corresponding present tense uses yielded the same translation solution (simple present tense) in the TL (see *will* 4.2.5.1), their past tense correspondences can be safely categorized together. The equivocal cases, such as in the above example under 'Introduction', will be included in this category for syntactic-semantic reasons and for ease of reference.

The two categories of *would*, i.e., 'hypothetical' *would* (4.2.5.2.1) and 'present relative to past axis' (plus one 'deep past tense') *would* (4.2.5.2.2), will be presented and discussed in the following:

4.2.5.2.1   'Hypothetical' *would*

This accounts for 74% of all instances of *would* in the ST analyzed. The distribution of translation solutions for 'hypothetical' *would* is as follows:

i) Past subjunctive of the following verbs: **82%**

werden (würde) 18%, *dürfen (dürfte)* 26%, miscellaneous 38%, such as: the respective predicates, e.g., *bestehen, ergeben*, etc., *haben* and *sein*, and the modals *können* and *müssen*.

Example:
Operation at much higher WHSV *would* only make economic sense where X has a reasonable economic value or where it can be disposed of very cheaply.

Ein Betrieb mit deutlich höheren WHSV-Werten *dürfte* nur dann wirtschaftlich sinnvoll sein, wenn X von ausreichendem wirtschaftlichen Wert ist oder sehr preiswert entsorgt werden kann.

ii) Nonmodal solution **13%**

Example:
Also, at this point, fluidized bed combustion is probably the most cost effective approach to disposal of this type of residue in a commercial scale coprocessing plant other than landfilling which *would face* environmental constraints.

Derzeit stellt die Wirbelschichtverbrennung wahrscheinlich das kostengünstigste Entsorgungsverfahren für Rückstände dieser Art in einer großtechnischen Coprocessing-Anlage dar, da bei einer Deponierung Umweltaspekte *ins Spiel kommen*.

iii) Others **5%**

Example:
This level could not be obtained in single stage operation without the use of hydrogen quenching due to parametric sensitivity at the higher operational temperatures *which would be required*.

> Dieser Wert könnte beim einstufigen Betrieb ohne Wasserstoffquenchen wegen der parametrischen Empfindlichkeit *bei den dann erforderlichen* höheren Betriebstemperaturen nicht erzielt werden.

As the results show, the past subjunctive of various verbs is the most frequent translation solution for 'hypothetical' *would*. However, it is noteworthy that some verbs occur more frequently than others. For example, *würde*, which may replace present, past and future subjunctive in German (Duden vol. 4, [5]1995:300), is often used (18%), as is *dürfte* (26%) (Köhler 1981),[33] with the latter being commonly used in statements referring to process economics (see above example i)). As mentioned earlier, the past subjunctive and its replacement form *würde* express irreality and potentiality, i.e., they refer to a hypothetical mode as does *would* in the ST.

In 13% of the translation solutions, we encounter a nonmodal use which, as the above example (ii)) shows, neutralizes the 'non-committal' element in the ST. This neutralization may occur in those instances in which for pragmatic reasons, such as domain knowledge or register, a 'hedging device' may not be considered necessary or usual in the TL.

In the 'Others' category, *would* is rendered by a 1:0-correspondence due to transposition, with the modality being implicitly maintained. In the above example (iii)), the relative clause is shifted to a premodification (see 3.2.1.1.1) with an inherently modal meaning, since it can be paraphrased by "die dann erforderlich würden/wären". This category also exhibits a 1:1-correspondence reflecting an elliptical use.

8% of all 'hypothetical' *would* have a rhetorical function. In those instances equivalence is achieved by the past subjunctive in the TT, e.g.:

> *It would be expected* that the blending option [...] would be more economical than the hydrotreating option.

> *Es wäre zu erwarten*, daß der Verfahrensweg der Mischung [...] wirtschaftlicher sein dürfte als durch Hydrotreating behandeltes Coprocessing-VGO.

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[33]   According to Köhler (1981:245), *dürfen* in German scientifc and technical discourse is used for cautious, hypothetical statements.

4.2.5.2.2 'Present relative to past axis' *would*
*This category contains one instance of 'deep past tense' *would*.

As mentioned earlier, this category accounts for 26% of all instances of *would* in the corpus. The distribution of translation solutions for *would* is as follows:

i) Modal solution (modal adverb, past and present subjunctive)   50%

Example:
It was shown that fluid catalytic cracking *would* be the preferred route to produce specification products from [...] rather than two-stage hydrotreating due to [...]

Es zeigte sich, daß FCC [...] zur Herstellung spezifikationsgerechter Produkte aus [...] *vermutlich* besser geeignet ist als zweistufiges Hydrotreating aufgrund [...]

ii) Nonmodal solution (present tense)   50%

Example:
It was also shown that coal derived liquid products, i.e., from direct coal liquefaction processes *would* result in greater catalytic activity loss for aromatics hydrogenation compared with [...]

Es zeigte sich ebenso, daß bei kohlestämmigen Flüssigprodukten, d.h. aus direkten Kohleverflüssigungsverfahren, der Verlust der Katalysatoraktivität bei der Aromatenhydrierung höher *ist* als [...]

The results show an equal share of modal and nonmodal solutions in the search for equivalence at the lexical-semantic level. The modal solutions reflect the hypothetical use of *would* in the conclusions of the report in similar semantic contexts, so that the translators obviously fell in to a certain degree with the author's inconsistent use of *would*. The same is true of some instances in which the present tense is used in the conclusions. Without this specific constraint, the above ST examples may have given rise to the same nonmodal translation solution in the TT (see *will* 4.2.5.1 ff.).

Would in *wh*-clauses is either translated by a nonmodal present tense (see example a) below) or by a 1:0-correspondence due to transposition (shift of *wh*-clause to prepositional phrase), (see example b) below) in the TT, reflecting the past tense use ('present relative to past axis') of 'regularity' or 'futurity' *will* (4.2.5.1 ff.). The main clauses containing *wh*-clauses relate to the actual research objectives within the R&D programme itself, e.g.:

a)   Experiments were also carried out using [...] coprocessing VGO blended with X to investigate whether such blends *would* provide a viable FCC option.
       Ferner wurden Versuche mit einem Gemisch aus [...] Coprocessing-VGO und X gefahren, um zu untersuchen, ob derartige Gemische eine wirtschaftliche Alternative beim FCC *darstellen*.

b)   Oil agglomeration to reduce the mineral matter in the coal using process derived light oil
was investigated to determine whether these oils *would* work as well as reference fuel oils
classically used in oil agglomeration.
Die Agglomeration mittels Öl zur Reduzierung der mineralischen Bestandteile
der Kohle mit Hilfe prozeßstämmiger Leichtöle wurde mit dem Ziel der Vergleichbarkeit
dieser Öle mit den traditionell zur Agglomeration verwendeten Referenzölen untersucht.

**Table 43   Distribution of translation solutions for 'hypothetical' *would* and
'present relative to past axis' *would* (categories 4.2.5.2.1 and 4.2.5.2.2)**

E: 'hypothetical' *would*	G: past subjunctive of *werden* (18%) , *dürfen* (26%) and other verbs (38%). Total: (82%) nonmodal (13%), Others (5%)
E: 'present relative to past axis' *would* (including one instance of 'deep past tense' *would*)	G: nonmodal (present tense) (50%), modal solution (50%) (e.g., modal adverb, past/present subjunctive)*

* As mentioned earlier, some translation solutions reflect the inconsistency in the use
of *would* on the part of the author.

Table 44   Total percentage distribution of translation solutions for *would*

E: *would*
G: modal solutions: 77%. These are in their order of frequency:
a)   past subjunctive of (the respective predicates, *werden* (*würde*), *dürfen* (*dürfte*), and the modals *können* and *müssen*),
b)   present tense+modal adverb, present subjunctive
G: nonmodal solutions: 23%. These are in their order of frequency:
a)   present tense
b)   1:0-correspondence due to transposition

Although Clyne (1991:61) rightly claims that "English-speaking authors make extensive use of 'non-committal' *would*",[34] for which the ST under investigation is a good example, we have no figures for the frequency of *would* in R&D documentation, nor do we know about the circumstances under which it is chosen in this specific text genre. Since no contrastive English-German LSP research has been done so far on a larger scale into modal auxiliaries employed in the genre of research reports, we do not even know whether the figures for the modals in our corpus (4.2) reflect a 'modal' distribution for research reports or are a specific feature of the report under investigation. The latter, however, may be assumed due to the very high percentage for *would* in the 'hypothetical'/'non-committal' mode. Although the 'non-

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[34]   Clyne's research (1991) is based on texts from the fields of linguistics and sociology written by German and English-speaking scholars.

committal' component is neutralized in certain instances for semantic co-textual and pragmatic contextual reasons, the 'non-committal', i.e., 'subjective', tone of this report as regards the propositions/predictions referring to the technical and economic feasibility of the process on a commercial scale is maintained on a textual basis.

4.2.6 Summary of this section

For ease of reference, the results of this analysis are summarized as follows:

Table 45   Overview of translation solutions for modal auxiliaries in the ST

May (4.2.1.1.1 and 4.2.1.1.2)	
E: 'uncertainty' *may*	G: modal adverbs, e.g., *möglicherweise, vermutlich* (100%)
E: 'rhetorical' *may* (e.g., The reader may select [...])	G: nonmodal impersonal construction (100%)

Might (4.2.1.2.1 and 4.2.1.2.2)	
E: 'present relative to past axis' *might*	G: German modal adjective (50%) German modal *können* (50%) (present tense/plus the occasional *u.U.*)
E: 'hypothetical' *might*	G: past subjunctive (with or without *u.U.*) (67%) Others, e.g., adjective (33%)

Must (have to/had to) and need (4.2.2)	
E: modals of necessity, i.e., *must (have to/had to), need*	
G: modal of necessity, i.e., *müssen* (100%)	

Should (4.2.3.1, 4.2.3.2 and 4.2.3.3)	
E: *should* of logical expectation G: past subj. of modals *müssen* (67%), *dürfen* (33%)	
E: *should* of recom./advisability G: past subj. of modal *sollen* (100%)	
E: 'rhetorical' *should*	G: past subj. of modal *sollen* (50%) modal construction *sein+zu+*infinitive (50%)
E: *should* of instruction* *(not in the corpus)	G: modal construction *sein+zu+*infinitive

Can (4.2.4.1.1 and 4.2.4.1.2)

E: 'objective' *can*
                                               G: modal *können* (63%),
                                               modal reflexive verb *sich lassen* (37%)

E: 'rhetorical' *can*
                                               G: modal reflexive *sich lassen* (80%),
                                               nonmodal reflexive verb construction
                                                       (20%)

Could (4.2.4.2.1, 4.2.4.2.2 and 4.2.4.2.3)

E: 'Deep past tense' *could*
                                      G: past tense of modal *können* (50%)
                            past tense of reflexive *sich lassen* (33%)
                                      Others, e.g., modal full verb (17%)

E: 'Present relative to past axis' *could*
                                      G: present tense of modal *können*
                                               (57%)
                                        present tense of *sich lassen* (14%)
                                        Others, e.g., nonmodal or modal
                                             *sein+zu+*infinitive   (29%)

E: 'Hypothetical' *could*
                                        G: past subjunctive of *können* (60%)
                                        Past subjunctive of *sich lassen* (10%)
                                        Others, e.g., nonmodal or modal
                                        *sein+zu+*infinitive (30%)

Will (4.2.5.1.1 and 4.2.5.1.2)

   E: 'regularity' *will*   G: nonmodal solution, i.e., present tense
                                               (100%)
   E: 'futurity' *will*   G: present tense (100%)

   E: 'Intentional' *will**   G: German modal *sollen*
      * (not in the corpus)

Would (4.2.5.2.1 and 4.2.5.2.2)

E: 'hypothetical' *would*
                                        G: past subjunctive of *werden* (18%), *dürfen*
                                        (26%) and other verbs (38%). Total: (82%)
                                        nonmodal (13%), Others (5%)

E: 'present relative to past axis' *would* G: nonmodal (present tense) (50%),
     (including one instance of   modal solution (50%) (e.g., modal adverb,
     'deep past tense' *would*)   past/present subjunctive)*
* As mentioned earlier, some translation solutions reflect the inconsistency in the use
  of *would* on the part of the author.

The above results indicate that the English ST modal auxiliaries have a wide variety of potential equivalents in the German TT including nonmodal as well as other solutions, depending on the semantics of a particular modal in a particular category. The investigation has also shown how equivalence at the lexical-semantic level may be achieved and how it may be influenced and modified by pragmatic aspects, i.e., register considerations, in particular, to achieve equivalence at the overall textual level in the case of modal translation. It has also shown that the 'past tense' forms of the modals may pose their own very specific problems in translation, and that they are certainly more intricate than some researchers appear to realize (e.g., Gutknecht and Rölle 1996:69). The results also indicate that "subjective modality" (Meyer 1989) - if we consider, e.g., 'non-committal' to be 'subjective' - may be a more frequent feature in the genre of research reports than in other scientific genres (Hyland 1998). This investigation may also contribute toward confirming Meyer's (1989:134) hypothesis that

> in research articles a larger variety of rhetorical strategies are needed which will also utilize the semantic potential of objective and subjective modality in a different and probably more varied way.

As far as equivalence is concerned, it has been shown that a consideration of the ways in which a particular modal with its semantic potential is used in a particular text-in-context is more important than the question of whether we have an instance of 'objective' or 'subjective' modality, since the semantic potential may well be situated in the middle of this continuum. However, Meyer's (1989) terminological distinction is definitely appreciated, since it contributes to much needed clarification of modality in the field of scientific and technical discourse (in addition to Huddleston's (1971) seminal work).

This research also casts some light on the importance of the use of nonmodal forms in the TT for modals in the ST, which may occur for semantic reasons (e.g., 4.2.5.1 *will*), but may also be opted for on pragmatic, i.e., register, grounds (see, e.g., 'hypothetical' *would* 4.2.5.2.1). The latter case points to a somewhat reduced need for 'hedging devices' in the German TT as compared with the English ST. This aspect of differing degrees of modality in the genre under analysis, but also in other scientific and technical genres, would be a very fruitful area of further translational and LSP research. As this research already indicates, the same is true of the use of

tenses in research reports, which may differ between the two languages for systemic (strict sequence of tense requirements in English) and again for register reasons.

To conclude this section, it should be pointed out that the findings presented here would have to be underpinned by a larger translation corpus of a similar text genre, text type and domain, but also by contrastive LSP research in this field. In both cases, similar corpus design criteria, such as text type, genre, domain, etc. (2.2.2.1) should be employed to allow a reasonable degree of comparability of results. Hyland (1998:119), for example, concludes his investigation of the modal auxiliaries with the statement that they are used "less frequently to express epistemic modality in scientific research articles,"[35] whereas this research has shown that epistemic modality seems to be more common in research reports (see the high frequency of hypothetical *would* 4.2.5.2.1).

Like the present research, LSP and further translational research should be carried out on the basis of entire texts-in-contexts (see, e.g., Hyland 1998) and not isolated sentences to record the meanings of modals as they are actually used in original SL and TL texts-in-contexts and in STs and their translations in contexts. Such research is urgently needed for the establishment of overall textual equivalence in the discourse genre under analysis.

4.3 Instances of 'secondary subjectification' and their German potential equivalents

Although the inanimateness of subjects as such is not necessarily an equivalence-relevant problem, it does become an issue under certain syntactic-semantic circumstances which manifest themselves in certain syntactic-semantic structures that pose equivalence-relevant problems in the TL due to the fact that "non-agentive semantic roles in German frequently resist being mapped onto subjects where this is possible in English" (Hawkins (1986:58) referring to Rohdenburg 1974), because the semantic range of the subject relation in English is much larger than in German, "and

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[35]   Hyland (1998:107, table 4) shows the differences in frequencies of modal auxiliaries "used to express hedging in various corpora", which may reflect variations in sampling (op. cit.:108). Unfortunately, these frequencies are counted per 10,000 words and not on a finite verb basis, so that they cannot be used for any comparison.

larger than most researchers have appreciated hitherto" (op. cit.:59-60).[36] The phenomenon involved here, which is rooted in the typological differences between German and English, is referred to as "sekundäre Subjektivierung" ('secondary subjectification') (König 1973, Rohdenburg 1974), which can be very broadly defined as involving cases in which the surface-structure subject does not correspond to the deep-structure subject (König 1973: 32-33)[37], as in *the report reviews x* which can be paraphrased by *in this report, I/we will review x* or *x is reviewed*. However, defining an instance of 'secondary subjectification' is often more intricate than the above example may suggest. The definitional problem was already discussed by Rohdenburg (1974) in his extensive study of this subject in which he claims that his proposed definition, which consists of several complex parts, cannot be more than a "Notbehelf" (*makeshift solution*) (Rohdenburg 1974:107). Moreover, his contrastive analysis is based on a corpus of both oral and written texts of mainly literary, didactic and journalistic discourse and, if available, on their translations and on native speaker informants.

The definition and categorization of instances of 'secondary subjectification' is all the more difficult in the translation of scientific and technical discourse due to the differences in the acceptable degree of anthropomorphization of the subject in the two languages involved here, viz., German and English. As Warner (1976:104-105) claims, anthropomorphization, e.g., of a machine or apparatus, is acceptable in German when human-like physical functions are involved, i.e., a machine can run, press, push, etc., but becomes debatable with mental and emotional functions,[38] e.g., in German, a probe cannot *sense* (*fühlen*) but only *react to* (*reagieren auf*) temperature differences, but can do so in English. Moreover, the acceptable degree of anthropomorphization may depend on and vary with the technical domain/sub-domain in question. In her contrastive LSP research, Göpferich (1995a:339) mentions two types of subjects occurring in instances of 'secondary subjectification',

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[36]   As Hawkins (1986:53) claims "the class of subjects and direct objects [...] is larger in English than it is in German. Numerous NPs which surface as subject or object in English cannot do so in German. Once again, the case system appears to be at the root of this contrast."

[37]   Cf. Rohdenburg's definition (1974:46) who talks of 'secondary subjectification' as involving instances in which the "logical subject does not also form the grammatical subject" (my translation): "Eine sekundäre Subjektivierung liegt immer dann vor, wenn das logische Subjekt nicht auch das grammatische Subjekt bildet."

[38]   "Dagegen besteht keine Einmütigkeit darüber, ob es abzuraten oder zu empfehlen ist, auch die geistige und die seelische Komponente für vermenschlichende Aussagen über Maschinen heranzuziehen; [...]" (Warner 1976:104)

i.e., "deverbative" nouns and designations of concrete objects having an instrumental role, in the context of English directive speech acts. Although the instrumental role of the English subject in scientific and technical discourse is obviously common, instrumentality alone cannot be considered a sufficient criterion for inclusion, because it would ignore, for example, cases such as "Table 1 summarizes the operating conditions [...]", which is clearly a case of 'secondary subjectification'. And although Göpferich's two subject types are also relevant from an equivalence point of view (4.3.2.2, 4.3.2.3), they have to be seen in close concatenation with their respective predicates and may need further sub-categorization (see, e.g., the separate consideration of deverbal nouns and verbals nouns, i.e., gerunds, in 4.3.2.3). As this research will show, further equivalence-relevant subject types plus predicates have been established on the basis of the corpus (see, e.g., 'documentary' subjects, 4.3.2.1, or *this*-subject 4.3.2.4).

Pending further and more detailed research into the conditions of 'secondary subjectification' in LSP discourse, it is necessary to define the equivalence-relevant categories, an investigation of which, it is hoped, will reveal relevant tendencies in translation solutions on an overall textual basis. The definition and investigation of separate categories seems an advisable step in order to explain specific translational shifts in certain categories which might otherwise pass unnoticed.

Any investigation of the complex subject of 'secondary subjectification' requires a combined consideration of the syntactic and semantic dimensions since, as Gerbert (1970:33) rightly argues, syntax and meaning complement and depend on each other. As the investigation will demonstrate, TT register considerations also play a pivotal role in this context and will have to be taken into account.

As the discussion so far has shown, any investigation of the problem of 'secondary subjectification' requires this more complex approach involving consideration of the subject in concatenation with the predicate and the complement concerned, i.e., the entire sentential and, if necessary, supra-sentential co-textual and textual environment, to identify those structures in which the problem is most acute and most common and, hence, relevant to an equivalence-oriented analysis. This should not, of course, be taken to mean that subject plus predicate structures without

'secondary subjectification' are irrelevant from the point of view of equivalence in general or that simple 1:1-correspondences may not be an equivalent solution, e.g., "treatment affects coprocessing performance", "die Aufbereitung hat einen Einfluß auf" (≠ *beeinflußt*), i.e., register considerations call for a transposition of the verb.

The identification of instances of 'secondary subjectification' involves consideration of the various non-agentive semantic roles present in English subjects in this type of discourse which may differ in distribution, frequency and type from LGP categories, viz., instrumental, locative, temporal, etc. (Quirk et al. [13]1995:10.21, 10.25; Hawkins 1986:59 ff.) and consideration of the valency and semantics of the verb and of its complement. Hence, analysis of this structure also means disregarding all those cases in which 'secondary subjectification' can unequivocally be ruled out to avoid falsification of the results, while including all instances of doubt which may arise from the differing degree of acceptable anthropomorphization of the subject in English and German. For instance, cases such as "but the product residues contained less coke" or "treatment affects coprocessing performance", were excluded from the examination, since we cannot speak of cases of 'secondary subjectification' here. However, a case such as "heteroatom content [...] would limit further uses like [...]" was included, because the presence of a 'secondary subjectification' cannot be definitely ruled out.

On a finite verb basis, the transitive active verbs in instances of 'secondary subjectification'[39] account for 33% of all active finite verbs and for 22% of all finite verbs (145 occurrences). Of these verbs, 74% are non-prepositional and 26% prepositional verbs.[40] For the typological reasons discussed earlier and as is shown

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[39]   This certainly does not mean that subjects in other structures, e.g., in certain passive clauses, do not pose this problem (cf. also Rohdenburg's (1974:106) definitional criteria). However, such an investigation would go beyond the scope of this thesis and would have to be carried out on the basis of a larger corpus to yield a significant frequency of occurrence.

[40]   The prepositional verbs correspond to what Quirk et al. ([13]1995:16.5) call "Type I prepositional verbs" and what Greenbaum (1996:5.36) classifies under "Monotransitive prepositional verbs". Except for two instances in which the prepositional verb expresses a copular relationship with its complement, "which should be regarded as a subject predicative rather than a prepositional object" (Greenbaum op. cit.:5.36), e.g., "the additive *acts as* a good metal scavenger", all other prepositional verbs under analysis are followed by a prepositional object. The prepositional objects are nouns or better complex noun phrases (89%) and gerunds (11%). It should be noted in this context that the use of 'prepositional' instead of 'intransitive' verb may help reduce the unclarity resulting from the use of the transitive/intransitive distinction (see Quirk et al. [13]1995:16.5). Certainly, a more detailed and separate categorization of subjects plus prepositional verbs/predicates in "secondary subjectification' would have to be carried out on the basis of a larger corpus.

here, it is in subjects plus transitive verbs that the problem is most frequent and most acute (cf. Rohdenburg 1974 and Hawkins 1986).

Since there has been no research into the conditions of 'secondary subjectification' in LSP discourse so far, it seems advisable to establish in a first step a list of predicates which occur or are very likely to occur in instances of 'secondary subjectification' and in a second step to establish different types of subjects plus predicates in 'secondary subjectification' on the basis of the ST under investigation. The grouping of verbs/predicates into related semantic areas will be followed by a sentential-semantic categorization of subject types plus predicates which is relevant from an equivalence point of view. The subject types described below with particular predicates are definitely not restricted to these predicates, but may also occur in concatenation with other predicates in other scientific and technical discourse genres. However, both the predicates and the subjects plus predicates may still be considered typical of the genre analyzed and at the same time point to other scientific and technical genres to furnish both LSP-relevant and translation-relevant insights which go beyond the scope of the corpus under investigation.

Also included in the analysis are two inanimate subjects plus predicates plus expanded AcI constructions,[41] the personal pronoun *it* and the relative pronoun *which* in subject function in instances of 'secondary subjectification', e.g.:

X is shown in Fig. 10, *which defines* the allowable operating region for [...]

It and *which* subjects have been allocated to the categories mentioned below in accordance with their respective antecedents.

In what follows, the relevant verbs/predicates (4.3.1) and subjects plus predicates (4.3.2 ff.), both of which occur in instances of 'secondary subjectification', are defined, counted and described, and the results of the analysis presented in descending order of frequency. Finally, another equivalence-relevant category, i.e., the subject+verb[transitive, active]+object[direct]-structure fulfilling the constraint of 'secondary subjectification', which contains subjects and predicates of all the following types will be presented and discussed (4.3.3).

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[41]   Expanded AcI construction means that the infinitive is *to be* plus past participle. This structure is typical of English technical discourse (Gerbert 1970:63), (see 3.1.2.1.5).

4.3.1 Verbs/predicates occurring in instances of 'secondary subjectification':

The following categorization of verbs/predicates into related semantic areas is based on the data found in the corpus and partly goes back to Rohdenburg (1974).

a) Verbs designating indication (in the broadest sense), verification, prediction, conclusion, such as *indicate, summarize, illustrate, show*[42], *compare, list, verify, predict*, etc.

b) Verbs designating a change of state, such as *reduce, limit, decrease, consume* ('degressive' change) and *increase, improve* ('progressive' change).[43]

c) Verbs designating result or achievement, such as *cause, achieve, produce, result in* and *lead to*. These verbs commonly occur in the context of a "cause and effect relationship" (Sager et al. 1980:190) with the cause being denoted by the subject and the effect by the predicate.

d) Verbs designating enablement, e.g., *allow, permit.*

e) Verbs designating need, e.g., *need, require.*

f) Verbs designating prevention and replacement, e.g., *prevent, avoid, replace, eliminate.*

g) Verbs designating inclusion, involvement and provision, e.g., *cover, include, involve, provide.*

h) Verbs designating suggestion, e.g., *suggest, assume.*

i) Verbs designating use, e.g., *use, utilize.*

Other verbs/predicates involved in 'secondary subjectification' are, e.g., *direct, favour, add, define, trap*, etc.

It is worth noting at this point that some of the above predicates, i.e., the semantically strong verbs, are expanded by verbs of 'trying', e.g., *attempt, try*, by modal auxiliaries, e.g., *can*, functional verb structures (see example below) or other verbs which take on a more structural function in this context, e.g., *help*. For example:

> These results indicated that the agglomerated coal *has the potential to allow* processing at higher severity to increase pitch conversion and distillables yield.

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[42] The verb *show* is one of the few verbs where a 1:1-correspondence may lead to equivalence. However, as the investigation shows, TL register-induced shifts could be ascertained as per the corpus under analysis which will be discussed here (4.3.2.1.1).

[43] The terms "degressive" and "progressive" in this context derive from Reinhardt et al. (^{3}1992:150-154).

4.3.2 Subject types plus predicates occurring in 'secondary subjectification' and their potential equivalents

In the following, six subject types plus predicates will be investigated in detail. These subject types are: 4.3.2.1 'documentary' subjects, 4.3.2.2 concrete chemical substances/technical objects and processes/methods in subject position, 4.3.2.3 deverbal and verbal nouns, 4.3.2.4 *this*-subject, 4.3.2.5 names of institutions, consortia, etc. as subjects, and 4.3.2.6 Others.

4.3.2.1 'Documentary' subjects
(plus predicate type a), in particular, and types c), d), g), h), and others)

Since 'documentary' subjects account for the largest subject category (42%) (61 occurrences) and can be considered 'universals' of STT, they will be dealt with in greater detail. A 'documentary' subject is defined for the purpose of this investigation as a subject that refers either overtly or covertly to a documentation, e.g., *report*, *table, fig.*, for overtly 'documentary' subjects, and, e.g., *experiments, data, results*, for covert documentation, i.e., cases in which the documentary character of the subject is implicit. These subjects often occur in concatenation with verbs of indication (see 4.3.1. a) above), but also with other verbs designating for example enablement (see 4.3.1. d) above). For the typological reasons discussed before, 'secondary subjectification' is almost always present in these instances.[44] The predicates of overtly 'documentary' subjects, in particular, can be expanded by verbs of 'trying' (*try, attempt, set out*) (cf. also Rohdenburg 1972:112-113), e.g., "A more fundamental study attempted to characterize the residues". It is interesting to note that Rohdenburg (op. cit.:112), who quotes three instances of what we call overtly 'documentary' subjects in English, without, however, either investigating them any further or considering the translation angle, claims that this structure is possible though unusual in German. Gnutzmann (1991:12), on the other hand, suggests in his contrastive analysis of "the communicative functions of the author's aims in introductions to English and German research articles" (op. cit.:15) that the appearance of this structure in German (he also mentions only a fairly limited amount of instances (op. cit.:12 no. 4) may be due to borrowing of this pattern by German authors who habitually quote from English sources - an argument which is very

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[44]   ⁻But see f.n. 42.

plausible. However, since there is no translational link between the texts he investigated, he does not - and cannot - give any hints as to how the problem may be solved and equivalence in translation achieved.[45] How equivalence in translation is in fact achieved with this structure can only be demonstrated on the basis of a translation corpus and will be shown in what follows.

First of all, however, an overview of the most frequently repeated 'documentary' subjects plus predicates occurring in the corpus is given below:

'Documentary' subjects and their predicates:

study	verify, concentrate on, focus on, suggest, indicate, involve, provide, conclude, show, attempt to characterize, lead to
report	review, summarize, tie together, illustrate, cover, attempt to relate
fig.	show, summarize, compare, define, allow
table	list, include, summarize
result/analysis	indicate, show, permit
experiment	suggest, indicate
data/work	allow, show
program	emphasize, focus on, address
Others: e.g., summary	tie together
test	show

As the overview shows, this subject type can occur with a variety of predicates. As mentioned before, it accounts for 42% of all subjects in the structure under analysis. 85% of the verbs/predicates are non-prepositional verbs and 15% are prepositional verbs (e.g., *focus on, concentrate on*). All prepositional verbs have a prepositional object complement. The complements of the non-prepositional verbs are *how*-clauses (12%), *that*-clauses (21%) and direct objects (67%).

Owing to equivalence-relevant shifts observed on the basis of the corpus, this subject group will be subdivided into two categories, i.e.:

Category 4.3.2.1.1   'documentary' subject+verb$_{[non-prepositional/prepositional]}$+complement$_{[direct\ object,\ how-clause/prepositional\ object]}$ and

Category 4.3.2.1.2   'documentary' subject+verb$_{[non-prepositional]}$+*that*-clause

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4.3.2.1.1 'Documentary' subject+verb[non-prepositional/prepositional]+complement[direct object, how-clause/prepositional object]

This category acccounts for 82% (50 occurrences) of all 'documentary' subjects plus predicates. Of these predicates 82% are non-prepositional verbs and 18% prepositional verbs. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   58%
German predicate types in descending order of frequency: passive
(both normal and statal, plus impersonal expressions, e.g., *es*,
plus modal auxiliary), intransitive active, passive variants (reflexive),
all predicates involving considerable transposition and modulation.

Example:
Table 1 summarizes the operating conditions resulting in the highest pitch and coal conversions.

In Tabelle 1 sind die Betriebsbedingungen, die zu den höchsten Pech- und Kohleumsätzen führen, *zusammenfassend dargestellt*.

ii) Subject-oriented structure retained in German   40%
German predicates: 1:1-correspondence (for *show*)[46], modulated
and transposed verbs, reflexive verbs.

Example:
Figure 5 compares the results for each of the above catalyst types [...]

Bild 5 zeigt die mit den o.g. Katalysatortypen [...] *erzielten Ergebnisse im Vergleich*.

iii) Others   2%

Although the results show a lead for prepositional phrasing, the percentages also imply the possibility of retaining the English subject-oriented structure in German in certain cases. Precisely because the availability of German verbs with 'documentary' subjects is so limited due to semantic constraints (Gnutzmann 1991:12), retention of this structure requires considerable transposition and/or modulation of the verb involving 0:1-correspondences, taking account of the sentential co-text and the context, which is in this case the document itself, to achieve equivalence at the lexical-semantic level, e.g.:

Figure 1 summarizes the overall program and *shows* how each area is interrelated.

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[46] German *zeigen* for English *show* in subject-retained structure, i.e., 1:1-correspondence, accounts for 14% of the translation solutions in ii).

Bild 1 gibt einen zusammenfassenden Überblick über das Gesamtprogramm und *verdeutlicht*, wie die einzelnen Bereiche zusammenhängen.

In the above example, the first predicate is class-shifted to an adjective within a functional verb structure (verb+noun), with the semantics of the English predicate being reflected by the German adjective, whereas the second predicate is modulated in translation. In subject-retained translation solutions, verb-to-noun class shifts, too, involving the use of functional verbs, other verbs, *haben* or *sein*, and/or further shifts may be the key to equivalence in the TT (see also example under ii) above).

Certainly, prepositional phrasing would have been possible both in the above example and in example ii), which shows that, in addition to the semantic constraint, register aspects come increasingly to the fore in this context. Although German scientific and technical register favours adverbial qualifications instead of subjects at the beginning of the sentence (Beneš 1976:95) - an aspect which correlates with the findings of this analysis so far - it cannot endure tedious repetition of certain English syntactic-semantic structures, such as are frequent with 'documentary' subjects. For instance, the 'documentary' subject plus the verb *show*, which accounts for 33% of all verbs in concatenation with 'documentary' subjects, gives rise to a variety of potential equivalents on a textual basis,[47] such as:

ex.: Fig. x shows y	Bild x zeigt/verdeutlicht y
	aus Bild x ist y ersichtlich
	in Bild x ist y dargestellt
	y kann Bild x entnommen werden
Others: tests showed	Versuche ergaben/zeigten
studies showed	aus den Untersuchungen ergaben sich

In this context, it is also interesting to note that the *Zustandspassiv* (Duden vol. 4, [5]1995:210) (statal passive) rather than the *Vorgangspassiv* (op. cit.:209) (normal passive) (e.g., *ist* ≠ *wird dargestellt*) is the equivalent verb form used with overtly 'documentary' subjects translated by prepositional phrasing in German.

Repetition is also avoided in the translation of the following frequently repeated structure "studies focused on/concentrated on", which resulted in the following potential equivalents:

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[47]   Checking against a TL parallel text (Dolkemeyer et al. 1989) corroborated this result.

studies* focused on/concentrated on	die Untersuchungen hatten [...] zum Schwerpunkt
	Schwerpunkte der Untersuchungen waren [...]
	Im Rahmen der/In den/ Untersuchungen wurden
	im wesentlichen/schwerpunktmäßig [...] behandelt.
	Bei den Untersuchungen ging es schwerpunktmäßig/
	im wesentlichen um [...]
also:	Der Schwerpunkt der Untersuchung wurde auf [...]
	gelegt. (Lenz et al. 1988:17)

(The past participle of focus is written with one *s* and with double *ss* in the corpus.)
*Different subjects (here: *area, program*) may lead to modulation of not only the predicate but the subject as well, e.g.:

This *area* focused on   Der hier angesprochene *Themenkreis* bezog sich im wesentlichen auf

A class shift from verb to adverb+functional or other verbs is the key to equivalence within prepositional phrasing. This shift is also applicable in those cases in which the noun *study* is implicit, e.g.:

Residue utilization/characterization *focussed on* [...] Bei der [...] *ging es schwerpunktmäßig*
um

So, potential equivalents for *focus on/concentrate on* are: *sich schwerpunktmäßig beziehen auf, im wesentlichen gehen um, zum Schwerpunkt haben, den Schwerpunkt legen auf.*

Although the interchangeability of these potential equivalents may be constrained by further supra-sentential aspects of cohesion and coherence, such equivalents are precisely what translators might reasonably expect from a translation-geared dictionary. How the above findings can help establish equivalence in the other translation direction can be demonstrated with the following example:

In diesen Arbeiten wurden im wesentlichen folgende Faktoren *untersucht.*
Research work carried out in this field concentrated on/focussed on/ examining the following factors.

As regards the translation solutions with prepositional phrasing, it is interesting to note that there is a wide variety of predicate forms, with the passive being the most frequent one (see i) in the presentation of results). Here, too, we find transposition and modulation of predicates. The following class shifts could be ascertained:

verb-to-adverb+functional verb	e.g.: Table 1 *summarizes* x
	In Tabelle 1 *sind zusammenfassend dargestellt*
verb-to-adjective+sein	e.g.: Fig. 12 *shows* x
	Aus Bild 12 *sind* [...] *ersichtlich*

In some cases in which two semantically similar predicates occur in one sentence, equivalence is achieved by a 1:0-correspondence for one of the predicates in the TT, e.g.:

Table 2 *lists* the operating conditions [...] and also *includes* results [...]
In Tabelle 2 *sind* [...] sowie auch [...] *aufgeführt.*

It is also interesting to note that in those instances in which the predicate is expanded by a verb of 'trying', prepositional phrasing plus transposition of predicate is the key to lexical-semantic equivalence, as in:

A more fundamental study attempted to characterize the residues [...]
In einer eher grundsätzlich angelegten Untersuchung wurde der Versuch unternommen, die Rückstände [...] *zu charakterisieren* [...]

It should also be noted that in 10% of all translation solutions (including the 'Others' category), supra-sentential aspects of cohesion and coherence came into play and influenced equivalence at the syntactic and lexical-semantic levels. This, certainly does not invalidate the above findings.

4.3.2.1.2 'Documentary' subject+verb[non-prepositional]+*that*-clause

This category acccounts for 18% (11 occurrences) of all 'documentary' subjects plus predicates. This subject type plus predicate plus *that*-clause complement accounts for 21% of all 'documentary' subjects plus transitive verbs. The distribution of translation solutions for this category is as follows:

i) Shift from verb to preposition with elimination   36%
of subordinate *that*-clause involving 1:0-correspondence for the verb

Example:
However, *the X economic analysis indicated that* [...]

Der Wirtschaftlichkeitsanalyse von X zufolge ist jedoch [...]
(also: *Nach der Wirtschaftlichkeitsanalyse von X ist* [...])

ii) Prepositional phrasing + intr. active verb (prepositional verb)   64%

Example:
Previous work at X showed that [...]

Aus früheren bei X durchgeführten Arbeiten ging
hervor, daß [...]

The elimination of the subordinate clause in i) contributes to economy of expression in the TT, in particular, when there are two English sentential clauses exhibiting 'secondary subjectification', one of which is translated by prepositional phrasing, as in the following example:

These results indicated that the agglomerated coal has the potential to allow processing at higher severity to increase pitch conversion and distillables yield.

Diesen Ergebnissen zufolge kann mit agglomerierter Kohle eine Verarbeitung bei schärferen Bedingungen zur Erzielung höherer Pechumsätze und destillierbarer Ausbeuten *erfolgen.*

The translation solution under i) is certainly also possible with other subject types in the same English structure, as in the following example:

This correlation indicates that [...]   Nach dieser Korrelation [...]

When taken together, the two categories exhibit the following translation trends in per cent:

Table 46   Distribution of translation solutions for 'documentary' subjects (categories 4.3.2.1.1 and 4.3.2.1.2)

Prepositional Phrasing	59%
Subject-oriented structure retained in German	33%
Others	8%

The German prepositions/prepositional word groups (Beneš 1976:93) (see Chapter 3, f.n. 45) and pronominal adverbs (Duden vol. 4, [5]1995:626 ff.) established are: *in/im/darin* and *aus* (these are the most frequent), *bei, nach, zufolge, hierzu* and *anhand/mit Hilfe von.*

4.3.2.2 Concrete chemical substances/technical objects and processes/methods in subject position (plus predicate types b) - g), i) and others)

These subjects are either concrete chemical substances/technical objects in subject position some of which having an instrumental role (Quirk et al. [13]1995:10.21; cf. also Göpferich 1995a:339), or processes/methods. Examples of these subjects plus predicates are given in the following:

'chemical' subjects:

coal derived liquid product, solids free product	result in, require
additive	avoid, increase, decrease, act as
VGO, HGO, solvent, residue	result in
blend	provide, result in
agglomerated coal, catalyst	(to have the potential to) allow
heteroatom content/sulphur content	limit, favour

equipment:

bench-scale unit, unit	result in, require
plant	require

processes and methods:

process	need, result in, require
measurement technique	use
method	result in

This subject type accounts for 19% of all subjects in the structure under analysis (27 occurrences). Since it may well be assumed that there are different equivalence-relevant results for subjects plus non-prepositional verbs plus direct objects and for subjects plus prepositional verbs plus prepositional objects for syntactic-semantic reasons, the following two categories will be investigated:

Category 4.3.2.2.1   Subject plus non-prepositional verb plus direct object

Category 4.3.2.2.2   Subject plus prepositional verb plus prepositional complement[48]

4.3.2.2.1   Subject plus non-prepositional verb plus direct object

The subjects plus predicates in this category account for 52% (14 occurrences) of all the subjects plus predicates investigated in 4.3.2.2. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   64%

Example:
The measurement technique used a [...] Gamma-ray densitometer unit [...]

Bei diesem Meßverfahren kam ein [...] Gamma-Dichtemesser [...] zum Einsatz,

ii) Subject-oriented structure retained in German   36%

Example:
[...] where *the better catalyst would allow operation at higher severities,* i.e., higher temperatures or longer residence times, all other factors being equal.

[...] wobei *der bessere Katalysator einen Betrieb bei schärferen Bedingungen ermöglichen dürfte,* d. h. höheren Temperaturen oder längeren Verweilzeiten unter ansonsten unveränderten Bedingungen.

As the results show, there is a clear lead for prepositional phrasing in the search for lexical-semantic equivalence in the TT. On the basis of a larger translation corpus an investigation into a separate category for the concrete chemical

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[48]   In two instances the complement is a "subject predicative" (Greenbaum 1996:5.36) (see f.n. ⁻ 40).

substances/objects would certainly provide interesting data on the different degrees of acceptable anthropomorphization in English and German scientific and technical discourse. With some of the 'chemical' subjects encountered in the corpus, e.g., *blend, additive, catalyst* in concatenation with some non-prepositional verbs (see above listing), there seems to be a similar degree of anthropomorphization in the TL, which is reflected in the retention of the subject-oriented structure in the TT (see example under ii) above).

4.3.2.2.2   Subject plus prepositional verb plus prepositional complement

The subjects plus predicates in this category account for 48% (13 occurrences) of all the subjects plus predicates investigated. It is important to note that the prepositional verb *result in* accounts for 85% of the predicates in this structure. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   46%

Example:
The Nedol solvent results in a steady decline over the 200 h test indicating serious fouling of the catalyst surface [...]

Beim Nedol-Lösungsmittel kommt es zu einem kontinuierlichen Rückgang im Laufe des 200-h-Versuchs, was auf eine starke Verschmutzung der Katalysatoroberfläche [...] hindeutet.

ii) Subject-oriented structure retained in German   54%

Example:
AT WHSV = X, *the bench-scale unit resulted in lower pitch conversions* for all temperatures investigated [...]

Bei WHSV = X *lieferte die Laboranlage geringere Pechumsätze* bei allen untersuchten Temperaturen [...]

As the results show, there is an almost equal share of prepositional phrasing and retention of subject-oriented structure in the TT. With all translation solutions in this category there is a great variety of transposed and modulated verbs in German to avoid inappropriate repetition of one translation solution for *result in*, e.g., *führen zu*, in the TT, such as:

result in   führen zu, sich ergeben, ergeben, sich zeigen, kommen zu, aufweisen, liefern.

This shows how register aspects in the TL come into play and modify the lexical-semantic level to achieve overall textual equivalence.

Prepositional phrasing in German in this category is preferred in those cases in which the predicate *result in* is used in tandem with chemical substances/products, e.g., *solvent*, *HGO*, *residue*, etc., as subjects (see example under i)) to comply with the TL register requirements as regards the presentation of the conceptual reality underlying the text. This differs from what was said about 'chemical' subjects in concatentation with non-prepositional verbs in 4.3.2.2.1, which shows the need to consider always the close concatenation between subjects and the semantics of the respective predicates and their co-textual and contextual environment as well as TL register constraints when translating instances of 'secondary subjectification'. The following example shows how prepositional phrasing plus modulation of predicate (German intransitive verb *sinken*) is used to achieve lexical-semantic equivalence:

> Drying in the pulverizer reduced the moisture content to ≈13% while *all the other methods resulted in moisture contents* between 3.9% and 5.8%.

> Bei Trocknung in der Mühle sank der Feuchtegehalt auf ≈ 13 %, während *er bei allen anderen Verfahren auf Werte* zwischen 3,9 % und 5,8 % *sank.*[49]

With the subject-retained structure in the TT, there are 1:1-correspondences and modulated verbs (see example ii)). Additional semantic and terminological constraints can in fact lead to heavily modulated predicates to achieve lexical-semantic equivalence, as in the following example, in which the complement is a "subject predicative" (Greenbaum 1996:5.36):

> [...], indicating that *the additive acts as a good metal scavenger* for heavy metals present in the feed.

> [...], daß *das Additiv einen positiven Fängereffekt* für im Einsatzmaterial enthaltene Schwermetalle *hat*.

The concretization/personification of the English additive which can "act as a good metal scavenger" requires abstraction in the TL due to a different TL perspective involving further terminological considerations and implies considerable shifting at the lexical-semantic level, viz., "the additive has a positive scavenging effect" (back-translation).

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[49]   For a further discussion of this example from a terminological-phraseological point of view and involving aspects of cohesion and coherence, see 5.2.1.1, iv) 2:1-solutions.

Table 47 Distribution of translation solutions for concrete chemical substances/technical objects and processes/methods in subject position (categories 4.3.2.2.1 and 4.3.2.2.2)

Prepositional phrasing	56%
Subject-oriented structure retained	44%

It is interesting to note that prepositional phrasing in the TL is more common with non-prepositional/transitive verbs plus direct objects (see also 4.3.3) for semantic considerations. Such considerations may be further constrained by differences in the acceptable degree of anthropomorphization in the two languages as reflected in their respective registers. The German prepositions/pronominal adverbs established within prepositional phrasing are: *bei/beim* (most frequent ones), *mit, für, wodurch. Bei/beim* is particularly frequent in the translations for ST structures with the predicate *result in*.

4.3.2.3 Deverbal nouns and verbal nouns, i.e., gerunds, (Quirk et al. [13]1995:I.35, 17.52 ff.) (plus predicate types a) - d), g) and others) in subject position

The deverbal nouns under analysis are mostly abstract nouns with suffixes such as -*ation*, and -*ment*. There is an equal share of deverbal nouns (50%) (13 occurrences) and verbal nouns, i.e., gerunds, (50%) (13 occurrences). The deverbal nouns with the suffix -*ation* can be classified as 'mathematical' subjects and 'chemical' subjects. Examples of deverbal and verbal nouns plus predicates are given in the following:

-*ation*	'mathematical' subject	extrapolation	show
		correlation	indicate, help illustrate, predict
		duplication	produce
		integration	allow
-*ation*	'chemical' subject	agglomeration	achieve
		coal-oil combination (concrete)	include, result
-*ment*		requirement	increase
-*ing* (gerund)		drying	reduce
		processing	result in
		increasing	result in, cause, increase, decrease
		hydrotreating	improve, result in, consume

statistical modelling	define
landfilling	face
understanding	lead to

It is interesting to note that the gerundial subjects predominantly occur with predicates denoting a change of state (4.3.1. b)) or result (4.3.1. c)).

This subject type accounts for 18% (26 occurrences) of all subjects in the structure investigated. Since different trends in translation are expected for deverbal and verbal nouns for mainly syntactic but also lexical-semantic reasons, the following two categories are investigated:

Category 4.3.2.3.1   Gerund plus non-prepositional/prepositional
                      verb+direct object/prepositional object

Category 4.3.2.3.2   Deverbal nouns plus non-prepositional/prepositional
                      verb+direct/prepositional object/ or *that-/wh*-clause

4.3.2.3.1   Gerund plus non-prepositional verb/prepositional verbs+ direct or prepositional object

The gerund accounts for 50% (13 occurrences) of all subjects investigated in this category. In this subject plus predicate structure, the prepositional verbs account for 38%, the non-prepositional verbs for 62%. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   92%

Example:
Processing the same coal sample dried by the different methods at a relatively high severity of 450°C and a nominal WHSV of X *resulted in no significant difference* in almost all measured process variables.

Bei Verarbeitung der gleichen jedoch auf unterschiedliche Art getrockneten *Kohleprobe* unter relativ scharfen Verfahrensbedingungen von 450 °C und einem Nenn-WHSV-Wert von X *ergaben sich* in bezug auf fast alle Prozeßvariablen [...] *keine nennenswerten Unterschiede*.

ii) Others   8%

The result shows a very clear lead for prepositional phrasing in German and suggests that the aspect of prepositional/non-prepositional (transitive/intransitive) verb use is of minor relevance for gerundial subjects from the point of view of translation. As regards the German prepositions, *bei* accounts for 61% and *durch* for

31% (others: 8%). Here, too, it is noteworthy that considerable modulation in translation may be required to achieve equivalence at the lexical-semantic level, e.g.:

> Also, at this point, fluidized bed combustion is probably the most cost effective approach to disposal of this type of residue in a commercial scale coprocessing plant other than *landfilling which would face environmental constraints.*

> Derzeit stellt die Wirbelschichtverbrennung wahrscheinlich das kostengünstigste Entsorgungsverfahren für Rückstände dieser Art in einer großtechnischen Coprocessing-Anlage dar, da *bei einer Deponierung Umweltaspekte ins Spiel kommen.*

The following verb+noun (here: object) to (reflexive or intransitive) verb shifts could be ascertained:

Using x *resulted in separation* of y and z	Bei Einsatz von x *trennten sich* y und z
Increasing x *caused a decrease* in y	Bei Erhöhung von x nahm y ab

As regards the 'Others' category, supra-sentential aspects of cohesion, e.g., connection of two sentences by integrating one into the other, came into play and modified syntactic and lexical-semantic aspects of equivalence.

4.3.2.3.2 Deverbal nouns plus non-prepositional/prepositional verb+direct/prepositional object/ or *that-/wh*-clause

The deverbal nouns also account for 50% (13 occurrences) of all noun subjects under analysis. As mentioned above, these are mostly abstract nouns with the suffixes -*ation*, and -*ment*. Here the non-prepositional verbs account for 92% and the prepositional verbs for 8%. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   61%

Example:
For all coals, *agglomeration achieved the maximum ash rejection possible* based on [...]

Bei allen Kohlen *konnte mittels Agglomeration die größtmögliche Entmineralisierung* basierend auf [...] *erzielt werden.*

ii) Subject-oriented structure retained in German   31%

Example:
The X-Y combination results in the largest oxygen content since the X coal had the highest oxygen content.

Die Kombination aus X/Y wies den höchsten Sauerstoffgehalt auf, da die X-Kohle den höchsten Sauerstoffgehalt hatte.

iii) Others   8%

As the results show, there is a lead for prepositional phrasing plus passive verbs, reflexive verbs plus occasional modulation and/or transposition of verbs in the search for equivalence at the lexical-semantic level. Retention of the subject-oriented structure in the TT always requires modulation (see example under ii) above) and/or transposition (here verb to noun plus functional verb shifts) of the predicate, as in the following example:

All of these requirements *increase* the capital and operating costs of the [...] process.

Alle diese Anforderungen *führen zu einer Erhöhung* der Investitions- und Betriebskosten des [...]verfahrens.

The German prepositions established in prepositional phrasing are in descending order of frequency *bei*, *durch*, *mit/anhand/mittels* and *nach*.

Taken together, the overall result for 4.3.2.3.1 and 4.3.2.3.2 above is as follows:

Table 48   Distribution of translation solutions for deverbal nouns and verbal nouns, i.e., gerunds (categories 4.3.2.3.1 and 4.3.2.3.2)

Prepositional phrasing	77%
Subject-oriented structure retained	15%
Others	8%

With 77% for prepositional phrasing, there is a very clear trend towards this translation solution with the deverbal and verbal noun subject plus predicate category in general and with gerundial subjects (4.3.2.3.1), in particular, in the corpus under investigation.

4.3.2.4 *This*-subject (plus predicate types b) - d), f) - h) and others)

In the ST analyzed, the demonstrative pronoun occurring in subject position is a "pro-form" (Quirk et al. [13]1995:12.8-10) used for anaphoric reference to either a nominal antecedent or a textual antecedent[50] (see 6.1.2). It accounts for 10% of all

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[50]   In the first case, the antecedent is a single noun/compound noun occasionally plus adjective or a noun phrase (nominal reference), in the second case the antecedent may be the propositional content of a larger part of discourse, e.g., a clause, a sentence or an entire section of discourse or parts of these (textual reference) (cf. Quirk et al. [13]1995:6.44, who talk of "sentential antecedent"). For an in-depth analysis of *this* in demonstrative reference see Chapter 6 and there f.n. 15. In the present analysis, 20% of the instances of *this* are

subjects in 'secondary subjectification' (15 occurrences). Of the predicates in this structure, 67% are non-prepositional verbs and 33% prepositional verbs. The following predicate types occur with *this*-subject:

4.3.1	b)	decrease, reduce
	c)	lead to, result in
	d)	allow
	f)	prevent, eliminate
	g)	include
	h)	suggest, assume

Others: e.g., save, compare, trap.

The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   60%
(Use of pronominal (prepositional) adverbs)
(Duden vol. 4, ⁵1995:626 ff.)[51] [52]

Example:
This eliminated the costly process of preparing batches of dried coal under separate contract.

Damit wurde das kostspielige Verfahren zur Herstellung von Trockenkohle-Chargen unter einem weiteren Vertrag *umgangen*.

ii) Others   40%

Example:
This led to a new project to study the effects of the mode of coal drying on coprocessing performance [...]

[...], *was zu einem neuen Projekt* zur Untersuchung der Auswirkungen des Kohletrocknungsverfahrens auf die Verarbeitungsleistung beim Coprocessing [...] *führte*.

The results show a lead for prepositional phrasing in the TT which, in this case and in contrast to the prepositional phrasing discussed so far, is invariably introduced by pronominal (prepositional) adverbs. These pronominal adverbs are relational adverbs and like the English *this*-subject may function as anaphoric reference (Duden vol. 4, ⁵1995:628) in texts. Hence they contribute to cohesion and coherence in the German TT (see Chapter 6). The pronominal adverbs encountered in the corpus for *this* are:

| this | damit, hiermit, wodurch, wobei, daraus, hieraus |

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[51] used in anaphoric nominal reference and 80% in textual reference.
As stated in Duden (vol. 4, ⁵1995:626, f.n. 1), the designation "prepositional" only refers to the formational aspect, whereas the designation "pronominal" highlights the pronominal function of the adverb. The latter designation is given preference here, therefore.

[52] In one instance a causal adverb (Duden vol. 4, ⁵1995:619), viz., *daher*, was used.

The TT predicates involved are mainly passive verb forms, passive variants (reflexive verbs), impersonal expressions, e.g., *man*, or 1:0-correspondences in the case of two English predicates rendered by one German predicate for syntactic and semantic reasons.

The translation solutions in the 'Others' category are highly interesting in that they show how supra-sentential aspects of cohesion come into play and modify syntactic and lexical-semantic levels of equivalence. Here we find 1:0-correspondences for both subject and predicate and integration of the remaining sentence into the foregoing sentence (see 6.1.2), combination of two sentences into one again using pronominal adverbs or the relative pronoun *was*[53] which introduce a subordinate clause (see above example under ii)), as well as 1:1-correspondences, however, in tandem with a 0:1-correspondence, i.e., introduction of a German noun/subject as reference to a 'sentential antecedent', e.g.:

> *This* led to the design, installation and commissioning, outside of the consortium program, of a new reactor hydrogen quenching system [...]

> *Diese Problematik* führte deshalb - außerhalb des Konsortiumprogramms - zur Konstruktion, Installation und Inbetriebnahme eines neuen Wasserstoffquenchsystems am Reaktor [...]

Since the 'Others' category accounts for as much as 40%, the translator - in the case of *this*-subject - is well advised to take further aspects of cohesion and coherence into account when searching for equivalence at the lexical-semantic level. Owing to its important referential function, the demonstrative pronoun/determiner *this* will be further discussed in Chapter 6.

4.3.2.5 Names of institutions, consortia, companies as subjects (plus predicates)

Whether - from the point of view of translation - institutions, consortia, etc. may be metaphorically perceived as agentive or not depends on the semantics of the respective predicate and on the sentential co-text. For the purpose of this investigation, all names of institutions, consortia, etc. plus predicates, e.g., *carry out,*

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[53] As mentioned already in the investigation of the postmodifying present participle (see 3.3.1.2), the relative pronoun *was* always refers to the content of the main clause (Duden vol. 9, [4]1997:619) or here to the content of the foregoing sentence.

undertake, compare, plus direct objects are considered in order to find out whether and when the subjects may be perceived as agentive and how this is reflected in translation solutions.

This subject type accounts for 3% (4 occurrences) of all subjects in the structure under investigation. All of these subjects occur in subject+transitive verb+direct object structure. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German   50%

Example:
X also compared catalyst deactivation when hydrotreating the coprocessing heavy gas oil [...]

Bei X wurde ferner die Katalysatordesaktivierung beim Hydrotreating von schwerem Coprocessing-Gasöl [...] *verglichen.*

ii) Subject-oriented structure retained in German   50%

Example:

X also carried out a series of analytical studies on [...]

Darüber hinaus führte X eine Reihe von Analysen an [...] *durch* [...]

The results show an equal share of prepositional phrasing and retention of subject-oriented structure in the TT. This result also shows how the semantics of the SL predicate in its sentential environment in tandem with TL register considerations governs translation solutions. The TL register tolerance of perceiving these subjects as agentive, which may lead to a retention of the subject-oriented structure in the TT, is obviously higher with verbs such as *undertake* (*unternehmen*) and *carry out* (*durchführen*) than with other more specific process-related verbs such as *compare* (*vergleichen*) (see above examples) or *analyze*. In the following example, the *-ing* forms *analyzing* and *comparing*[54] became the predicate of the TT sentence due to considerable shifting at the syntactic level, with a 1:0-correspondence for the English predicate:

X carried out a work-in-kind contribution to the consortium program by analyzing and comparing the economics of different coprocessing areas.

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[54]   For an investigation of the gerund used as adverbial phrase see 3.3.2.

Bei X wurden die Wirtschaftlichkeitsfaktoren der verschiedenen Coprocessing-Fälle *im Rahmen eines Sachleistungsbeitrags* zum Konsortiumprogramm *analysiert* und *verglichen*.

This change in predicate obviously triggered prepositional phrasing in the TT to achieve equivalence at the syntactic and lexical-semantic levels. The investigation of these subjects plus their predicates on the basis of a larger corpus would be a fruitful area of further research to find out more about the translation-relevant differences in the perception of agentiveness of consortia, companies, etc. in the two languages. The only German preposition encountered in prepositional phrasing is *bei*.

4.3.2.6 Other subject types

The remaining subject types are general abstract nouns which occur with the predicate types c), e) - g) and others, e.g.:

use, use (of)	require, produce, avoid
presence (of)	result in
approach	involve
selection process	try to satisfy

These subjects account for 8% (12 occurrences) of all subjects in the structure under investigation. Of the predicates in this structure, 67% are non-prepositional verbs and 33% prepositional ones. The distribution of translation solutions for this category is as follows:

i) Subject transposed to prepositional phrasing in German 67%

Example:
The selection process tried to satisfy the needs and desires of each consortium member.

Bei der Projektauswahl bemühte man sich, die Bedürfnisse und Wünsche jedes einzelnen Konsortiummitglieds *zu berücksichtigen*.

ii) Subject-oriented structure retained in German 33%

Example:
The study of the molecular structure of [...] *can lead to* more insight into [...]

Eine Untersuchung der molekularen Zusammensetzung der [...] *kann* genauere Erkenntnisse über [...] *liefern*.

The results show a clear trend towards prepositional phrasing in the TT for the structure under investigation. In the two translation solutions the predicate again

may undergo considerable transposition and modulation. The translation solution of prepositional phrasing also includes pronominal adverbs, as in the following example:

The approach involved emulsification of the residue in water [...]
Hierbei ging es um eine Emulgierung des Rückstands in Wasser [...]

The German prepositions/pronominal adverbs occurring within prepositional phrasing are *bei, in* (these are the most fequent ones), *hierbei* and *wodurch*.

A combination of the results for categories 4.3.2.1 to 4.3.2.6 gives the following overall result for the structure under investigation:[55]

Table 49   Distribution of translation solutions for all instances of 'secondary subjectification' (categories 4.3.2.1 to 4.3.2.6)

Prepositional phrasing	62%
Retention of subject-oriented structure	29%
Others	9%

As the overall results show, prepositional phrasing - in tandem with passive verbs, passive variants, and others as predicates - is the key to equivalence at the lexical-semantic level in 62% of all translation solutions. In 29% of the cases, equivalence is achieved by retaining the subject-oriented structure in the TT, which almost always involves considerable transposition and/or modulation of predicate. In 9%, further aspects of cohesion and coherence involving supra-sentential translation solutions come into play and modify the syntactic and lexical-semantic levels of equivalence. It should be stressed that this overall result merely reflects a general tendency, since the figures may vary within specific categories, as we have seen (see, e.g., the result for gerunds in 4.3.2.3.1).

The distribution of the German prepositions (also: preposition+article), pronominal adverbs, etc. established in the TT within prepositional phrasing and with some of the translation solutions under 'Others' is given in the following:

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[55]   The overall result for the categories investigated has been published in Krein-Kühle (2001).

Table 50 Distribution of German prepositions/pronominal adverbs established with the translation solutions for instances of 'secondary subjectification'

bei (*beim*)	29%
in (*im*)	17%
pronominal adverbs: *damit, darin, daraus, hieraus, hierbei,*	
hiermit, hierzu, wobei, wodurch	16%
aus	15%
mit, mit Hilfe von, anhand/mittels	7%
durch	7%
nach/zufolge	4%
für	3%
Others, e.g., relative pronoun *was*	2%

Finally, another equivalence-relevant category (4.3.3), i.e., the subject+verb[transitive, active]+object[direct]-structure fulfilling the constraint of 'secondary subjectification', which contains subjects and predicates of all the above categories, will be presented and discussed in the following.

4.3.3 Subject+verb[transitive, active]+object[direct]-structure fulfilling the constraint of 'secondary subjectification'[56]

For the typological reasons outlined in the introduction to this section, it is precisely this frequently used structure which makes equivalence difficult to achieve. While a tentative kind of 'conversion rule' for translating the above structure, although without the mentioned qualification, has been suggested by Franck (1980:22-23),[57] Schröter ([3]1990:28) and, already in a modified form, by Krein-Kühle (1995a:64-65), this 'rule' has never been verified on the basis of a complete ST-TT pair in context, and may be considered somewhat too general.

The above structure accounts for 58% (84 occurrences) of all instances of 'secondary subjectification' established on the basis of the corpus. It contains subjects and predicates from all of the above categories. Owing to the large amount of

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[56] This definition correlates to some extent with Rohdenburg's (1974:106) definitional criterion d., i.e., "nichtmetaphorisch verwendete unbelebte oder als nichtintentionsfähig verstandene Subjekte in Verbindung mit transitiven Verben, die belebte und intentionsfähige (agentiv- oder experiencerfähige) Subjekte wählen." (Non-metaphorically used inanimate subjects or subjects incapable of expressing intention in concatenation with transitive verbs which choose animate (agentive or experiencer) subjects capable of expressing intention) (my translation).

[57] (E) subject+verb (transitive, active)+object ⇔ (G) prepositional phrase+verb (either intransitive active or transitive passive)+subject.

documentary subjects (4.3.2.1), which account for 39% (33 occurrences) of the subjects investigated here, these are given separate consideration in 4.3.3.1. The remaining subjects, accounting for 61% (51 occurrences), are dealt with in 4.3.3.2. The results in translation trends for these two categories will be presented and discussed in the following:

4.3.3.1 Documentary subjects+verb[transitive, active] +object[direct]

These subjects account for 39% (33 occurrences) of the subjects in the category under investigation. The distribution of translation solutions for this category is as follows (for examples see 4.3.2.1.1):

      i) Subject transposed to prepositional phrasing in German   61%
      ii) Subject-oriented structure retained in German   36%
      iii) Others   3%

It is interesting to note that this result correlates to some extent with the overall result for 'documentary' subjects under 4.3.2.1.

4.3.3.2 'Non-documentary' subjects+verb[transitive, active]+object[direct]

These subjects account for 61% (51 occurrences) of the subjects in the category investigated. The distribution of translation solutions for this category is as follows:

      i) Subject transposed to prepositional phrasing in German   71%
      (prepositions and pronominal adverbs)

      Example:
      Statistical modelling of reactor performance *can define allowable operating regions* [...]

      Durch statistische Modelluntersuchungen der Reaktorleistung *lassen sich zulässige Betriebsbereiche definieren* [...]

      ii) Subject-oriented structure retained in German   23%

      Example:
      Each had a separate set of priorities and interests *which directed their respective objectives.*

      Jedes Teilnehmerland hatte eigene Prioritäten und Interessen, *die für die jeweiligen Forschungsziele ausschlaggebend waren.*

      iii) Others   6%

As the results show there is a clear preponderance of prepositional phrasing in the search for equivalence when translating the structure under analysis into German. Compared with the results for 'documentary' subjects in 4.3.3.1 above and under 4.3.2.1, the percentages shifted somewhat implying that the retention of the English subject-oriented structure in German is more likely with 'documentary' subjects - although there is still a clear lead for prepositional phrasing - and less likely with the other subjects in the structure under investigation. Again retention of the subject-oriented structure in German involves considerable transposition and/or modulation of the predicate for semantic reasons (see example under ii)).

The investigation of the above two categories also revealed the ranking in descending order of frequency of German verb forms used with prepositional phrasing, which is as follows: *Vorgangspassiv* (normal passive), intransitive active verbs, passive variants, such as reflexive verbs, so-called *Wortbildungsmittel* (Duden vol. 4, ^{5}1995:317.7, 943 ff.), i.e., transposition into another word class by suffixation, for instance -*lich*, or functional verb structures (*Funktionsverbgefüge* op. cit.:317.5), *Zustandspassiv* (statal passive), as well as impersonal expressions, e.g., *man* or *es*. The ST predicate which is passivized in the TT may additionally undergo modulation and may be extended by a modal auxiliary, e.g., *können*. The passive voice in German has a considerable wealth of forms, some of which, on the basis of the above ranking, have proved to be of particular relevance in the search for equivalence in STT.

As regards the 23% of cases in which the English subject is maintained in the TL, aspects of acceptable anthropomorphization in German (involving 1:1-correspondences) and further lexical-semantic aspects come into play. Retaining the English subject in German frequently calls for transposition and/or modulation for semantic reasons (see example under ii)).

It should also be noted that in 18% of all translation solutions in 4.3.3.2 (including the translation solutions under 'Others'), supra-sentential aspects of cohesion and coherence came into play and led to futher modifications of the syntactic and lexical-semantic levels of equivalence. This was due, in particular, to the presence of *this*-subject in the analysis (4.3.2.4 and Chapter 6). Certainly, this aspect does not invalidate the above findings.

Taken together, the results for the above two categories yield the following figures:

Table 51   Distribution of translation solutions for subject+verb[transitive, active]+object[direct]-structure fulfilling the constraint of 'secondary subjectification' (categories 4.3.3.1 and 4.3.3.2)

Prepositional phrasing	67%
Subject-oriented structure retained	28%
Others	5%

This result underpins the general trend towards prepositional phrasing in the TT for the structure under investigation and the general validity of the conversion 'rule' mentioned earlier. However, the results also show that this 'rule' cannot be considered absolute but only dynamic and has to be relativized on a text-in-context basis, because against this background other translation solutions, too, may contribute to both syntactic and lexical-semantic equivalence. Although the above figures correlate to some extent with those established for the categories discussed in 4.3.2.1 - 4.3.2.6, the percentage for prepositional phrasing is higher and that for the 'Others' translation solutions lower compared with the results given in Table 49, a fact which certainly has to do with the transitivity of the predicates.

In textual terms, the distribution of the figures established for categories 4.3.2.1 - 4.3.2.6, which constitute the benchmark for the feature of 'secondary subjectification', is very interesting in that it implies that the achievement of overall textual equivalence involves a good 60% of prepositional phrasing, a bare 30% of subject-oriented structures and a mere 10% of other translation solution with the structure under investigation.

4.3.4   Results for verbs/predicates in 'secondary subjectification'

As regards some of the predicates occurring in instances of 'secondary subjectification' in the ST, the following potential equivalents, which appear both within prepositional phrasing and subject-retained structure in the TT in both transposed and/or modulated form, were established on the basis of the corpus:

<u>Verbs designating result or achievement (4.3.1. c))</u>, such as *achieve, produce,*
result in and *lead to.* In the case of the verb *achieve,* equivalence is obtained in all
cases with German *erzielen.*[58] Potential equivalents for *produce* are *sich ergeben* and
führen zu.[59] Of all prepositional verbs in 'secondary subjectification' *result in* and
lead to account for 65% (*result in* 54%, *lead to* 11%). Since these two verbs and
result in, in particular, occur in the corpus with such a high frequency, an
investigation of all instances of *result in* and *lead to* used in the corpus as predicates
revealed the following interesting trend in translation solutions: For semantic and
register reasons, 47% of the subjects in concatenation with these two verbs are
translated by prepositional phrasing in German, as against 41% in which the subject-
oriented structure is maintained and 12% Others. In all cases there is a great variety
of transposed and modulated verb forms in the TT. Potential equivalents for these
two verbs are:

> führen zu, aufweisen, liefern, ergeben, sich niederschlagen in, sich ergeben, sich
> zeigen, kommen zu.

The establishment of a list of predicates used with inanimate subjects in
'secondary subjectification' in STs as well as their translation solutions both within
subject-retained structures and prepositional phrasing on the basis of a larger corpus
would be a fruitful area of further research.

It is noteworthy that in 19% of all translation solutions for *result in* there is a
verb-plus-complement to (passive) verb (also: *sein*)+adjective shift in the TT, e.g.:

> [...] hydrotreating [...] *resulted in enormous improvement* in FCC performance.
> [...] *durch Hydrotreating* [...] [*wurde*] das Betriebsverhalten beim FCC *stark verbessert.*

In these instances in which *result in*+noun obviously functions as a functional
verb structure, equivalence at the lexical-semantic level is achieved by a semantically
appropriate verb or *sein*+adjective. This is certainly also true of other verbs in such
structures , e.g., *cause a decrease - abnehmen,* within prepositional phrasing in the
TT.

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[58]   The verb *erzielen* is also used in all other instances of *achieve* in the corpus (this also
involves substantivation (cf. Infinitives, 3.1.3) and 1:0-correspondences for register
reasons).

[59]   All other instances of *produce* in the corpus result in the following potential equivalents:
ergeben, sich ergeben, herstellen, erstellen, produzieren, erzeugen, erzielen (this again
involves substantivation (cf. Infinitives, 3.1.3) and 1:0-correspondences for register
reasons).

It is assumed that an investigation of English functional verb structures (having semantically weak verbs+semantically strong nouns) and their potential German equivalents may reveal a trend towards semantically strong verbs in German,[60] whereas an investigation of these verbs, in particular when they are complemented by adverbs, may reveal a trend towards functional verb structures in English involving an adverb-to-adjective shift, e.g.:

> Das setzt voraus, daß sie [die Kolbenringe] mit ihrem Umfang *dicht* an der
> Zylinderwand und mit einer Flanke an der Kolbennutenflanke *anliegen*.
> (Kolbenring-Handbuch 1995:6, italics added).

> This requires that the piston ring *makes a good fit* with both the cylinder wall and the
> top or bottom piston groove side. (my translation)

On the other hand, German functional verb structures may reveal a tendency towards full verbs in English and vice versa, e.g., *Anwendung finden - apply, use*.

Such an investigation would be very helpful in the search for equivalence at lexical-semantic level, but should be carried out on the basis of a more comprehensive corpus.

<u>Verbs designating enablement (4.3.1. d))</u>, e.g., *allow, permit*. These are translated by modal *können* (most frequent solution), reflexive *sich - lassen* and *ermöglichen* rather than *erlauben* (no occurrence).

<u>Verbs designating need (4.3.1. e))</u>, e.g., *need, require*, are translated by *erforderlich sein, erforderlich machen* or the modal auxiliary *müssen* rather than *erfordern, benötigen*. (*Brauchen* can be completely ignored for register reasons in the LSP context). Apart from one LGP use of *brauchen*, there are no instances of the latter three German verbs in the TT.[61]

<u>Verbs designating prevention and replacement (4.3.1 f))</u>, e.g., *prevent, avoid, replace, eliminate*. Apart from being translated by *verhindern*[62] prevent and avoid can also be transposed and modulated depending on the sentential co-text to *nicht erforderlich sein* (*to avoid the need to do*) or *verzichten können auf* (*to replace the*

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60 For a similar observation of instances of "verbalisation", in which English nouns are translated into Galician as verbs in a literary context, see Álvares Lugrís (1999).

61 In fact, *brauchen* occurs in the corpus only once in an LGP sentential co-text, see example under 4.1.2.4, end of section.

62 The German verb *vermeiden* is used once in the translation of an infinitive construction.

need for), if something negative or unwanted is 'avoided' or to *nicht möglich sein*, if something positive is 'prevented'. A potential equivalent for *eliminate* is *umgehen* (see example under 4.3.2.4).

Verbs designating inclusion, involvement and provision (4.3.1 g)), e.g., *cover*, *include, involve, provide*. These verbs often require modulation with the equivalent TL verb being found by taking the semantics of the sentential co-text into consideration. Potential equivalents for *include* are 1:0-correspondences (here also supra-sentential aspects of cohesion are involved), *gehören zu* and *zum Einsatz kommen*, for *cover*, *behandeln* and *sich beziehen auf*, for *provide*, *darstellen*, *hervorgehen aus*, and for *involve gehen um* and *durchführen*, e.g.:

> The [...] studies *involved* feedstock evaluations, [...]
> Im Rahmen der [...] Untersuchungen [...] *wurden* Bewertungen des Einsatzmaterials,
> [...] *durchgeführt*.

Verbs designating use (4.3.1 i)), e.g., *use, utilize*. Here, only the correspondences *verwenden, einsetzten*, and *anwenden* can be considered potential equivalents, since *gebrauchen* and *benutzen* clearly appear in LGP and do not belong to German scientific and technical register. Functional verb structures requiring a class shift in translation, such as *Anwendung finden* or *zum Einsatz kommen*, are potential equivalents which are preferred for register reasons (Gerbert 1970:39; Fluck [2]1997:97-98). However, depending on the degree of acceptable anthropomorphization, modulation of *use/utilise* to *arbeiten mit, funktionieren mit* (in particular with concrete technical subjects, such as machine, apparatus (see example a) below), in contrast to method or technique which cannot 'use'/'utilise' something in German, since they are perceived as abstract (hence prepositional phrasing is needed, see example b) below) can be the key to equivalence, in particular, if further translational shifts come into play (premodification of the postmodifying past participle (3.2.1.1.1) in example a)), as in the following examples:

> a) *The apparatus* designed to process the mixture *uses* a valve-controlled air-stream jet.
> *Das* zur Behandlung des Gemenges konstruierte *Gerät funktioniert/arbeitet mit Hilfe* einer
> ventilgesteuerten Luftstromdüse.   (Krein-Kühle 1995a:65)
> b) *The measurement technique used* a [...] Gamma-ray densitometer [...]
> *Bei diesem Meßverfahren kam* ein [...] Gamma-Dichtemesser *zum Einsatz* [...].

4.3.5 Summary of this section

For ease of reference a combination of the results for categories 4.3.2.1 to 4.3.2.6* is given below:

Table 52 Overview of translation solutions for instances of 'secondary subjectification'

Prepositional phrasing	62%
Retention of subject-oriented structure	29%
Others	9%

*4.3.2.1 'Documentary subjects', 4.3.2.2 Concrete chemical substances/technical objects and processes/methods in subject position, 4.3.2.3 deverbal and verbal nouns, 4.3.2.4 *this*-subject, 4.3.2.5 names of institutions, consortia, companies as subjects and 4.3.2.6 others.

As the above investigation has shown, there is a clear trend towards prepositional phrasing in translations into German of the analyzed English structures exhibiting instances of 'secondary subjectification'. This agrees with general LGP based findings (König 1973; Rohdenburg 1974; Hawkins 1986) on this subject and underpins the conversion 'rule' mentioned in (4.3.3). However, from the point of view of equivalence in translation it is interesting to note that other translation solutions, too, may contribute toward achieving not only syntactic and lexical-semantic, but also overall textual equivalence. This investigation shows that prepositional phrasing accounts for 62% and retention of the subject-oriented structure for 29% of the cases. And in 9%, further aspects of cohesion and coherence involving supra-sentential translation solutions come into play and modify the syntactic and lexical-semantic levels of equivalence. It should be stressed that this overall result merely reflects a general trend, since the figures may vary within specific categories. However, viewed against a textual background, it can be said that it is the interplay of the above translation solutions selected in compliance with TL register considerations that helps achieve overall textual equivalence, as is shown in the following example:

> *This report reviews* the three-year R&D program carried out in the X Consortium. *It summarizes* major accomplishments or achievements, *ties together* common research elements and *illustrates* how they are interrelated in the overall process development scheme. *The report attempts to relate* the impact of significant findings or results on overall process economics.

> *Der vorliegende Bericht gibt einen Überblick über* das 3jährige im X-Konsortium durchgeführte F&E-Programm. *Darin werden* die wesentlichen Ergebnisse *zusammengefaßt*, die einzelnen Forschungselemente *miteinander verknüpft*, und *es wird dargelegt*, wie diese Forschungselemente im Gesamtverfahrensablauf zusammenhängen. *In diesem Bericht wird auch*

versucht, den Einfluß der wesentlichen Erkenntnisse und Ergebnisse auf die Gesamtwirtschaftlichkeit des Verfahrens *deutlich zu machen*.

Retention of the subject-oriented structure invariably requires considerable transposition and/or modulation of predicate, except for the occasional 1:1-correspondence, as do many of the other translation solutions, which is an important aspect in the search for equivalence with this structure. It was also found that, apart from syntactic and lexical-semantic considerations, register aspects and supra-sentential aspects of cohesion and coherence influence the syntactic and lexical-semantic levels, a point which will be discussed further on the basis of demonstrative reference in Chapter 6.

The results of this investigation confirm the observation that German scientific and technical register favours adverbial qualifications instead of subjects at the beginning of the sentence (Beneš 1976:95) and also correlates with findings from contrastive special languages research indicating that this specific syntactic pattern in English not only contributes to economy of expression but also to the arrangement of information in the sentence by stressing the thematic function of the subject (Gnutzmann 1991:13). In English, as a '"fixed word-order language'" (Quirk et al. [13]1995:2.14), there is a close connection between the theme of the sentence and its subject (König 1973:32), this is not always the case in German where the function of word order is "to assign weights to the constituent parts of the train of thought" (Kirkwood 1966:179). In those instances in which prepositional phrasing occurs at the beginning of the sentence, it fulfils the same thematic function as the English subject. But also in other sentential positions it contributes as "equivalence in difference" (Jakobson [1959]1992) to cohesion and coherence in the German TT.

The preponderance of prepositional phrasing is even clearer with the structure investigated in 4.3.3, as the analysis has shown:

Table 53 **Overview of translation solutions for subject+verb**[transitive, active]**+object**[direct]**-structure fulfilling the constraint of 'secondary subjectification' (category 4.3.3)**

Prepositional phrasing	67%	(71%)
Subject-oriented structure retained	28%	(23%)
Others	5%	(6%)*

* The figures in parentheses refer to 'non-documentary' subjects in the above structure (4.3.3.2).

The investigation has also highlighted the difficulty of identifying instances of 'secondary subjectification' in view of the differences associated with the acceptable degree of anthropomorphization of the subject in the two languages involved. This aspect may depend on and vary with the technical domain under analysis. However, sets of verbs were established the presence of which may point to instances of 'secondary subjectification' (4.3.1, 4.3.4) and may give rise to prepositional phrasing in German. Pending further pre-translation LSP research work, translators are well advised always to consult TL parallel texts to establish the acceptable degree of anthropomorphization in a specific discipline as expressed via the register used.

Further research into 'secondary subjectification' in LSP and in scientific and technical translation is necessary to examine the underlying conditions of this typological difference between English and German in scientific and technical discourse. On the basis of a larger translation corpus a more detailed sub-categorization could bring to light further equivalence-relevant insights, e.g., establishing the prepositions that occur with specific types of subjects[63] within prepositional phrasing in TTs, the influence of abstract and concrete subjects on translation solutions, or predicate-related aspects, such as transitivity and intransitivity.

Finally, it should be said that it is precisely the structure investigated here that is often the reason for interferences in German (cf. also Gnutzmann 1991:12), so that translators in their search for equivalence should at the same time adopt a corrective approach.[64]

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[63] For example, it may be rightly assumed that with instrumental subjects translated by prepositional phrasing prepositions such as *mit, mittels, anhand, mit Hilfe von, durch* are very frequent.

[64] This structural interference has even found its way into the writings of translation scholars, e.g., "Der erste Abschnitt analysiert [...]" (Schmitt 1999:back cover)

4.4 Summary of this chapter

The investigation of *have* and *be* as main verbs, modal auxiliaries and instances of 'secondary subjectification' has shown how equivalence is established at the lexical-semantic level. The analysis of *have* and *be* reveals a clear trend towards more specific German verbs and other solutions in the search for equivalence in translating these English verbs. As regards *have*, more specific verbs and other solutions account for 70%, whereas *haben* only accounts for 30%. As regards *be*, there is also a clear trend towards more specific verbs (46%) and other translation solutions (16%) which together account for 62%, whereas *sein* accounts for 38%. Since *be* is not only the "most common" copular verb, but also the "most neutral" one in meaning (Quirk et al. [13]1995:16.23), consideration of the semantics of the complement and of the clausal and sentential co-text plays a pivotal part in achieving lexical-semantic equivalence. The categories investigated point to the importance of structural aspects, too, in the investigation of *be* as main verb, suggesting that specific structures lead to specific trends in translation solutions (see 4.1.2.4, 4.1.2.6). Jumpelt's early statement (1961:73) that the two verbs *have* and *be* must be rendered more specifically in indicating content in German has now been underpinned on a corpus basis. The verbs in question - though more specific than German *haben* or *sein* - still belong to what Pörksen (1986:188) calls 'pallid' verbs, which are a typical feature of German scientific and technical discourse. The methodological framework applied enables us not only to establish what these specific verbs are, but also to bring to light the nature and extent of the transposition and modulation required to achieve equivalence at the lexical-semantic level for the relevant structures under investigation. We have seen how syntactic and semantic aspects of equivalence may coincide and how the latter take priority over the former. Both aspects may be governed by pragmatic, i.e., register considerations. It is the established textual distribution of *haben* and *sein*, the use of more specific verbs and expressions as well as other translation solutions discussed in the individual categories that help achieve overall textual equivalence.

The investigation of the modal auxiliaries has yielded a wide variety of potential equivalents in the German TT including nonmodal and other solutions, depending on the semantics of a particular modal in a particular category and on

pragmatic considerations. 'Uncertainty' *may* (4.2.1.1.1) is rendered by modal adverbs in German (100%) and 'rhetorical' *may* (4.2.1.1.2) by nonmodal impersonal expressions (100%). Present relative to past axis' *might* (4.2.1.2.1) shows a trend towards modal adjective (50%) and present tense modal *können* (50%) plus the occasional modal expression *u.U.* With 'hypothetical' *might* (4.2.1.2.2) there is a trend towards past subjunctive (with or without additional modal expression) (67%) and other solutions (e.g., modal adjective) (33%).

The modals of necessity, i.e., *must* (*have to/had to*) and *need* (4.2.2) yield a very clear trend towards German modal *müssen* (100%). *Should* of logical expectation (4.2.3.1) leads to the past subjunctive of the German modals *müssen* (67%) and *dürfen* (33%). For *should* of recommendation/advisability (4.2.3.2) there is a clear trend towards the past subjunctive of German modal *sollen* (100%), whereas in the case of 'rhetorical' *should* (4.2.3.3), there is an even distribution of past subjunctive of modal *sollen* (50%) and modal construction *sein+zu+infinitive* (50%). The latter solution is also a potential equivalent for *should* of instruction (not in the present corpus). With 'objective' *can* (4.2.4.1.1), there is a trend towards modal *können* (63%) and modal reflexive verb *sich lassen* (37%), whereas 'rhetorical' *can* (4.2.4.1.2) yields a trend towards modal reflexive *sich lassen* (80%) and nonmodal reflexive verb construction (20%). In the case of 'deep past tense' *could* (4.2.4.2.1), there is a trend towards past tense of modal *können* (50%), past tense of reflexive *sich lassen* (33%) and others (17%), such as modal full verbs. 'Present relative to past axis' *could* (4.2.4.2.2) yields a trend towards present tense of modal *können* (57%) and present tense of *sich lassen* (14%), as well as other modal and nonmodal solutions (29%). 'Hypothetical' *could* (4.2.4.2.3) yields a trend towards past subjunctive of *können* (60%) and past subjunctive of *sich lassen* (10%) as well as other modal and nonmodal solutions (30%). In the case of 'regularity' *will* (4.2.5.1.1) and 'futurity' *will* (4.2.5.1.2), there is a clear trend towards nonmodal present tense solutions (100%). The German modal *sollen* is a potential equivalent for 'intentional' *will* (not in the corpus). For 'hypothetical' *would* (4.2.5.2.1) there is a clear trend towards the past subjunctive of various verbs (82%) (above all *dürfen* and *werden*), with nonmodal solutions accounting for 13% and other solutions for 5%. 'Present relative to past axis' *would*[65] (4.2.5.2.2) yields an equal share of

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[65]   This category includes one instance of 'deep past tense' *would* see 4.2.5.2.2.

nonmodal present tense solutions (50%) and modal solutions (50%), with some solutions reflecting the inconsistency in the use of *would* on the part of the author.

This investigation has not only yielded trends in translation solutions, but also shown how equivalence at the lexical-semantic level may be achieved and be influenced by pragmatic aspects, i.e., register considerations, in particular, to ensure equivalence at the overall textual level. It has been found that nonmodal forms are used in the TT for modal counterparts in the ST both for semantic reasons and on pragmatic, i.e. register, grounds. The results indicate a somewhat reduced need for "hedging devices" (Clyne 1991) in the German TT as compared with the English ST, an aspect which would be a fruitful area of further translational and LSP research.

The investigation of instances of 'secondary subjectification' has shown how detailed categorization of different subject types in concatenation with specific verbs has led to different trends in translation solutions (see respective categories). The subject types studied with specific verbs are 'documentary' subjects (4.3.2.1), concrete chemical substances/technical objects and processes/methods in subject position (4.3.2.2), deverbal and verbal nouns (4.3.2.3.), *this*-subject (4.3.2.4), names of institutions, consortia and companies as subjects (4.3.2.5), and others (4.3.2.6). A combination of the results for these categories has shown a clear trend towards prepositional phrasing in the German TT, which accounts for 62%. Retention of the subject-oriented structure accounts for 29%, and in 9% of the cases further aspects of cohesion and coherence involving supra-sentential translation solutions come into play and modify the syntactic and lexical-semantic levels of equivalence. Retention of the subject-oriented structure invariably requires considerable transposition and/or modulation of predicate, except for the occasional 1:1-correspondence, as do many other translation solutions, which is an important aspect in the search for equivalence with this structure. Viewed against a textual background, it is the interplay of the different translation solutions established that helps achieve overall textual equivalence. The results of this investigation confirm the observation that German scientific and technical register favours adverbial qualifications instead of subjects at the beginning of the sentence (Beneš 1976:95) and also correlates with findings from contrastive special languages research indicating that this specific syntactic pattern in English not only contributes to economy of expression but also to the arrangement of

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information in the sentence by stressing the thematic function of the subject (Gnutzmann 1991:13). In those instances in which prepositional phrasing occurs at the beginning of the sentence, it fulfils the same thematic function as the English subject. But also in other sentential positions it contributes as "equivalence in difference" (Jakobson [1959]1992) to cohesion and coherence in the TT.

The investigation has also highlighted the difficulty of identifying instances of 'secondary subjectification' in view of the differences associated with the acceptable degree of anthropomorphization of the subject in the two languages involved. However, sets of verbs were established the presence of which may point to such instances (4.3.1, 4.3.4). Pending further pre-translational LSP research work which should examine the underlying conditions of this typological difference between English and German in scientific and technical discourse, translators are well advised to consult TL parallel texts to establish the acceptable degree of anthropomorphization in a specific domain as expressed via the register used. A larger translation corpus and a more detailed categorization could bring to light further equivalence-relevant aspects, the influence of abstract and concrete subjects on translation solutions, or predicate-related aspects, such as transitivity and intransitivity. Since the structure investigated here is often the reason for interferences in German (Gnutzmann 1991:12), translators in their search for equivalence should at the same time adopt a corrective approach.

This chapter has shown how equivalence is established at the lexical-semantic level with the features investigated. Trends in translation solutions for these features have been established and it has also been shown how this level may influence and modify the syntactic level, but may itself be influenced and modified by pragmatic considerations. Apart from syntactic and semantic considerations, it is again register that strongly influences the lexical-semantic level. The register requirement of a higher degree of verbal specificity (with *have* and *be*, in particular), versatility (to reduce tedious repetition) and formality is fulfilled by the textual distribution of the translation solutions established and discussed in the respective categories, so that overall textual equivalence can be deemed achieved. Apart from a couple of 1:1- or near-1:1-correspondences, the results again point to the 'non-corresponding availability' of languages, a potential which should be fully exploited when it comes

to achieving equivalence in translation. This research also points to the interrelatedness of some of the features investigated (e.g., *have* as infinitive preceded by the verbs of assumption, see 3.1.2.1.4 and 4.1.1.2). The findings have also shown how the lexical-semantic level may be governed and modified by terminological and phraseological considerations (see 4.1.1.1 and 4.3.2.2). How equivalence is achieved at the terminological-phraseological level will be discussed in the following chapter.

5   Equivalence at the terminological-phraseological level

Fachübersetzen strebt zuallererst Äquivalenz auf der begrifflichen Ebene an [...]
Begriffliche Äquivalenz konkretisiert sich auf der sprachlichen Ebene als
Entsprechung, als Möglichkeit der Zuordnung von Benennungen in Ausgangs- und
Zielsprache. Sich entsprechende Benennungen in verschiedenen Sprachen sind
äquivalente Benennungen oder einfach Äquivalente. Von Äquivalenten spricht man
auch noch auf den sich anschließenden Ebenen der fachsprachlichen Wendungen,
Fügungen und Standardformulierungen [...] Die Äquivalenzebenen dieser Gruppen
fachsprachlicher Module kann man folglich als gemischt terminologisch/phraseo-
logisch bezeichnen.

<div align="right">(Hohnhold 1990:57-58)</div>

Zur Bestimmung der Äquivalenz auf der Grundlage des Begriffsvergleichs - eine
Analyse, die sich bisher auf den einzelnen Begriff und seinen Systembezug
beschränkte - tritt nun eine weitere Komponente der Äquivalenz, nämlich die
Äquivalenz der sprachlichen Mittel hinsichtlich ihrer Verknüpfungsmöglichkeiten
mit anderen sprachlichen Mitteln, [...]

<div align="right">(Picht 1988:193)</div>

Any special language/sub-language is primarily characterized by its specific terminology, i.e., "the items which are characterised by special reference within a discipline" (Sager 1990:19). As has been shown in the foregoing chapter, lexical-semantic equivalence considerations reach their limits when the terminological-phraseological aspect comes into play, as is the case when knowledge of allocational systems is no longer sufficient and must give way to the specific higher ranking TL norms and conventions reflected in the special language of a particular domain. Whereas 'words' "function in general reference over a variety of sublanguages" (Sager 1990:19), terms of art, i.e., specialist terms, mirror very specific concepts all of which contribute to a conceptual whole in a particular domain/sub-domain. Therefore, terminological-phraseological equivalence is essential if we are to ensure factual accuracy and to produce an equivalent TT capable of performing its communicative function among experts in the TL culture.

The hypothesis considered here is that the terminological-phraseological level may influence and modify the lower levels of equivalence, i.e., the syntactic and lexical-semantic levels, but may itself be influenced by pragmatic considerations, i.e., domain knowledge and register considerations. Compounding, in this case 2-element compounds as an equivalence-relevant feature at the terminological-phraseological level, will be investigated in this chapter to test the above hypothesis, to describe how

equivalence is established at this level and to identify and describe trends in translation solutions.

Terminology and phraseology belong to the same textual level, because there is a direct link between them in an equivalence-related discussion (Picht 1988:193; Hohnhold 1990:57-58). A translator working in a particular field has to know not only the equivalents of certain terms, semi-technical terms, in-house jargon, etc. in a certain text-in-context, but also the set of collocates which are compatible with a certain equivalent. For example, in piston ring technology, a piston ring (*Kolbenring*), can "freely enter the groove" (*in die Kolbennut eintauchen*) or "stick in the groove" (*festbrennen/stecken* and not *feststecken*), (Krein-Kühle 1995a:99-100). However, phraseology as understood here refers not only to specialized collocations, but also includes different kinds of specialized prepositional word groups or other technical phrases ranging from expressions of a more general technical nature, e.g., *on a commercial scale - im großtechnischen Maßstab*; *at high severity - bei verschärften Betriebsbedingungen*, including standard expressions, e.g., *to be a function of*, to highly specialized domain/sub-domain-related expressions, e.g., *x wt% on maf slurry feed - x Gew.-% bezogen auf den Einsatzslurry, waf*.[2]

Since the frequency of occurrence of phraseological items in the ST under investigation is not high enough to yield statistically underpinned findings, phraseological items are not discussed in this analysis. Research into the phraseology aspect would have to be carried out on the basis of more comprehensive parallel and translational corpora to yield equivalence-relevant findings that may fill the gaps in specialized dictionaries and glossaries, which are notoriously weak on phraseological units. Nothwithstanding their relevance from the point of view of equivalence in translation, longer phraseological units may not be conducive to the establishment of regularities due to their very nature as complex syntagmatic-semantic-conceptual entities that fail to exhibit uniform structural patterns. As mentioned before, definitional aspects will have to be considered in this context (see also f.n. 2).

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[1]   maf = moisture and ash free; waf = wasser- und aschefrei.

[2]   For an overview of more recent studies on terminological phraseology, which discuss, i.a., different approaches to the demarcation of terms from terminological phrases see Tryuk (2000). For a bibliography of phraseology covering publications from 1993 to 1995 see Pavel (1995). For introductions to terminology see Wüster ([2]1985), Sager (1990) and Arntz et al. ([4]2002).

According to Weise (1999:1430), the "special vocabulary" (*Sonderwortschatz*) of the special language of chemistry may be subdivided into several layers: a) systematic nomenclature, i.e., the designation system of chemical substances, e.g., *oxygen*; b) terminology proper, by which unequivocal designations are established via definitions, e.g., *catalyst*; and c) semi-technical terms and trivial names, which are not defined, but frequently used, e.g., *operation, burner*. Terminology proper, in particular, mirrors very specific concepts, all of which contribute to a conceptual whole, i.e., the "logic" (Hervey and Higgins 1992:168) of a particular discipline. Of course, nomenclature, semi-technical terms and trivial names, too, contribute their share to this conceptual whole in a text-in-context. A substantial amount of the compound terms that will be investigated in this analysis can be allocated to layers b) and c) above.[3] However, there are some other compound terms that do not belong to one of the above layers and that are rarely accounted for in terminological studies, because they are difficult to integrate into the more or less rigid structures of conceptual systems. These compound terms are text-related terminological units, i.e., terminological units that occur in the production of texts.[4] These include "hybrids" and other text-related compound terms.[5] For the purpose of this analysis, hybrids are defined as those combinations of technical and/or semi-technical terms, plus general terms (the latter being the nucleus in most cases), e.g., *process development unit studies*, which refer to a complex mix of specialized plus general concepts. Other text-related compounds are compounds of a complex, and potentially multi-conceptual nature that consist of technical and semi-technical units, that may also arise in the production of text, due to a register-induced tendency towards economy of expression, e.g., *product aromatics content*.[6] The frequency of occurrence of such text-related compounds, including hybrids, may vary with, e.g., a specific domain and its register constraints or intersecting domains with their register

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[3]   As regards momenclature, there are only two items, i.e., parent names, in the corpus analyzed, see 5.2.1.1, f.n. 24, 25.

[4]   Of course, a clear-cut distinction between these compound terms and the term categories mentioned by Weise (1999:1430) is not always possible, because certain forms of syntactic compression may be on their way to becoming specialized terms (see f.n. 37 and 5.3).

[5]   I take Pearson (1998:127) to mean something similar when she talks of "modified terms", in which "not all of the components may belong to the term".

[6]   The ST author could have written *the aromatics content of the product*, but this may have counteracted economy of expression as a typical feature of register in scientific and -technical discourse.

constraints, genre considerations and - to a certain extent - the individual preferences of the author. Although these text-related compounds should be dealt with at the level under analysis because they are terminologically laden, they should be given separate consideration for equivalence-relevant reasons (see 5.3).

As the above discussion has shown, it would be necessary to extend the three layers mentioned by Weise (1999:1430) to include the layer of phraseological units that are terminologically laden and - from the viewpoint of compounding - the layer of text-related terminological compounds to properly account for equivalence at the terminological-phraseological level. The layer of text-related compounds may include not only specific multi-element compound terms, but also what will be referred to here as "terminological word groups in *of*-relation" [7] and "conjunctive compounds" [8] (see 5.2.1.5, end of section).

For equivalence-relevant reasons, specific compound terms belonging to specific layers may have to be given separate consideration. For example, according to Gläser and Winter (1975), nomenclature has a labelling rather than a definitional function for classificatory purposes (in the context of chemistry see, e.g., the IUPAC (International Union for Pure and Applied Chemistry) nomenclature), whereas terms and term compounds are not generally formed according to the IUPAC rules. A term refers to a concept whose contents and extension are fixed by the agreement of experts. It has a definitional and distinguishing function (Gläser and Winter 1975:737). From the point of view of translation, nomenclatures facilitate the work of the translator, in that they offer an internationally pre-specified TL correspondence for a SL item, *oxygen* - *Sauerstoff*, (i.e., this correspondence can almost always be considered an equivalent), whereas - as regards terminology - specialized dictionaries and glossaries may be treacherous in that they may offer several correspondences for one SL term. These correspondences may or may not be potential equivalents in certain texts-in-contexts. Certainly, it must be said that although there is a clear trend towards standardization within chemical nomenclature, this should not be taken to mean that there are no differences within the individual languages or between BE and AE (Weise 1999:1430).

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[7] This category includes one item with an *on*-relation.
[8] In this category the preposition *versus* is used in a similar function in three instances.

Since the hypothesis suggested here is that the terminological-phraseological level may influence the lower levels, i.e., the syntactic and lexical-semantic levels, of equivalence, but may itself be influenced by pragmatic considerations, it is important to delimit terms which happen to be compounds and belong to particular layers described earlier from other compounds occurring in the ST. This can only be done to a satisfactory degree by applying the conceptual criterion. This criterion, in its turn, can only be applied if the analyst has recourse to SL and TL parallel texts, i.e., original SL and TL texts on the same domain/sub-domain and of the same or a similar genre, to further domain and sub-domain-related documentation and, in the case of cutting-edge research in particular, to experts in the field. Recourse to such documentation and expert advice is not only necessary to establish and verify the compound terms in the ST, but also to verify their TT counterparts.[9] In short - from the point of view of equivalence - it is essential that the compound terms in question be investigated in their ST and TT co-textual and contextual surroundings, the co-text here referring to both the immediate and the overall textual environment, and the context here referring both to the conceptual reality underlying the text and reflected in it (see Introduction), with due account being taken of "the situation in which the text is being used" (Malmkjær 1991:470), i.e., expert-to-expert communication.

5.1 Compounding as an equivalence-relevant feature at the terminological-phraseological level

The "modification of existing resources" (Sager et al. 1980:257 ff.; Sager 1990:72 ff.) is one of the major approaches to term formation. It can be brought about by derivation, compounding, conversion and compression (Sager 1990:72). Compounding, which is very broadly defined by Sager (1990:72) as "the combination of existing words into new ones" is the most productive tool in term formation in English chemical discourse in addition to derivation (Weise 1999:1431). As Sager et al. (1980:265-266) rightly claim, compounds in special languages "are created more systematically and regularly to fit into terminological systems." Like other features of scientific and technical discourse investigated here (see, e.g., the non-finite verb

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[9]   The documentation used is given in Bibliography II.

forms, Chapter 3), compounding is motivated by the tendency towards linguistic economy and contributes to compactness of expression in scientific and technical discourse. Compounds and multi-element or string compounds, in particular, are one of the greatest challenges faced by translators due to the differences in SL and TL term formation processes and the complexity of the relations between their constituents, involving ellipsis, polysemy and redundancy aspects, so that their semantic-pragmatic analysis and translation is a very creative performance.[10]

For the purpose of this investigation, a compound term is defined as a combination of linguistic units, such as nouns, participles, adjectives, proper names, to form a new syntagmatic entity that yields a new specialized meaning on the basis of the semantic relationship between its constituent parts and refers to a domain/sub-domain-related concept. This definition is extended to include text-related compounds, such as hybrids, that are terminologically laden and may refer to complex combinations of technical/semi-technical concepts and technical/semi-technical plus general concepts. The present definition may have to be further refined for the investigation of individual compound term types (see 5.2).

A specific feature of this corpus is the frequent use of eponymic compounds (5.2.1.2), i.e., compounds containing proper names, which is due to the fact that frequent reference is made in the ST to proprietary processes and equipment, since the ST is dealing with cutting-edge research.

The terminological compounds counted in our ST account for 11% of all words in the ST. The percentage distribution of the compounds is as follows:[11]
(Figures below rounded to the first place after the decimal point in the table. In the further discussion all figures rounded off.)

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[10]   Cf. Dopleb (2002:46) for a similar observation in his analysis of technical compounds. Cf. Gallagher (2002) for an investigation of compounds in economic texts.
[11]   There may be variations between particular domains/sub-domains and text genres. Sager et al. (1980:272) mention Herzog's (1971) distribution for the language of computing: i.e., "2 elements 10%, 3 elements 36%, 4 elements 40%, 5 elements 12%, 6 elements 2%."

Table 54　Distribution of the compounds occurring in the ST

Compound types	Percentage	Occurrences
2-element compounds	50.2%	597
3-element compounds	28.4%	338
4-element compounds	8.9%	106
5-element compounds	2.4%	29
6-element compounds	0.7%	8
7-element compounds	0.4%	5
8-element compounds	-	
9-element compounds	-	
10-element compounds	0.1%	1
Others		
Terminological word groups in *of* relation[12]	1.8%	22
Conjunctive compounds (and/or)[13]	7.1%	84
	100%	1190

As this overview shows, 2-element compound terms, which account for a good 50% are the most common compound type in the ST. These will be discussed in greater detail in 5.2.

3-element compounds are the second most frequent group of multi-element compounds in the ST and account for about 28%. Of this figure, 8% are 3-element compounds that contain proper names, also in abbreviated or acronymic form, e.g., *X-type additive*, or the term *coprocessing*, e.g., *high throughput coprocessing*, or technical abbreviations, e.g., *bench-scale CSTR*, including the symbols for chemical elements, or combinations of the above types, e.g., *raw coprocessing VGO*.[14] The remaining 20% include highly technical compound terms, e.g., *bubble column reactor*, *fluidized bed combustion*, *superficial gas velocity*, mixed technical/semi-technical compound terms, e.g., *two-stage process*, *pilot plant tests* and a couple of hybrids, e.g., *reactor instability problems*, *distillates upgrading consortium* and other more text-related compounds.

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[12]　See f.n. 7.
[13]　See f.n. 8.
[14]　VGO = vacuum gas oil

The 4-element compounds account for roughly 9% of the compounds counted. Again, we find highly specialized compound terms, such as *weight hourly space velocity, high volatile bituminous coal, coal derived liquid product,* hybrids, such as *highly dispersed catalyst evaluation,* and combinations of different types of specialized terms, semi-specialized terms, abbreviations, chemical symbols, and proper names, e.g., *10.000 b/d coprocessing unit, N/C atomic ratio.*

The 5-element compounds account for a good 2%. They show much the same picture as the 4-element compounds in the distribution of types. Some examples: *X-type expanded bed reactor, pre-emulsified water-solvent mixture,* for highly technical compound terms, and *higher expanded bed catalyst cost* for a hybrid.

For 6-, 7- and 10-element compounds the results are below 1% with decreasing frequency of occurrence (there are no 8- or 9-element compounds). All three categories contain hybrids and other compounds occurring in the production of text, but still referring to a complex mix of technical, semi-technical or general conceptual entities, e.g., *bench-scale continuous stirred tank reactor studies,* and also highly specialized compounds, e.g., *industrial-scale circulating fluidised bed combustors.*

Although hybridization occurs in all compound types, there is a leap in the degree of hybridization with compounds having 4 or more elements even if, starting from the 4-element compounds, the increase in the degree of hybridization no longer coincides with the increase in the number of compound elements. As regards the other compounds occurring in the production of text, they, too, appear in all compound types. Whether their number rises with an increase in the number of compound elements, which may be assumed, would have to be investigated on the basis of a more comprehensive corpus.

In their detailed investigation of word patterns in chemical discourse, Gläser and Winter (1975:752) mention that few compounds with more than three elements can be found in chemical dictionaries, because their use as terminological entities

depends on the domain and the individual style of the author.[15] In this context, Sager et al. (1980:274) rightly suggest that the lack of longer terminological units in specialized dictionaries may partly arise from "the double composite nature of these terms, their analytic nature, their transparency and partly from the alphabetic ordering system of most dictionaries." Since - as has been mentioned earlier - such compounds are difficult to integrate into the more or less rigid structures of conceptual systems, they are often neglected in terminological and/or lexicographical work, although they are of the utmost importance in a translational context, because they may be embedded in the immediate co-text in many complex context-sensitive ways. This takes the translator beyond terminological considerations when it comes to establishing equivalence at both the terminological and overall textual levels. The higher the number of constituents, the more complex may be the nature of the compound, reflecting double or multi-conceptual aspects. Hybrids and/or other terminologically-laden compounds, which arise in the production of text and are both co-textually and contextually motivated, should be given more detailed consideration in an equivalence-relevant investigation, even if they may not be conducive to the establishment of regularities, as the number of constituents ($\geq$ 4) rises. Still, consideration and description of such compounds may heighten translators' problem awareness and improve their problem-solving potential. The fact that such text-related compounds occur with all compound types examined points to their relevance in the translation context.

As regards the compound types under 'Others', terminological word groups in *of*-relation account for roughly 2% and conjunctive compounds for about 7%. A terminological word group in *of*-relation may contain compound terms which have been dissolved to fit them into a particular co-text, as in *the method of drying the coal*. They are relevant from an equivalence point of view, because they may give rise to different degrees of composite[16] formation in the TL, e.g., *das Kohletrocknungsverfahren*, but they involve problems of defining categorial rules/patterns for their detection. (For more examples see 5.2.1.5, end of section).

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[15]   In this context, Gläser and Winter (1975:752) distinguish between 2- or 3-element compound terms ("Mehrworttermini"), which are defined, and terminologically used compound units ("Mehrwortverbindungen"), which are more context-sensitive.

[16]   The term *composite* is used to differentiate German multi-element terms which are written in one word from English multi-element compounds which are written apart.

These word groups include terminologically-laden nominal word groups of the following patterns: N+prep$_{of}$+V$_{ing}$+N, N+prep$_{of}$+N+N, N+prep$_{of}$+N+V$_{ing}$.[17]

Conjunctive compounds, accounting for a good 7%, are understood here to refer to compounds in which the conjunctions *and* or *or* occur to indicate a certain relationship between the individual linguistic units, e.g., terms, compounds, terminological attributes. These include the basic structural patterns of N+conj$_{and/or}$+N+N (cf. also Weise 1972:214), e.g., *coal and pitch conversions* (see German example below) or N+N+conj$_{and/or}$+N, e.g., *distillate yields and properties*, but may be extended to take in more complex units of a multi-conceptual nature, e.g., *naphtha, light gas oil and heavy gas oil distillate samples* or *a low and high ash fluidized bed combustion feedstock* (see German example below).[18] In translation, the semantic-conceptual relationship within these conjunctive compounds, may not always be straightforward and may have to be made explicit due to linguistic/grammatical constraints in the TL, e.g., by using the hyphen, as in *Kohle- und Pechumsätze*. Also, such compounds may have to be completely dissolved to form longer syntactic units due to their complex and/or multi-conceptual nature, e.g., *Einsatzstoffe mit niedrigem bzw. hohem Aschegehalt für die Wirbelschichtverbrennung*. Here again, though, pragmatic aspects, e.g., considerations of cohesion and coherence, may come into play and influence and modify equivalence at this level.

These two compound types, which belong to the layer of text-related compounds, are of the utmost importance when it comes to establishing equivalence at the terminological-phraseological and overall textual levels. Since together they account for as much as 9% of all compounds counted, they seem to play an important part in ST production - even if they may be motivated in part by author idiosyncrasy - and should be given more detailed consideration on the basis of a more comprehensive corpus, though, due to their complex nature, not all sub-types will be conducive to the establishment of regularities.

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[17]   The definite article may occur with some nouns in the above patterns.
[18]   Such structures appear in Weise (1972:214) under "longer syntactic word groups" (my translation).

An analysis of the 2-element compound terms is given in the following sections.

5.2 English 2-element compound terms and their German potential equivalents

As has been mentioned earlier, 2-element compound terms account for a good 50% (597 occurrences) of all compounds counted and are the most common compound type in the corpus. Due to their high frequency of occurrence and their straightforward structural patterns, they are very likely to yield statistically underpinned trends in translation, which are relevant from an equivalence point of view and, at the same time, enable us to demonstrate how equivalence works at the terminological-phraseological level. This straightforward patterning says nothing, of course, about the semantic relations that may hold between the constituents of 2-element compounds. As Winter (1987) has demonstrated, a variety of different semantic relations may hold between the individual constituents, e.g., genitive, possessive, instrumental or purpose relations, as in *blending feedstock* (i.e., a feedstock for blending), to cite an example of a purpose relation. However, as it is basically impossible to deduce the meaning of an unknown term from its allocation to a certain structural pattern (Winter 1987:73), the semantic relationship which holds between the constituent parts of an SL compound does not necessarily give any indication of the pattern of the TL equivalent. So what we are left with is the establishment of trends in the structural patterns of TL equivalents for their SL counterparts. This, however, has to be done by carefully categorizing the different types of 2-element compound terms, while taking due account of their ST and TT co-textual and contextual surroundings in order not only to establish regularities in translation solutions, but also to show how equivalence operates at the terminological-phraseological level.

The establishment of structural similarities/dissimilarities in the TL equivalents for their SL counterparts in this context is one of the research desiderata mentioned in Weise (1972:218), which - to our knowledge - has not yet been filled. So hopefully this research will also contribute toward closing a gap in this respect.

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On the basis of their occurrence in the corpus, the 2-element compound terms are subdivided into compound noun structures (categories under 5.2.1) and adjective+noun compound structures (categories under 5.2.2). The compound noun structures account for 77% (459 occurrences) and the adjective+noun compound structures for 23% (138 occurrences) of all 2-element compounds, or 38% and 12% resp. of all compounds counted.[19]

5.2.1 2-element compound noun structures and their potential equivalents

The following overview contains the categories of the two-element compound noun structures investigated here and arranged in their order of frequency of occurrence in the ST:

Table 55   Distribution of 2-element compound noun structures in the ST

Categories	Occurrences	%
5.2.1.1 Noun+noun, e.g., *pitch conversion*	277	60%
5.2.1.2 Eponymic compounds (9%), e.g., *Nedol solvent* 　　5.2.1.2.1　　(V_{ing}=*coprocessing*)+noun compounds (5%) and 　　5.2.1.2.2　　abbreviated/acronymic proper names+(V_{ing}= 　　　　　　*coprocessing*) compounds (1%).	68	15%
5.2.1.3 V_{ing}+noun, e.g., *coking propensity*	44	10%
5.2.1.4 Technical abbreviation+noun, e.g., *FCC feedstock*	29	6%
5.21.5 Noun+preposition+noun, e.g., *time on stream*	27	6%
5.2.1.6 Noun+V_{ing}, e.g., *hydrogen quenching*	<u>14</u> 459	<u>3%</u> 100%

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[19]　Weise (1972:217) records as much as 78% for the structural types N+N (40%) and A+N (38%). "Die Strukturtypen S + S (40%) und A + S (38%) treten in unserem Material nicht nur am häufigsten auf, sondern sie sind auch durch Reihen- und Blockbildung am reichsten untergliedert. Der Anteil der Fachtermini in diesen Strukturtypen ist sehr hoch." However, his figures cannot be compared to the present results due to equivalence-relevant differences in categorization. For example, Weise also subsumes multi-element compound terms ($\geq$ 2 elements) under his two basic structural types, e.g., *carbon-metal bond*, which in this research are given separate consideration. Although this certainly does not impair Weise's findings from the point of view of special languages research, translational research may need different categorization to yield equivalence-relevant insights. On the other hand, some categories do coincide with Weise's at a structural rather than a percentage level.

To qualify for inclusion in this analysis and unless otherwise specified in the individual categories, the above 2-element compounds have to belong to one of the two classes of compounds defined as follows:

a) Compounds with special reference in <u>one</u> of the intersecting
    domains/sub-domains represented in the ST. These are technical compound
    terms with a high degree of technicality that refer to specific domain/
    sub-domain-related concepts. For example: *coal liquefaction, reactor
    voidage, cost analysis*, etc.

b) Compounds used in the ST but having special reference <u>over a</u>
    <u>wider variety</u> of domains/sub-domains. These are semi-
    technical compound terms with a lower degree of technicality that refer to
    more general, but still technical, concepts. For example: *measurement
    technique, process performance, specification product*, etc.

    For similar definitions see, e.g., Sager (1990:19) and Pearson (1998:40).[20]

The above distinction is by no means rigid, because semi-technical compound terms may be used as technical terms in certain domains/sub-domains. Hence, it may occasionally be difficult to decide to which of the above classes a compound belongs. However, setting up these two classes helps distinguish the above compound types from those that are to be excluded from the category under investigation, for example hybrids, i.e., compounds consisting of a technical or semi-technical term determinant plus a general term or word nucleus, such as *feedstock prices*, because exclusion and

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[20] Sager (1990:19), for example, distinguishes between "terms" ("special reference within a discipline") and "words" ("general reference over a variety of sublanguages"). Pearson (1998), who takes a broader approach to terminology, claims that it is only by an examination of context that we can determine "whether language is behaving 'terminologically' or normally" (op. cit.:26). She suggests that it does not really matter whether a term is "subject-specific" "(i.e. special reference in one domain)" or "general" "(special reference in more than one domain)", "because users will be more interested in distinguishing between term and word status than in knowing what type of term it is [...]" (op. cit.:40). This is certainly also true from the point of view of translation equivalence at the terminological level, because translators have to find the potential equivalents for both types of term. Unfortunately, the term "context" is not defined in her book, and our impression is that her work is rather co-textually ("the rest of the text") than contextually-conceptually informed (definition in brackets by Malmkjær 1991:470). This may be appropriate for her investigation, but in translation both co-text and context have to be taken into account to establish equivalence at both the terminological level and the overall textual level, as the present analysis will show.

separate consideration of the latter compound type may be relevant from an equivalence point of view.[21]

With reference to Weise's (1999:1430) stratification of the special vocabulary of chemical discourse, the compounds examined here belong to layers b), i.e., terminology proper and c) semi-technical terms. The layers of phraseological units and text-related compounds, such as hybrids, have been excluded from the analysis for the reasons mentioned earlier. Although, as has been discussed earlier, the layer of nomenclature should also be given separate consideration, two chemical names occurring in the ST have been included in the analysis for the reasons given in 5.2.1.1.

The various 2-element compound categories are discussed in detail in what follows.

5.2.1.1 Noun+Noun compounds and their potential equivalents[22]

Noun+noun compounds are the most common 2-element compounds in the corpus. They account for 60% (277 occurrences) of the compound noun structures, 47% of the 2-element compounds and 23% of all the compounds counted.[23]

Although, for the reasons mentioned earlier, a distinction should be made between nomenclature and terminology, two chemical names, i.e., parent names or "Sammelstoffnamen"[24] (Gläser and Winter 1975:741-742), occurring in the ST have been included in this analysis. Since they are the only two parent names in the corpus, separate consideration cannot be justified. According to Gläser and Winter (ibid.),

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[21] For example, the trend towards dissolution of the compound in the TT may be higher. Since the 2-element compound hybrids account for only 3%, however, translation trends in this category would have to be described on the basis of a more comprehensive corpus.

[22] A summarized version of this section has been published in Krein-Kühle (2002).

[23] In Weise's chemical discourse corpus consisting of 4000 words the structural type noun+noun accounts for 21.6% (Weise 1972:213). This figure is based on a sample of 500 items. Comparability with the present analysis is limited, however, because his category also contains compounds with proper names and abbreviations which are given separate consideration in the present analysis. Moreover, Weise also included adjective and verb structures, as well as prepositional and other word groups (op. cit.:215-216), since his analysis is aimed at presenting an overview of the lexical-grammatical structural types occurring in English chemical discourse.

[24] "Sammelstoffnamen sind Benennungen für eine Stoffklasse, deren Vertreter durch ein gemeinsames Merkmal ausgezeichnet sind." (Gläser and Winter 1975:741) ("Parent names are designations of a class of substances, the members of which are characterized by a cõmmon feature", my translation).

such parent names refer to the conceptual background so that they have some properties of terms. However, they may not always be unequivocally defined, in which case they cannot be regarded as terms. The two parent names in question are *molybdenum octoate* and *moybdenum naphthenate*. The suffix *-ate* in chemistry most commonly "designates a salt from acids in *-ic*" (Sager et al. 1980:263). The common feature of the names with the suffix *-ate* is that the "central atom of the anion complex is saturated with oxygen atoms or other atoms or groups as ligands" (Gläser and Winter 1974:741, my translation). *Molybdenum octoate* and *molybdenum naphthenate* may be considered terms, because they are unequivocally defined by fulfilling this requirement.[25]

The distribution of translation solutions for this category, which is the most common of the 2-element compounds, is as follows:

i) **Noun+noun composites in German**[26]   **64%**
The term *composite* is used to differentiate German two-element terms which are written in one word from English compounds which are written apart (f.n. 16). In the course of this analysis, the term *composite* will also be used for German hyphenated two-element terms (see, e.g., 5.2.1.2, eponymic compounds).

This type of composite has a "binary structure" meaning that each of its elements can stand on its own, but their order cannot be reversed without changing the meaning. It complies with the Duden definition for "Zusammensetzungen (Komposita)", (Duden vol. 4, [5]1995:734 ff., 826 ff.).[27]

Examples:	coal liquefaction	Kohleverflüssigung
	distillate fractions	Destillatfraktionen
	reactor operation	Reaktorbetrieb
	coal concentration	Kohlekonzentration

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[25]   *Molybdenum octoate* and *moybdenum naphthenate* designate the salts of octanoic acid and naphthenic acid, respectively, with molybdenum acting as the ligand. These two acids belong to the carbonic acids which form real salts, unlike, e.g., "*sodium ethanolate*" which has no anion. Substances of the latter type are not real salts, but in most cases amorphous powders. This parent name is not uniformly defined and, according to Gläser and Winter (1975:742), cannot be considered a term. Knowledge of this conceptual background may be essential in the translation context. (I am indebted to Dr. E. Kühle for enlightening me on this subject).

[26]   This group contains one hyphenated item.

[27]   "Unter Zusammensetzungen (Komposita) verstehen wir Wörter, die ohne zusätzliche Ableitungsmittel aus zwei oder mehreren selbständig vorkommenden Wörtern gebildet sind." (Duden vol. 4, [5]1995:734). ("Composites are words which consist of two or more words occurring independently of one another, without additional derivation", my translation).

pitch conversion	Pechumsatz, Pechumsetzung*
	*See discussion of results.

ii) Noun+linking element+noun composites   13%

This is a sub-type of the noun+noun composite type in that it complies with the above description, but has an additional linking element ("Fugenelement")[28] between the two nouns (cf. Duden vol. 4, [5]1995:843 ff.; Fluck [2]1997:63-64). The linking elements between determinant and nucleus occurring in the TT composites are 's' and 'n'. In the examples below the "Fugenelement" is 's':

Examples:	capital cost	Investition*s*kosten
	activation energy	Aktivierung*s*energie

As regards the structural similarity between the two languages, the above two composite types, i.e., i) and ii), are closest to their English compound counterparts. Taken together, the above two types account for 77% of all translation solutions for the category under investigation.

Total of i) + ii)   77%

iii) Word groups   11%

According to Fluck ([2]1997:65-66),[29] a terminologically-laden word group consists of at least two syntactically linked "words", which are written apart. In the German TT there are almost equal shares for the following structures:

a) Word groups with genitive or prepositional attribute (6%)

Examples:	coke prevention	Minimierung der Koksbildung
	distillables aromaticities	Aromatengehalt im destillierbaren Anteil

b) Adjective+noun (5%)
(Including participles in adjective function)

Examples:	distillables yields	destillierbare Ausbeuten
	specification products	spezifikations*gerechte* Produkte

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[28] These linking elements ("Fugenelemente") can be flection-related (e.g., indicating genitive) or non flection-related (Duden vol. 4, [5]1995:843). For an overview of the linking elements in German technical language composites see Fluck ([2]1997:63-64).

[29] Fluck ([2]1997:65-66) speaks in this context of "Wortgruppen mit Terminuscharakter". He also gives an overview of such terminological word group patterns in German.

German technical discourse often uses additional adjectives for class shifts (Schröter [3]1990:12; Krein-Kühle 1995a:85) (see second example above), which, though semantically weak, are important for structural reasons. Although they have zero translation equivalents in the English ST, they contribute to equivalence in the TT both at the lexical-semantic[30] and terminological levels.

iv)   2:1-solutions   4%

A 2:1-solution implies that the English ST compound is rendered by <u>one</u> technical term, semi-technical term, general term (word) or pronoun in the German TT for pragmatic reasons, in particular register considerations, to establish cohesion and coherence in the TT. This translation solution may also be chosen due to domain knowledge-induced shifts in perspective, which require a conceptual reality to be expressed in a different way in the TT, as in the following example:

> [...] droplets which could be wet by the continuous phase (ie. water phase) [...]
>   water phase   Wasser

In the above context of dispersion[31] (emulsion), the *continuous phase* is termed the "Dispersionsmittel" (*dispersion agent*) in German, which in this context is water. Hence, the term *phase* becomes redundant in the TT.

Due to the co-textual surrounding, the nucleus/determinant of the ST compound may occasionally be considered redundant, which may lead to an ellipsis in the TT, as in:

>   residue stream   Rückstand

Considerations of cohesion involving a change of cohesive devices may come into play and modify equivalence at the terminological level. In the example below a device of lexical cohesion in the ST, viz., repetition, is rendered by the device of reference in the TT. In this example, the reiterated item *moisture contents* has become a personal pronoun, viz., *er*, referring back to the first mention of *moisture content*. The general term/word *Werte* (*values*) was included to establish cohesion in the TT:

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[30]   For examples of extensions of English plural nouns to German composites at the lexical-semantic level see Krein-Kühle (1995a:83-84).

[31]   For a definition of "Dispersion" see, e.g., Brockhaus (vol. 1, 1989).

Drying in the pulverizer reduced the *moisture content* to ≈13% while all the other methods resulted in *moisture contents* between 3.9% and 5.8%.

Bei der Trocknung in der Mühle sank der *Feuchtegehalt* auf ≈ 13 %, während *er* bei allen anderen Verfahren auf *Werte* zwischen 3,9 % und 5,8 % sank.

v)   Prefix+noun composites   2%

Affixation contributes to precision of expression by distinguishing between certain processes or aspects or by elucidating them (Sager et al. 1980:257-264; Fluck [2]1997:54-61). As Herman (1993:16), quoting Hawkins (1986), rightly points out, "German verbs are systematically restricted by prefixes in a manner which has no counterpart in English". German nouns, too, can be restricted in this way.[32] In the examples below, the semantics of the nucleus in the SL compound is rendered by a prefix in the TL composite.

Examples:	catalyst precursors	*Vor*katalysatoren
	ash rejection	*Ent*mineralisierung

vi)   Verb stem+noun composites   2%

In this composite type the determinant is a verb stem proper (i.e., without the infinitive ending '-en') or a verb stem extended by the linking element 'e' (Duden vol. 4, [5]1995:839, 840 ff.) and the nucleus is a noun.

Examples:	residence times	*Verweil*zeiten
	measurement technique	*Meß*verfahren

vii)   Verbal solutions   1%

These solutions may be due to domain knowledge-induced shifts in perspective, which require a conceptual reality to be expressed in a different way in the TT or may be due to register constraints involving further shifts within the sentential co-text of the TT, as in the following example:

[...] due to higher *water production* when more coal is present because of the higher oxygen content in the feed.
[...] weil bei höherer Kohlekonzentration durch den erhöhten Sauerstoffgehalt des Einsatzmaterials mehr *Wasser anfällt*.

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[32]   For a detailed and highly informative overview of affixation in German scientific and technical discourse see Reinhardt et al. ([3]1992:35-125). For a discussion of affixation from an equivalence point of view see Krein-Kühle (1995a:84-85). Affixation is a characteristic and systematic feature of German scientific and technical discourse and should not be considered a "defect" in a translational/equivalence-related context (even if the affix is considered to be "desemanticized"), as is done by Horn-Helf (1999:181) (see 1.2.4).

In the above example, the nucleus *production* is rendered by the terminological verb *anfallen* in the TT, which has become the predicate of the subordinate clause.

viii)   2:3-solutions   1%

A 2:3-solution is used when a ST ellipsis is translated by the full composite term in the TT. This procedure may be necessary for register-related reasons of cohesion or coherence in the TT.

Examples: yield curve   *Koks*ausbeutekurve

bed temperatures   *Wirbel*schichttemperaturen

ix)   Others   2%

These translation solutions imply register-induced and/or domain knowledge-induced explicitness and domain knowledge-induced shifts in perspective. This type of explicitness is necessary for establishing cohesion and coherence in the TT, for example:

Most of the work in the consortium program was related to *reactor operation. Reactor operation* was divided into three sub-areas: [...]

Der Großteil der im Rahmen des Konsortiumsprogramms durchgeführten Forschungsarbeiten bezog sich auf den *Bereich Reaktorbetrieb, der* in die drei folgenden Unterbereiche gegliedert wurde:

For reasons of cohesion and coherence, the above two ST sentences have merged into one in the TT so that the relative pronoun *der* (referring back to *Bereich Reaktorbetreib*) was used for the second instance of *reactor operation.* The word *Bereich* (*area*) has been inserted, because in German only the *Bereich Reaktorbetrieb* can be subdivided, but not the *Reaktorbetrieb* itself. Since the second instance of *reactor operation* was translated by the relative pronoun *der*, the explicitness established in the translation of the first instance is compensated, so that the German sentence overall is no more explicit than its ST counterpart.

Domain knowledge-induced shifts in perspective involve, e.g., personified ST compound terms which may require abstraction in the TL, as in the following example:

[...], indicating that the additive acts as a good *metal scavenger* for heavy metals present in the feed [...]
[...], daß das Additiv einen positiven *Fängereffekt* für im Einsatzmaterial enthaltene Schwermetalle hat [...]

In the above example the determinant *metal* is considered redundant in the TT due to repetition (*heavy metals*) in the ST sentential co-text, with the conceptual reality being expressed in a different way, viz., "the additive has a positive *scavenging effect*" (back-translation). This shift in perspective which manifests itself at the terminological level implies further shifting at the lexical-semantic level.[33]

As the results show, the composite types mentioned under i) and ii) are the most common of all translation solutions. Taken together they account for 77% of all translation solutions in the category investigated. From the point of view of structural similarity, these two composite types are the closest to their English compound counterparts. Certainly, this does not mean that simple 1:1-correspondences are always the key to equivalence. Although they are quite common, (see, e.g., the first four examples under i)), co-textual considerations may come to the fore and lead to terminological variation in the TT, as in the following examples:

a)   For the three combinations with *pitch conversions* ≥90%, the low to high ranking in terms of hydrogen consumption efficiency [...] is as follows:

b)   [...] assuming *pitch conversion* is a first order reaction [...]

In example a) the technical compound term *pitch conversion* is a quantified variable and, therefore, its terminological equivalent is *Pechumsatz*. In example b) *pitch conversion* is described as a reaction, i.e., it has a procedural aspect. In this case, the terminological equivalent in the TT is *Pechumsetzung*, which in its function as *nomen actionis*[34] exhibits this procedural aspect as well.

If an unknown technical compound term is not found in specialized dictionaries or glossaries, translators normally try to make sense of it by looking up those elements of the compound which are unknown to them. However, even if the unknown element is lexicalized, the correspondences found may not be equivalents in a different co-text/context. For example, in the case of *sulphur capture*, the correspondences offered for *capture* by specialized dictionaries, (e.g., Gross [4]1990; Wenske 1992), such as *Einfangen* refer to different contexts (e.g., capture of

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[33]   That the conceptual reality in question is indeed described by the composite term *Fängereffekt* could be underpinned by a parallel text (Lenz et al. 1988).

[34]   Many verbal nouns with the suffix *-ung* may function not only as *nomina actionis*, but also as *nómina acti* (Duden vol. 4, [5]1995:875).

electrons), and cannot be uncritically transferred to a different domain. In fact, only by recourse to parallel texts (if available) or to experts in the field can the terminological equivalent be established. In this context, i.e., fluidized bed combustion, the terminological equivalent is *Schwefeleinbindung* (*sulphur 'bonding'*).

Also, concrete-to-abstract shifts may occur in the translation of technical compound terms, e.g., the equivalent of *carbon types* may be *Kohlenstoffverteilung*, the latter element of the compound being a verbal abstract noun (Duden vol. 4, [5]1995:873). *Carbon types* here means *carbon-type composition*.

The trend established here towards noun+noun composites in German may also justify the formation of term compounds by analogy. For example, the compounds *sulphur content* and *oxygen content* are lexicalized as *Schwefelgehalt* and *Sauerstoffgehalt*, respectively (see, e.g., Wenske 1992). The compound *heteroatom content* does not exist as an entity in specialized dictionaries or glossaries, but the TL equivalent can be formed by analogy, i.e., *Heteroatomgehalt*.

Special mention should be made of ellipsis and synonymy in the ST and their translation solutions in the TT. Although quantitatively marginal, they are relevant from a qualitative point of view. Of the compounds analysed 2% are used elliptically.[35] It is interesting to note that there is an increase in the degree of explicitness due to co-textual or contextual constraints in only 1% of the cases (for examples see viii) 2:3-solutions), whereas in the other cases the ellipses are retained or even further reduced to one single term. This by no means implies that the TT fails to achieve equivalence in this respect. Duden (vol. 4, [5]1995:1206 ff.) rightly warns against using the concept of ellipsis in an inflationary way, because the saving of parts of speech may not be considered an omission within a certain subject/domain, communicative situation or relationship between interlocutors. In expert-to-expert

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[35]   Strictly speaking, all compound terms showing the term *reactor* as determinant are ellipses, because different reactor types, to which these compound terms refer, are mentioned in the ST. However, due to clarification via the co-textual surroundings, none of these reactor types was made explicit in the TT. Since technical compound terms with the term *reactor* as determinant are lexicalized in special dictionaries (see, e.g., Wenske 1992), compounds with the determinant *reactor* are not considered to be ellipses in the context of this-analysis.

communication via translation, there is not always a need to use the full compound term or to make an ellipsis explicit in the TT to a higher degree than is necessary for smooth knowledge transfer to and/or understanding by the TL experts in the field.[36] For example, the elliptical compound term *deactivation curves* is rendered by its German elliptical counterpart *Desaktivierungskurven*, because it is unequivocally clear from the co-text that *deactivation* refers to *catalyst deactivation* mentioned in the same section.

The 2:1-solutions in iv) show, that from the point of view of the TT, some elements of the English compound terms investigated are considered redundant in the co-text in which they occur which has prompted an ellipsis in the TT. So, while on the one hand, not every ST ellipsis needs to be translated by a full compound term - unless retention of the ellipsis would impair communication, e.g., by creating instances of polysemy that cannot be monosemized by recourse to the specific co-text or context, - on the other hand, elements of ST compound terms may be considered redundant, which may give rise to further ellipses in the TT. The way ellipsis and redundancy are dealt with as regards the compounds investigated underpins Wandruszka's idea of the "asystematische Disponibilität" (*non-systematic availability*) (Wandruszka 1969:528) and what is called in this work the 'non-corresponding availability' of languages, an aspect which is to be fully exploited when it comes to achieving equivalence in translation.

This latter point is also prominent when it comes to synonymy. Synonyms occur in 2% of the compounds investigated. Apart from one instance, synonymy was eliminated in the TT by using uniform terminology. For example:

coal part = coal portion   Kohleanteil
coke prevention[37] = coke suppression   Minimierung der Koksbildung

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[36]   Horn-Helf (1999:124) rightly criticizes Schmitt (1999:315) for considering such ellipses ("Kondensate") in the TT as a violation of "the maxim of terminological consistency" (my translation).

[37]   A somewhat more explicit version of the technical compound term *coke prevention* has been found in an earlier parallel text: "The role of hydrogen is limited to stabilizing generated smaller molecular fragments and *to preventing coke formation*." (Szladow et al. 1989:139) (italics added). Although the expression "to preventing coke formation" has been triggered by grammatical-syntactic constraints, we may still see in this a development in the formation of compound terms, because the conceptual reality of this expression is found in the compound term *coke prevention*. The German equivalent points to the fact that *prevention* or *suppression* of coke formation is hardly feasible, which is why in

On the other hand, synonymy is introduced in the TT for various reasons, such as the need to differentiate between two composite terms in the TT due to co-textual constraints as against only one compound term in the ST, where it need not be differentiated (see the above example of *pitch conversion*). Synonymy is also introduced to specify certain concepts more exactly in a particular co-text and/or context, for example the compound *process performance* has been translated by *Verfahrensleistung* or *Verarbeitungsleistung* depending on co-textual and contextual considerations. Perhaps this sort of synonymy in the TT should be termed requisite terminological variation, to free the concept of synonymy from the negative connotations it usually has in terminology,[38] because in the context of translation, terminological variation may help the translator achieve equivalence at the terminological and overall textual levels. Although from a quantitative point of view, terminological variation in highly specialized translation is certainly a marginal phenomenon - and rightly so - it is still important from a qualitative point of view, as this discussion has shown.

Contrastive special languages research into the aspects of ellipsis, redundancy, polysemy and synonymy in scientific and technical discourse on the basis of large corpora would help determine when and how these features are used. Such insights could be directly put into service in the field of translation. Rogers (1997), for example, found that synonymy in specialized texts may be attributable to linguistic factors, such as "the role of the grammatical category number and the role of the combining elements in compound formation as head or modifier" (op. cit.:244), a finding which may have direct implications on equivalence in translation. Certainly, corresponding research would also have to be carried out in the area of translation itself to establish how equivalence is actually achieved with the above features.

Although a clear trend towards composites, which account for 81% (including noun+noun composites, noun+linking element+noun composites,

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German the term *Minimierung* (minimization) is used.

38 However, more recent approaches to terminology do accept synonyms. "Modern terminological theory accepts the occurrence of synonymic expressions and variants of terms and rejects the narrowly prescriptive attitude of the past which associated one concept with only one term" (Sager 1990:58). Cf. also Rogers (1997:219): "[...] it is well known that synonymic variation is common in special-language texts despite the best efforts of standardising bodies."

prefix+noun composites, and verb stem+noun composites) was established in the TT, the above discussion shows that these noun+noun composites are not always simple 1:1-correspondences. The remaining translation solutions (19%) reflect a variety of forms at the terminological level in the TT. The investigation has shown how terminological considerations may govern and modify the lexical-semantic and syntactic levels of equivalence. It also shows how pragmatic considerations, i.e., register aspects, specifically considerations of cohesion and coherence, and domain knowledge-induced shifts in perspective, may come into play and influence and modify the terminological level of equivalence. It is the interplay of all the various translations solutions established that helps achieve overall textual equivalence.[39]

The results of this analysis are summarized in the following in descending order of frequency:

Table 56   Distribution of translation solutions for noun+noun compounds

i)	noun+noun composites	64%	
	ex.: hydrogen consumption - Wasserstoffverbrauch		
ii)	noun+linking element+noun composites	13%	
	ex.: liquid holdup - Flüssigkeitsinhalt		
iii)	Word groups	11%	
	a) Word groups with genitive or prepositional attribute (6 %) ex.: coke prevention - Minimierung der Koksbildung		
	b) Adjective + noun (5%) ex.: distillables yields - destillierbare Ausbeuten		
iv)	2:1-solutions	4%	
	ex.: combustion efficiency - Wirkungsgrad		
v)	Prefix+noun composite	2%	
	ex.: catalyst precursor - Vorkatalysator		
vi)	Verb stem+noun composite	2%	
	ex.: residence times - Verweilzeiten		

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[39]   For the sake of scientific correctness, it should be said that the TT counterparts of some compounds in the ST could not be unequivocally verified due to the fact that the ST refers to cutting-edge research and describes some proprietary processes. For reasons of confidentiality, further information on these processes is not available. I am indebted to Dr. Friederike Krey, one of the very few experts in the field in Germany, for enlightening me on the subject and for helping me establish a reasonable degree of certainty as regards the compounds in question.

vii)	Verbal solutions	1%
	ex.: due to [...] water production [...] - weil [...] Wasser anfällt [...]	
viii)	2:3-solutions	1%
	ex.: yield curve - Koksausbeutekurve	
ix)	Others	2%

For the sake of clarity the figures only are given in the following table:

Table 57   Overview of German potential equivalents for English noun+noun compounds

I) Composites		**81%**
with the following types:		
a) noun+noun	64%	
b) noun+linking element+noun	13%	
c) prefix+noun	2%	
d) verb stem+noun	2%	
II) Word groups		**11%**
a) involving genitive or prepositional attributes	6%	
b) adjective+noun word groups	5%	
III) Others		**8%**
a) 2:1 solutions	4%	
b) 2:3 solutions	1%	
c) verbal solutions	1%	
d) further solutions	2%	

5.2.1.2 Eponymic compounds and their potential equivalents

For the purpose of this investigation, eponymic compounds are defined as compounds containing proper names (also in abbreviated or acronymic form),[40] i.e., names of consortia and/or companies or places as determinant, and technical or semi-technical terms (for a definition of the two types see 5.2.1) or technical abbreviations as nucleus.[41] Although these compounds may be considered to be somewhere in-

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[40]   As Sager et al. (1980:278) rightly remark, "acronyms [...] are constantly being created in special languages to designate institutions, processes and products [...]"

[41]   In three instances the proper name itself is a 2-element compound, e.g., *Cold Lake bitumen*. However, these two elements are treated as one semantic unit in the case of proper names. In one instance the nucleus is an ellipsis with metonymic behaviour, e.g., *Amoco Pipestill*, with *pipestill* implying *pipestill vacuum bottoms*. This example occurs three times in the corpus and is made explicit once in the TT for reasons of coherence.

between the technical/semi-technical and text-related layers of the lexicon of the domains/sub-domains reflected in this ST, they have been included in this analysis because they seem to be a typical feature of the research report, which is reflected in their relatively high frequency of occurrence. These eponymic compounds account for 15% (68 occurrences) of the compound noun structures, 11% of the 2-element compounds and 6% of all compounds counted. This category includes the following two sub-categories:

Sub-category 5.2.1.2.1	(V_{ing}=*coprocessing*)+noun compounds and
Sub-category 5.2.1.2.2	abbreviated/acronymic proper name+(V_{ing}= *coprocessing*) compounds.

These two sub-categories have been included here for equivalence-relevant reasons, since similar trends in translation solutions can be expected, the term *coprocessing* being considered a proper name (for V_{ing}+noun compounds and noun+V_{ing} compounds see 5.2.1.3 and 5.2.1.6, respectively).

The distribution of translation solutions for the main category 5.2.1.2, which accounts for 60% (41 occurrences) of all eponymic compounds investigated, is as follows:

i) Hyphenated 2-element composites   **76%**

Examples:	X additive	X-Additiv[42]
	Nedol solvent	Nedol-Lösungsmittel
	Cold Lake bitumen	Cold-Lake-Bitumen

ii) Word groups   **10%**

Example:	Rheinbraun coal	rheinische Braunkohle

iii) Others   **14%[43]**

The results show a clear trend towards hyphenated 2-element composites in the TT, which is in line with the grammatical constraints regarding the use of the hyphen in German composites containing proper names (cf. Duden vol. 4, [5]1995:113,

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[42] X here stands for a proper name, which cannot be disclosed for confidentiality reasons.
[43] These solutions refer to repetitive instances of one proper name which is elliptically used. From the point of view of translation, the implicitness contained in this proper name is maintained in translation, since only the proper name is used in the TT in the specific context.

843).[44] According to Sager, eponymic compounds designate "substances, materials, objects, instruments, methods, processes and measurements" and have "the advantage of unique differentiation but lack systematic import" (Sager 1990:77). However, the advantage of "unique differentiation" only exists, if the compound refers to a fully defined and well-established concept, e.g., *Brinell hardness - Brinell-Härte*, as is the case in terminological studies. From the point of view of translation, eponymic compounds may be less uniquely differentiated, because they may be text-bound, i.e., they may be *ad hoc* creations in the production of text. None of the eponymic compounds under investigation refers to well-established and fully defined concepts, but are all text-in-context bound. Some of them are highly elliptical and/or characterized by a high degree of implicitness. For example, the compound *X unit* is used elliptically for the full form *X bubble column reactor* mentioned earlier in the ST. And even if there is a general understanding about what a *bubble column reactor* is, we are not given a more detailed description of the features of an *X bubble column reactor* for confidentiality reasons, i.e., this reactor type is used in a proprietary process.

Another example is *Nedol solvent* which replaces its synonymous full form *Nedol coal liquefaction process spent donor solvent* in the further course of the ST for register reasons, i.e., avoidance of tedious repetition of the very long full form. The same is done in translation, i.e., *Nedol-Lösungsmittel*, for the same reason.

As mentioned earlier, some of these eponymic compounds may be highly implicit, because they do not "simply" relate to the full form of one more complex multiple compound, but to various bits and pieces of information given throughout the text. For example, the following information is contained in the eponymic compound *X additive*:

> it is "prepared using the feedstock coal",
> it is "Fe loaded on coal",
> it is "highly dispersed", it is "disposable"
> it has a "high iron concentration",
> it "can act as a gasification catalyst"
> it has positive effects, because its presence "results in much lower preasphaltene and asphaltene concentrations", and because it "acts as a good scavenger for heavy metals present in the feed".

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[44] For the use of the hyphen in German multi-element technical composites see Fluck (²1997:66-67).

In the context of this research report, many eponymic compounds refer to proprietary processes and substances, e.g., additives or catalysts, whose details and exact composition are not fully disclosed for confidentiality reasons. So this non-disclosed information is contained in these compounds and is implied in the TT composites as well. Making one of these compounds more explicit in translation would not lead to equivalence, because the fact that such an explicitness would have to be restricted to one or two informational aspects (see, e.g., example above) - since not all of these aspects can be made explicit - would imply a reduction in the remaining implicit (and also non-disclosed) meaning potential of the compound.

As the above translation trend shows, the implicitness established with some of the ST compounds analyzed is maintained in the TT composites, so that equivalence at the terminological level can be deemed achieved.

The translation solutions under ii) above account for 10% of the total. These are adjective+noun word groups or word groups with genitive or prepositional attributes. The example under ii) above nicely demonstrates a case of "shifted" implicitness, in that the English compound implicitly contains the information that *Rheinbraun coal* is always brown coal (lignite), whereas the German adjective+noun word group explicitates this aspect, but - by referring to the geographical location, i.e., *Rhenish* - keeps the mining operator, i.e., *Rheinbraun* implicit. There is, however, no loss of information whatsoever, because the target experts in the field know that the *Rheinbraun* company is the only brown coal mining operator in the Rhenish area.

As regards the translation solutions under iii), 'Others', see f.n. 43.

It is interesting to note that in three instances in which the nucleus is a technical abbreviation this English abbreviation has been adopted in the hyphenated TT composite, e.g., *Amoco VGO*, *Amoco-VGO*, (for technical abbreviation+noun compounds see 5.2.1.4 below).

5.2.1.2.1 (V_{ing} = *coprocessing*)+noun compounds

As regards this sub-category, which accounts for 33% (22 occurrences) of the compounds in this category, the distribution of translation solutions for the (V_{ing} = *coprocessing*)+noun compounds[45] is as follows:

i) Hyphenated 2-element composites   **73%**

Examples:	coprocessing technology	Coprocessing-Technologie
	coprocessing process	Coprocessing-Verfahren
	coprocessing conditions	Coprocessing-*Betriebs*bedingungen

ii) Word groups   **27%**

Examples: coprocessing HGO	schweres Coprocessing-Gasöl
coprocessing performance	*Verarbeitungs*leistung beim Coprocessing

As expected on the basis of the results for the eponymic compounds in the main category above, there is a clear trend towards hyphenated 2-element composites in German. The fact that the percentage distribution of the word group translation solutions differs from that in 5.2.1.2 may be attributed to the repetitive nature of the determinant, i.e., *coprocessing*, which - though the name of the process itself cannot be changed - may become a constituent of a word group in the TL for register reasons, i.e., avoidance of repetition of the hyphenated form.

It is interesting to note that the extension of the English nucleus to make a German compound noun (in the above examples the extension is identified by italics), which often occurs with plural abstract nouns[46] (see Friederich 1981:44; Krein-Kühle 1995a:83-84; Königs 2000:504 ff.), may also occur in the case of singular nouns, in the case of *coprocessing performance* under ii) for register reasons, viz., either to avoid monotonous repetition or to make a conceptual reality a little more precise due to differences in perspective in the two languages involved.

The translation solutions under ii) are word groups, both adjective+noun word groups and word groups with prepositional attributes. As regards the above

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[45] This sub-category includes the abbreviation *HGO* (heavy gas oil) as nucleus in three instances.

[46] For an example see iii) b) in 5.2.1.3. The plural abstract noun nucleus, i.e., *economics*, has become a plural composite in German, i.e., *Wirtschaftlichkeitsbetrachtungen*, and the determinant, i.e., *processing*, has been class-shifted to an adjective with extension, viz., *verfahrensbezogen*.

example showing the abbreviation *HGO* as nucleus, the translator may have opted for an explication of the nucleus in the TT with a view to improving communication, a step which may have become necessary, first, because *HGO* cannot be considered a commonly known abbreviation, either in English or in German in this context, and second, because - unlike other abbreviations in the ST - *HGO* is explained at no point in the text, but can only be understood by recourse to the co-text and context.

5.2.1.2.2 Abbreviated/acronymic proper name+(V_{ing} = *coprocessing*) compounds

As regards this sub-category, which accounts for 7% (5 occurrences) of the compounds in this category, the distribution of translation solutions for the abbreviated/acronymic proper name+(V_{ing} = *coprocessing*) compounds is as follows:

i) Hyphenated 2-element composites **100%**

Example: VEBA coprocessing   VEBA-Coprocessing

As the result shows, hyphenated 2-element composites are the key to equivalence, which is not surprising when compared with the results in categories 5.2.1.2 and 5.2.1.2.1. The use of hyphenated 2-element composites in all instances can be attributed to the fact that both the abbreviated/acronymic determinant and the nucleus are proper names, which are adopted into the TT as 1:1-correspondences, though with a hyphen for grammatical reasons (cf. Duden vol. 4, [5]1995:113, 843).

Taken together, the translation solutions for the three categories discussed above yield the following overall percentage distribution:

Table 58 **Distribution of translation solutions for eponymic compounds (categories 5.2.1.2, 5.2.1.2.1 and 5.2.1.2.2)**

Hyphenated 2-element composites	76%
Word groups	15%
Others	9%[47]

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47   See f.n. 43.

5.2.1.3 V$_{ing}$+noun compounds and their potential equivalents

For the purpose of this investigation, the designation V$_{ing}$ is used here for ease of reference as an umbrella term for nominal forms with the suffix -*ing*.[48] The V$_{ing}$+noun compounds account for 10% (44 occurrences) of the compound noun structures, 7% of the 2-element compounds and 4% of all compounds counted. The distribution of translation solutions for this category is as follows:

i) Noun+linking element+noun composite*   75%
* One instance is a noun+noun composite,
    e.g., coking coal   Kokskohle.

Examples:	coking propensity	Verkokungsneigung
	operating conditions	Betriebsbedingungen
	bridging liquid	Lösungsvermittler

ii) Verb stem+noun composite   14%

Example:	cracking catalyst	Krackkatalysator*
	boiling point	Siedepunkt

*This example exhibits the verb stem of a 'Germanized' verb borrowed from English, viz., *kracken* from *crack*.

iii) Word groups   9%
a) Word groups with prepositional attribute (7%)

Examples:	blending feedstock	Einsatzstoff für die Mischung
	hydrocracking fractions	Fraktionen aus dem Hydrokracken

b) Adjective + noun (2%)

Example:	processing economics	verfahrensbezogene Wirtschaft-lichkeitsbetrachtungen

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[48]   In this context, Gerbert (1970:70 ff.) speaks of gerunds only, whereas, e.g., Quirk et al. (1972:I.21 [*b*]) distinguish between "deverbal nouns" and "verbal nouns", i.e., gerunds, and Quirk et al. ([13]1995) between "denominal nouns" (I. 32), "deverbal nouns" (I. 34, I. 35) and "verbal nouns" (17.54). Certainly, the -*ing* suffix can also denote a participle in adjectival form and function, e.g., "surprising result", but these instances are not terminological compounds and thus do not concern us here. As regards terminological compounds, a clear-cut distinction between adjectival and nominal form, such as in *processing industry*, is not always feasible. Whether such a distinction, even if clearly possible, is relevant from an equivalence point of view would have to be investigated on the basis of a more comprehensive corpus. For the purpose of this investigation, all forms with -*ing* suffixes in the context of terminological compounds are considered nominal forms. (For a general discussion of "the gradience from deverbal nouns via verbal nouns to participles" see Quirk et al. [13]1995:17.54).

iv) Others   **2%**

Such as domain knowledge-induced shifts in perspective involving a 1:0-
correspondence for the ST compound.

The above result shows a very clear trend towards noun+linking element+noun composites for the category investigated. It is interesting to note that - unlike the noun+noun compounds (see 5.2.1.1), which yielded a clear trend towards noun+noun composites in the TL - there is only one occurrence of a noun+noun composite in this category, whereas all other solutions under i) exhibit the noun+linking element+noun solution. Still, as results the TL noun composite solution, the results for category 5.2.1.1 and for this category show a nice correlation, viz. 77% and 75% respectively.

It should also be noted that some of the above compounds were not included in TL/SL parallel text, specialized glossaries or dictionaries. Their clarification required recourse to an expert in the field as the only possible way to verify the TL equivalents. For example, only by consulting an expert was it possible to verify the equivalent *Lösungsvermittler* (*solutizer*) for *bridging liquid* to a reasonable degree in this particular context.

Relative to the results for category 5.2.1.1, the variety of translation solutions for this category is somewhat restricted, which may be due, i.a., to quantitative aspects (much fewer compound candidates in this category).

5.2.1.4 Technical abbreviation+noun compounds and their potential equivalents

For the purpose of this investigation, abbreviation+noun compounds are defined as compounds containing a technical abbreviation as determinant and a technical or semi-technical term as nucleus.[49] Abbreviations and acronyms are preferred forms of

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[49] In one instance, this order is reversed, i.e., the technical term is the determinant and the abbreviation is the nucleus, e.g., *feedstock WHSV*. In four cases, the abbreviation is a chemical symbol denoting a chemical element, e.g., *Fe* (iron), *Mo* (molybdenum). In two instances, the determinant is a combination of letters and numbers, e.g., *+525°C fraction*, *D-1122-distillation* (number changed for confidentiality reasons). Not included in this count are instances of 'proportional' abbreviation+noun compounds because of their low frequency of occurrence. From the point of view of translation, these instances yield word groups in the TT, e.g., "a [...] unit of *10,000 bbl/d capacity*" - "eine Anlage mit einer

compression in special languages and sublanguages and belong to their various terminologies (cf. Sager et al. 1980:277-280). They can be domain-conditioned or text-conditioned, although a clear-cut distinction between these two forms may not always be feasible. Like the proper names mentioned under 5.2.1.2, abbreviations, too, are capable of compounding and are widely used in compound structures in scientific and technical discourse. In our corpus, abbreviation+noun compounds account for 6% (29 occurrences) of the compound noun structures, 5% of the 2-element compounds and 2% of all compounds counted. The distribution of translation solutions for this category is as follows:

i) Hyphenated 2-element composites   **69%**
with borrowing of English abbreviation

Examples:	FCC feedstock	FCC-Einsatzmaterial
	CSTR experiments	CSTR-Versuche
	NMR techniques	NMR-Verfahren

ii) Others*   **31%**
*14% of these are word groups

Example:	THF insolubles	Tetrahydrofuran-Unlösliche
	PDU operation	Betrieb der Technikumsanlage
	FCC performance	Betriebsverhalten beim FCC

As the result shows, there is a clear trend towards hyphenated 2-element composites in German, which is in line with the grammatical constraints regarding the use of the hyphen in German composites containing abbreviations, in which case its use is obligatory (Duden vol. 4, [5]1995:843). What is noteworthy in this context is the high degree of borrowing.[50] Except for one instance, which will be discussed later, all English abbreviations are maintained in the TT. Recourse to parallel texts (Dolkemeyer et al. 1989; Krey 1994) confirmed that some of the abbreviations investigated, e.g., *WHSV* (*weight hourly space velocity*), are also referred to in German publications on the subject. Except for two instances, i.e., *THF* and *NMR*, which can be found, e.g., in Wenske (1992), all other abbreviations were found in the

Leistung von *10.000 barrel/Tag*" (italics added). As agreed with the client (personal communication), weights and measures in this research report were not converted. Conversion was not deemed necessary owing to the domain knowledge of the specialist recipients. However, the abbreviation itself is made intelligible, e.g., "bbl/d" - "barrel/Tag".
[50] Certainly, this statement does not refer to chemical symbols which are internationally understood and accepted.

Rheinbraun in-house database. They had been extracted from a few English STs and their translations, but are not found in specialized dictionaries or glossaries. Still, these English abbreviations are accepted by the small minority of SL and TL experts in this particular field. The majority of these abbreviations can be considered domain-conditioned and the rest may be situated somewhere between text-conditioned and domain-conditioned, e.g., *PDU* (*process development unit*).

To establish aspects of cohesion and coherence, all occurrences of the abbreviations in the category under investigation were examined, and it was found that except for two instances, i.e., *THF/THFI* and *NMR*, all other abbreviations were added in brackets after the first occurrence of the full form in the ST. This was also done in the TT.[51] *NMR* (*nuclear magnetic resonance*) refers to a well-defined concept which is known over a wider variety of domains, both in English and German technical discourse (Brockhaus vol. 4, 1989), so that it is explained neither in the ST nor in the TT. The case is somewhat different for *THF/THFI*, as will be discussed later.

In the translation solutions under i), we find not only simple 1:1-correspondences (see examples above), but also extensions of the English noun nucleus to form a German composite nucleus, e.g., *PDU run*, *PDU-Versuchslauf*, which can hardly be considered an unequivocal case of explicitness, since the German term *Lauf* on its own in the context in question is not sufficient from the point of view of terminological specificity.

14%, i.e., roughly half, of the translation solutions under ii) are word groups with genitive or prepositional attribute (see above examples). The remaining instances involve domain knowledge-induced shifts and composites, i.e., the abbreviation becomes the full term in the TL, but only in the case of chemical symbols in the context of parent names, e.g., *Mo octoate - Molybdänoctoat*.[52] Resolution/partial resolution of the abbreviation occurs in only one instance, viz., in the case of *THF/THFI*. This abbreviation occurs in the following 2-element

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[51] The full form plus abbreviation in brackets appears again in the ST and TT in the case of the highly repetitive abbreviations FCC and PDU in the respective main chapters and in the conclusion (FCC only).

[52] See the maintenance of the chemical symbol in a different context, e.g., *Fe microemulsion, Fe-Mikroemulsion*.

compounds, which succeed one another in the ST with no explanation: *THF insolubles*, *THF analysis* and *THFI residues*. However, THF can be found, e.g., in an English-German dictionary of chemistry (Wenske 1992), although the abbreviation is not given there as a potential equivalent in German. For reasons of cohesion and coherence, the abbreviation contained in the above three compounds has been dissolved in the TT as follows:

THF insolubles   *Tetrahydrofuran-Unlösliche*

THF analysis   *Analyse der Tetrahydrofuran-Unlöslichen*
This compound is elliptically used, since it is not the THF that are analyzed but the THF insolubles. The German translation is a correction of the somewhat careless English wording in this particular case, rather than an instance of explicitation.

THFI residues   *THF-unlösliche Rückstände*

The last example introduces the abbreviation THF in the TT, but only after the full form was given on first occurrence, so that cohesion and coherence can be established. Mention of the full form with the abbreviation in brackets on first occurrence and use of the abbreviation in further occurrences may be a sensible general recommendation for both ST production and the establishment of textual equivalence in translation - at least in expert-to-expert communication. This recommendation can be underpinned for the time being by reference to SL parallel texts.[53] Certainly, a specific text-in-context may require a different procedure for different reasons. Further research into this topic on the basis of larger LSP and translation corpora would have to be carried out to verify this recommendation.

It was possible to ascertain terminological variation in the case of the most common abbreviation, i.e., *FCC*, in combination with the semi-technical term *performance*. Due to sentential and co-textual constraints, the following potential equivalents were established:

FCC performance   FCC-Leistung
                         FCC-Ergebnisse
                         Betriebsverhalten beim FCC

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[53]   Recourse to other English domain-specific sources (e.g., Wallace et al. 1989, Szladow et al. 1989) showed that on first occurrence the abbreviations (*THF* and *THFI*) are given in brackets after their full forms, and later the abbreviations alone. However, in Fouda et al. (1989) only one of the abbreviated forms, i.e., *THF insolubles*, is given without explanation.

This investigation of abbreviations+noun compounds demonstrates again the hegemony of English in this domain, too. Since more research work is published in English than in German, so that these English abbreviations are already in general use, there is obviously a tendency for German researchers to refer to the English abbreviations, in new areas of research in particular, instead of making an attempt to coin potential German equivalents.

Abbreviations and acronyms, which may be complete inventions on the part of the author and text-based only, and which are therefore very cryptic at times, require systematic inclusion in any domain/sub-domain-specific terminologies to enable equivalence to be achieved at the terminological level (Krein-Kühle 1995a:96-97).

5.2.1.5 Noun+preposition+noun[54] structures and their potential equivalents

Although they are not strictly speaking compounds, noun+preposition+noun structures belong to the typical structural patterns in scientific and technical discourse and due to their very nature, viz., they refer to a conceptual entity, can be categorized under the noun+noun structures (cf. Weise 1972:214). Thus, to qualify for inclusion in this category, these nominal groups must refer to a technical or semi-technical conceptual unit or entity, e.g., *amount of solids*, *tolerance for coking*, and should be delimited from those cases in which a nominal group is extended into a different relational hierarchy within the immediate sentential co-text, e.g., *method of adding solvent to*, since this delimitation may be relevant from an equivalence point of view, i.e., different possibilities of composite formation may arise in the TT, e.g., *Verfahren der Lösungsmittelzugabe zu*. It should be noted that the structure investigated here is followed by predicates, past participles, prepositions, conjunctions, commas or full stops, but not by another noun and very rarely by another *of*-relation. The prepositions involved are *of* (most frequent occurrence) and *for*, *to*, *on* (single occurrences).

The noun+preposition+noun structures account for 6% (27 occurrences) of the compound noun structures, 5% of the 2-element compounds and 2% of all

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[54] In two instances the second noun is a V_{ing} form and in one instance this noun is an abbreviation of a substance.

compounds counted. The distribution of translation solutions for this category is as follows:

i) Noun+noun composites   **44%**
(Including noun+linking element+noun composites, 18%)

Examples:	amount of solids	Feststoffmenge
	time on stream	Verweilzeit
	tolerance for coking	Verkokungstoleranz

ii) Word group with genitive or prepositional attributes   **44%**

| Examples: | degree of reproducibility | Grad der Reproduzierbarkeit |
| | amount of distillables | Menge an destillierbaren Anteilen |

iii) Others   **11%**[55]
Such as 2:1-correspondence, e.g., types of catalysts - Katalysatoren, or verbal solution, as in the example below:

It can be seen that the *rate of increase* of distillables production rate with increasing WHSV is greater than *that* of the pitch production rate.

Es zeigt sich, daß die Destillatproduktionsrate mit steigendem WHSV-Wert stärker *ansteigt* als die Pechproduktionsrate.

The figures indicate an equal share of noun+noun composites (44%), including noun+linking element+noun composites, and words groups in the TT (44%), suggesting that there is a substantial degree of composite formation in the TL for SL noun+preposition+noun structures. The example under iii) shows a verbal solution for register reasons with elimination of the demonstrative pronoun *that* used as reference. As regards the above result, the hypothesis here is that the optionality in translation solutions is higher in what has been called semi-technical terms, e.g., *removal of solids - Feststoffentfernung, Entfernung von Feststoffen*, and lower in highly terminologized items, such as *time on stream - Verweilzeit* (here composite formation in German is more likely to occur as the one equivalent terminological solution). Still, as has been discussed earlier, a clear-cut distinction between the two types of term is not always feasible and when it comes to the use of such terms in

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[55]   Any diserepancy due to rounding off.

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texts-in-contexts, different pragmatic constraints, e.g., redundancy aspects, may influence both types of term and modify equivalence at the terminological level.

The word group translation solution can also be triggered by the type of the TL equivalent for the second noun in the structure, as shown in the second example under ii). The German adjective+noun equivalent precludes the option of composite formation in the TL.

The various word groups in *of*-relation, which may contain terms which have been dissolved to fit them into a particular co-text and which account for about 2% of all compounds counted (see Table 54), are a highly interesting area of equivalence-relevant research, which would have to be carried out on the basis of a more comprehensive corpus with a view to establishing the number and type of TL composites formed and the shifts involved. Some examples:

the method of drying the coal	das Kohletrocknungsverfahren
from the bottom to the top of the reactor	vom Reaktorboden bis zum -kopf
near the top of the reactor	in Reaktorkopfnähe
the length of mixing time	die Mischdauer
the emulsification of oil in water	die Öl-in-Wasser-Emulsion

5.2.1.6 Noun+V$_{ing}$ compounds and their potential equivalents

In this category the V$_{ing}$ term is the nucleus of the compound and the noun term the determinant.[56] The noun+V$_{ing}$ compounds account for 3% (14 occurrences)of the compound noun structures, 2% of the 2-element compounds and 1% of all the compounds counted. The distribution of translation solutions for this category is as follows:

i) Noun+noun composites   64%

Examples:	vacuum drying	Vakuumtrocknung
	hydrogen quenching	Wasserstoffquenchen
	bitumen upgrading	Bitumenveredelung

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[56]   This category includes one instance in which the determinant is a verb, e.g., *freeze drying*, with the TL equivalent being a verb stem+noun composite, i.e., *Gefriertrocknung*.

ii) Others   **36%**
Such as: 2:1-correspondence, domain knowledge-induced explicitation
(see example a)) or 0:1-correspondence and word groups with prepositional
attribute (see example b)):

Example a):   slurry drying   Slurry-in-situ-Trocknung

Example b)   distillate upgrading   Weiterverarbeitung der Destillate

The result shows a clear trend towards noun+noun composites in the search

for equivalence at the terminological level. However, relative to the results for

category 5.2.1.3, the percentage for the composite solution is 11% lower. The

composite solution under i) contains noun+noun composites only, whereas for

category 5.2.1.3 it contains - apart from one instance - only noun+linking

element+noun composites. So, this result may also be interpreted as a useful trend

when it comes to TL term formation for the SL compounds investigated in the two

categories.

The translation solutions under ii) include word groups with prepositional

attribute as well as domain knowledge-induced explicitation and shifts in perspective,

the latter two requiring that a conceptual reality be expressed differently in the TT,

showing how pragmatic considerations come into play and modify the terminological

level of equivalence.

5.2.1.7 Summary of the investigation of compound noun structures

The table below is a summary of the translation solutions and their percentage

distribution established for all categories investigated:[57]

(Figures under 5.2.1.1-5.2.1.6 rounded to the first place after the decimal point. Total figures
rounded off.)

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[57]   For this overview some of the translation solutions subsumed under "Others" in categories
5.2.1.4 and 5.2.1.6 are given separate consideration, e.g., word groups.

Table 59 Overview of translation solutions for 2-element compound noun structures

Categories:	5.2.1.1 N+N	5.2.1.2 Epon.	5.2.1.3 V_{ing}+N	5.2.1.4 Abb+N	5.2.1.5 N+p+N	5.2.1.6 N+V_{ing}	Total
N=noun, epon.=eponymic compounds, abb=abbreviation, p=preposition For further information see various categories.							
Translation solutions:							
i) noun+noun composites	38.8%				1.5%	2%	(sum) (42.3%) 42%
ii) noun+linking element+ noun composites	7.6%		7.2%		1.1%		(15.9%) 16%
iii) Hyphenated 2-element composites		11.3%		4.4%			(15.7%) 16%
iv) Word groups	6.5%	2.2%	0.9%	0.9%	2.6%	0.4%	(13.5%) 14%[1]
v) 2:1-solutions	2.4%				0.2%	0.2%	(2.8%) 3%
vi) Verb stem+noun composite	1.1%		1.3%				(2.4%) 2%
vii) Prefix+noun composite	1.3%						(1.3%) 1%
viii) Others[2]	2.6%	1.3%	0.2%	1.1%	0.4%	0.4%	(6%) 6%
	60.3%	14.8%	9.6%	6.4%	5.8%	3%	(99.9%)[3]
rounded to	60%	15%	10%	6%	6%	3%	100%

[1] a) Word groups with genitive or prepositional attribute (10%)
   b) Adjective+ noun (4%)
[2] Such as 2:3-solutions, verbal solutions, etc.
[3] Any discrepancy due to rounding off.

As the above results show, noun+noun composites (42%) are the most frequent translation solution in the TT, followed by noun+linking element+noun composites (16%), hyphenated 2-element composites (16%) and word groups (14%). However, as the overview aptly summarizes, not all translation solutions occur equally in all categories. For example, noun+noun composites are the most frequent translation solution for noun compounds in categories 5.2.1.1 and 5.2.1.6. In 5.2.1.5,

1oun+noun composites plus noun+linking element+noun composites and word groups have equal shares. Some translation solutions do not occur at all in certain categories. The hyphenated 2-element composites, for example, only occur in categories 5.2.1.2 and 5.2.1.4.[58] The high percentage for these composites is due to the high percentage of eponymic compounds and compounds with abbreviations in the ST under analysis. Terminological word groups[59] and the translation solutions subsumed under "Others" appear in all categories investigated. A relative frequency of 14% confirms that these word groups, which occur with different frequencies in the categories examined, play an important part in German scientific and technical language (cf. Fluck [2]1997:65-66). The translation solutions under "Others", such as register-induced verbal solutions or explicitations, which may become necessary for reasons of cohesion and coherence, and domain knowledge-induced shifts in perspective, which require a conceptual reality to be expressed in a different way in the TT, show how pragmatic considerations come into play and modify the terminological level of equivalence. The fact that these translation solutions appear in all categories investigated shows that pragmatic considerations must not be overlooked, if overall textual equivalence is to be achieved.

As mentioned in the introduction to this chapter, compounding is characteristic of scientific and technical discourse in English because it contributes to compactness of expression. For example, according to Pelka's count (1971) quoted in Fluck ([2]1997:65), 84.7% of German scientific and technical terms consist of two elements, a figure which shows that composite formation is a very productive and characteristic feature of German technical discourse. As the above results indicate, German has different linguistic means of composite formation, see i), ii), iii), vi) and vii). If added up, we obtain 77% for these translation solutions. This figure refers to composite formation in the German TT, as a structurally similar, but - as we have seen - by no means identical, way to achieve compactness of expression. Certainly, this does not mean that the remaining 23% are less compact (cf. 2:1- or 2:3-correspondences). The word groups, too, are by no means examples of explicitation, but reflect the different way in which a conceptual reality is expressed in the TT. The

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[58]   Apart from the one hyphenated item in 5.2.1.1 (see f.n. 26) which has not been given separate consideration in the counting for this overview.

[59]   See f.n. 29.

few cases of explicitation in the TT (see translation solutions under "Others" in the various categories) were necessary to establish cohesion and coherence of the TT, as in the case of improving on a compound carelessly used in the ST.

The above results underpin again the "asystematische Disponibilität" (*non-systematic availability*) (Wandruszka 1969:528) or 'non-corresponding availability' of languages, an aspect which ought to be fully exploited when it comes to achieving equivalence in translation. Even if there are similar structural patterns in the TL, e.g., noun+noun composites, this does not mean that there is always a simple 1:1-correspondence, as has been discussed under category 5.2.1.1. Also, ellipsis, redundancy, polysemy and synonymy occurring in the ST compounds may be dealt with in a "non-systematic" way to achieve overall textual equivalence, although as we have seen, not every ellipsis need be rendered as full form (see 5.2.1.1). It has also been shown that terminological variation may occur in the TT for co-textual reasons, and an extension of the English nucleus to make a German composite noun may occur for register reasons.

On the basis of this research it may be concluded that the optionality in translation solutions is higher in what has been called semi-technical compound terms and lower in highly terminologized items, although both may be influenced and modified by pragmatic constraints.

5.2.2 Adjective+noun compound structures and their potential equivalents

Adjective+noun compound structures are characteristic of scientific and technical discourse (Weise 1972:214-215;[60] Gläser and Winter 1975:744 ff.). Like the compound noun structures discussed under 5.2.1 above, they contribute to compactness of expression and are systematically created in special languages to fit into terminological systems (Sager et al. 1980:265-266). To qualify for inclusion in this category, the adjective+noun compounds have to be technical or semi-technical compounds (see 5.2.1 for definitions). The following overview contains the categories of the two-element adjective+noun compound structures investigated here and arranged in their order of frequency of occurrence in the ST:

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[60] In Weise's (1972:214-215) corpus, adjective+noun structures ("Strukturtyp A+S") account for 37.6%. However, comparability with this research is limited for the reasons given in f.n. 19, 23.

Table 60 Distribution of 2-element adjective+noun compounds in the ST

Categories	Occurrences	%
5.2.2.1 Adjective+noun, e.g., *mineral matter*	114	83%
5.2.2.2 Past Participle+noun, e.g., *unreacted coal*	14	10%
5.2.2.3 Adjective+V_{ing}, e.g., *secondary upgrading*	6	4%
5.2.2.4 Adjective+technical abbreviation, e.g., *nominal WHSV*	4	3%
	138	100%

The above adjective+noun compound structures account for 23% of all two-element compounds investigated and for 12% of all compounds counted. The individual categories will be discussed in what follows.

5.2.2.1 Adjective+noun compounds and their potential equivalents

Adjective+noun compounds account for 83% (114 occurrences) of the compound structures under analysis, 19% of all two-element compounds investigated and 10% of all compounds counted. This means that they are the most frequent compound structure in category 5.2.2 and the second most frequent structure overall (categories 5.2.1+5.2.2). The distribution of translation solutions for this category is as follows:

i) Word groups*, i.e., adjective + noun[61]   **55%**

*One instance is a word group with prepositional attribute:
Example: volatile content[62]   Gehalt an flüchtigen Bestandteilen

mineral matter	mineralische Bestandteile
molecular structure	molekulare Zusammensetzung
catalytic site	katalytisch *aktive* Stelle
heavy ends	hochsiedender Anteil

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[61]   In one instance the TL determinant is a present participle in adjective function. 14% of these word groups include extensions of either the nucleus or the determinant (e.g., by an adverb).

[62]   It cannot be decided unequivocally whether the ST compound is used sloppily (i.e., a typo) or elliptically here, i.e., *volatiles* or *volatile matter content*. The translator has opted for the full form in German, so that equivalence at the terminological-phraseological and overall textual levels can be deemed to have been achieved.

ii) Composites[63]   **33%**
     with the following distribution of types:

a)   Adjective+noun composites: 14%

        Examples: heavy metals   Schwermetalle
                       total voidage   Gesamtleerraum

b)   Noun+noun composites:[64]   11%

        Examples: bituminous coal   Steinkohle
                       tubular reactor   Rohrreaktor

c)   Noun+linking element+noun composites: 7%

        Examples: operational temperatures   Betriebstemperaturen
                       economic analysis   Wirtschaftlichkeitsanalyse

d)   Others   1%
        such as prefix+noun composites:

        Example: preliminary experiments   Vorversuche

iii)   Others   **12%**
        Such as verbal solutions, 2:1-solutions, 2:3-solutions, i.e., full TL terms
        for ST ellipses (see example below) and other cases of
        explicitation (see discussion of results)

        Example: hot filtration   heiße Druckfiltration

The figures reveal a trend towards adjective+noun word groups (55%) in the TT for the category analyzed. Of course, this does not mean that simple 1:1-correspondences are always the key to equivalence. Although they may occur (e.g., *linear correlation - lineare Korrelation*), constraints imposed by knowledge of domain and its respective register may come to the fore and may have to be taken into account to achieve equivalence at the terminological-phraseological level. For example, the equivalent for *mineral matter* (see above), i.e., *mineralische Bestandteile*, can only be established by reference to TL parallel texts (e.g., Krey and Oelert 1995). Although the English compound term may be found in specialized dictionaries (e.g., Gross [4]1990, Wenske 1992), the translation solutions offered in these dictionaries can only be regarded as correspondences, which may well become potential equivalents in certain contexts. However, none of the correspondences

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[63]   The German nucleus may occasionally be itself a two-element composite (see second example under ii) a)).

[64]   In this category one instance has a noun+adj.+noun structure in the TL, e.g., *subbituminous coal - Glanzbraunkohle*.

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offered can be considered potential equivalents in the context under investigation. The same holds for the term *molecular weight*, the equivalent of which, in the specific context of coal-heavy oil coprocessing, is *mittlere Molmasse* (see Krey 1994; Krey and Oelert 1995).[65] The German equivalent exhibits a higher degree of terminological precision and specificity, which is required on register grounds.

Here again, extensions of either the English nucleus to make a German compound noun, as in *reproducible runs - reproduzierbare Versuchsläufe*, or extensions of the English determinant to form a two-element German attribute (see third example under i)) may occur to make a conceptual reality somewhat more precise in the TT. Also, the English adjective may become part of a German two-element nucleus due to the fact that a conceptual reality is expressed differently in the TL, e.g., *overall distillables - destillierbarer Gesamtanteil.*

The translation solutions under ii) show a variety of composite types, which together account for 33% of all translation solutions in this category. This figure is quite substantial, showing that composition is a versatile means of term formation in the category investigated. How difficult it may be to establish equivalence at the terminological-phraseological level will be demonstrated on the basis of the following examples, viz., *bituminous coal* and *subbituminous coal.* In this context, the translators rightly point out in a footnote that equivalent terms are difficult to establish due to the differences in coal classification systems. They refer to a comparative table which states the different coal types with their respective characteristic values, such as volatile matter content, in the UN-ECE, USA (ASTM) and Germany (DIN) and which has been issued by the BGR,[66] and choose the terms of greatest conceptual overlap, i.e., *Steinkohle* and *Glanzbraunkohle*, respectively.[67] However, recourse to a TL parallel text (Heidecke et al. 1990) yields the composite term *Übergangskohlen* for *subbituminous coal* with the adjective *subbituminous*

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[65] The adjective+noun compound *molecular weight* may have been used somewhat carelessly instead of *mean molecular weight* or *mass* in the ST.

[66] "Bundesanstalt für Geowissenschaften und Rohstoffe" ("German federal agency for geosciences and raw materials", my translation).

[67] Information obtained by recourse to dictionaries (e.g., Wenske 1992) or data bases may be treacherous. For example, the search for the two coal types in question in EURODICAUTOM (2002), yielded *backende Kohle* and *Fettkohle* for *bituminous coal*, but *Steinkohlenfeuerung* for *bituminous coal firing*, whereas *subbituminous coal* is cited with five correspondences without any contextual information.

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being cited in brackets. This shows how difficult it may be to establish a terminological equivalent in the case of different classification systems.

As regards the translation solutions under iii) "Others", there are verbal solutions and cases in which a full term is given for an elliptically used term. In the above example under iii), mention of the full term in the TT may be considered necessary, because in the English ST, the elliptical form is used on first occurrence (page 6 of the ST), i.e., prior to the use of the full term, which is introduced only on page 46 of the ST. This instance shows that translators - in their search for equivalence at the terminological-phraseological and overall textual levels - improve on carelessly used linguistic items, a step which may only be made possible - as this example illustrates - by a constant dialogue with the entire text-in-context.

These translation solutions also include 2:1-correspondences as in the following example, *analytical studies - Analysen.* In these cases, the English determinant carries the terminological weight, with the nucleus being a more general semi-technical term. In German, nominalization of the determinant's terminological content with a 1:0-correspondence for the English nucleus may lead to equivalence at the terminological-phraseological level.

Special mention should be made of ellipsis and synonymy in the ST and their translation solutions in the TT. Of the compounds under investigation, 11% (or 6% if figures are corrected for repetitions) are used elliptically. This figure is clearly higher than that established for category 5.2.1.1, i.e., 2% (there are no repetitive items here). It is interesting to note that there is an increase in the degree of explicitation when full terms are used, i.e., 2:3-correspondences, in 2.5% of the cases, whereas in 3.5% of the cases the ellipses are retained in the TT. For example, the compound term *tubular reactor,* which is both a text-conditioned and a domain-conditioned ellipsis[68] here, is also rendered elliptically in the TT, i.e., *Rohrreaktor.* The same is true of *heterogeneous catalyst,* i.e., *Kontaktkatalysator,* with the full term being *heterogeneous supported catalyst.* Since the full term is mentioned on first occurrence in the same sectional co-text, cohesion and coherence can be established in both ST and TT by using the elliptical form alone. For the reasons mentioned

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[68] This compound term is text-conditioned, because it replaces the full term *X-type tubular reactor* and is domain-conditioned because it implies *tubular-flow reactor.*

under 5.2.1.1, retention of ellipses in the TT by no means implies that the TT fails to achieve equivalence in this respect. Ellipses are also used, for example, to avoid the tedious repetition of a rather long full form in the TT. For example, the conceptual reality of the above *heterogeneous supported catalyst* is differently expressed in the TL, i.e., in the somewhat longer attributive form of *auf Trägermaterial aufgebrachter Kontaktkatalysator*.

A special case in point is that of the elliptically and repetitively used terms *low coal* and *high coal*, which stand for the full terms *low* and *high feed coal concentrations*, resp., and may be considered ellipses occurring in the production of the source text. To establish cohesion and coherence for the sake of smooth communication, the idea of "concentration" or "content" has to be made explicit in German, i.e., *niedrige Kohlekonzentration, hohe Kohlekonzentration* when the elliptical English forms are used. Failure to extend the English nucleus, i.e., *coal*, to a German compound term, i.e., *Kohlekonzentration* or *Kohlegehalt*, and rendition by a 1:1-correspondence would simply make no sense in German. These cases of explicitness, which account for half of the translation solutions under iii) "Others" above, account for 5% of the translation solutions for the ellipses investigated. Hence, as regards the total 11% of ellipses used in the ST in this category, 3.5% are retained in the TT and 7.5% are made explicit strictly on systemic grounds and for reasons of cohesion and coherence. Therefore, this figure of requisite explicitness is somewhat higher than that in category 5.2.1.1, where only half of the ST ellipses are made explicit in the TT.

Synonyms occur in 6% (including one instance of repetition) of the compound structures investigated compared with 2% (including one instance of repetition) in category 5.2.1.1. Synonymy was eliminated in 2% of all cases by using uniform terminology in the TT, e.g., *basic data, baseline data - Basisdaten*, whereas in 4% synonymy was maintained in the TT, e.g., *insoluble matter, insoluble material - unlösliches Material, unlösliche Bestandteile*. Maintenance of synonymy in the TT does not imply that the translators failed to achieve equivalence at the terminological-phraseological level, since, as early as 1961, Jumpelt (1961:178) was rightly calling on experts in the field to accept a certain tolerance range as regards linguistically-conditioned (not subjectively-conditioned) variation. As has been demonstrated in

5.2.1.1, terminological variation may even become necessary for pragmatic, i.e., register-induced or domain knowledge-induced, reasons. It would be interesting to know whether synonymy in translation occurs more frequently with semi-technical terms than with technical terms, but this aspect would have to be investigated on the basis of a more comprehensive corpus.

5.2.2.2 Past participle+noun compounds and their potential equivalents

This compound structure consists of a past participle in adjective function as determinant and a noun as nucleus. This structure accounts for 10% (14 occurrences) of the adjective+noun structures and 2% of all two-element compound structures investigated (categories 5.2.1.+5.2.2) and 1% of all compounds counted. The distribution of translation solutions for this category is as follows:

i)   **Word groups**   **93%**

a) Past participle+noun   71%

Examples: fused rings   kondensierte Ringe

unconverted residues nicht umgesetzte Rückstände

dotted line   gestrichelte Linie*
*(see discussion of results)

b) Participle group, i.e., premodifying attribute, + noun   22%

Examples: unreacted coal   nicht in Reaktion getretene Kohle

supported catalyst   auf Trägermaterial aufgebrachter
Katalysator

ii)   **Composites**   **7%**

Example: dried coal   Trockenkohle

As the above result shows, there is a very clear trend towards word groups consisting of a past participle or participle group+noun in the search for equivalence at the terminological-phraseological level. However, as Gläser and Winter (1975:745) rightly point out, translation problems may occur with this structure in

particular, due to the fact that the structure of constituents in German differs from that in English. This, as we have seen, is true of other compound structures examined here as well (see 5.2.1.3 for example). Such structural differences are reflected, e.g., in the above composite solution or other translation solutions, e.g., "stoppered bottle" - "Flasche mit Stopfen" (example taken from Gläser and Winter 1975:745).

The category analyzed also exhibits a neat case (see third example under i) a) above), in which the translator needs to refer to a figure to establish equivalence at the terminological-phraseological level. The *dotted line* mentioned in the ST with regard to a particular figure is in fact a *dashed line* and is rendered as such, i.e., *gestrichelte Linie*, in the TT. Recourse to dictionaries may be misleading, e.g., Ernst ([6]2000) mentions *punktierte Linie* for *dotted line*, and although *dotted* means *gestrichelt* in the drawing/mathematical context, only recourse to the figure itself yields final certainty. This example demonstrates how important it is to check utterances in the text that refer to figures or other documents against such figures or documents. The fact is that figures and other documents may themselves be defective and in such cases would have to be checked against the conceptual reality underlying them or verified by reference to the author or other experts in the field.

Ellipses occur in 7% of the cases in the ST and are maintained in the translation, because they do not impair cohesion and coherence in the TT.

From the point of view of terminological-phraseological equivalence, it would be interesting to investigate the past participle+noun compound structure on the basis of a larger corpus, which may lead to the establishment of a greater range of translation solutions.

5.2.2.3 Adjective+V$_{ing}$ compounds and their potential equivalents

This compound structure accounts for 4% (6 occurrences) of the adjective+noun structures and 1% of all two-element compound structures investigated (categories 5.2.1+5.2.2) and 0.5% of all compounds counted. Due to the fact that one of these compounds is repetitively used in 67% of the cases, the figures given below would

have to be verified on the basis of a larger corpus. The distribution of translation solutions for this category is as follows:

i) Prefix+noun composite   **67%***
*This figure reflects the repetitively used instance.

    Example: secondary upgrading   Nachverarbeitung

ii) Word groups, i.e., adjective+noun   **33%**

    Examples: statistical modelling   statistische Modelluntersuchungen

                       initial commissioning   erste Inbetriebnahme

The above result shows a lead for composite formation in the TT. However, as mentioned before, the above figures would have to be verified on the basis of a larger corpus due to the high degree of repetition of one and the same item and the low frequency of occurrence of this structure.

In this category, too, adjective+noun structures play an important part in achieving equivalence at the terminological-phraseological level. Here again, there are extensions of the English abstract nucleus to form a somewhat more concrete German composite nucleus, (see first example under ii) above), a step which helps achieve equivalence. Admittedly, in this particular case, the 'German' term *Modellierung* for *modelling*, which is a current term in the field (information of TU Bergakademie Freiberg), would also have helped achieve equivalence at the terminological-phraseological level. This does not, however, invalidate the terminological variant *Modelluntersuchungen* in this specific co-text.

5.2.2.4 Adjective+technical abbreviation compounds and their potential equivalents

This compound structure accounts for 3% (4 occurrences) of the adjective+noun structures, 0.7% of all two-element structures investigated (categories 5.2.1+5.2.2) and 0.3% of all compounds counted. Since the instances in this category are repetitions of one and the same item, such compound structures would have to be investigated on the basis of a larger corpus. Still, the result for this compound structure agrees with that established for the technical abbreviation+noun compounds

discussed under 5.2.1.4, in that the English abbreviation is adopted in the TT in a hyphenated form, though with an extension in this particular case.

Example: nominal WHSV   WHSV-Nennwert[69]

To achieve equivalence at the terminological-phraseological level, the fact that the *nominal WHSV* is a *value* has to be made explicit for systemic reasons. It should be noted that this is not an instance of borrowing that leads to redundancy in the TL equivalent, as may be the case when ST abbreviations/acronyms are borrowed into the TL, e.g., *DOS = DOS-Betriebssystem*.

5.2.2.5 Summary of the investigation of adjective+noun compounds

The table below is a summary of the translation solutions and their percentage distribution established for the categories investigated:

(Figures under 5.2.2.1-5.2.2.4 rounded to the first place after the decimal point. Total figures rounded off. Any discrepancy due to rounding.)

Table 61   Overview of translation solutions for 2-element adjective+noun compounds

Categories:	5.2.2.1 A+N	5.2.2.2 P+N	5.2.2.3 A+V$_{ing}$	5.2.2.4 A+abb		Total
	N=noun, A=adjective, abb=abbreviation, P=past participle For further information see various categories.					
Translation solutions:						
i) Word groups **of these:**	**45.7%**[1]	**9.4%**	**1.4%**		**(sum)** **(56.5)**	**57%**
a) adjective+noun	45%		1.4%			
b) with prepositional attributes	0.7%					
c) participle/participle group+noun		9.4%				
ii) Composites **of these:**	**27.5%**	**0.7%**	**2.9%**	**(31.1%)**		**31%**
a) adjective+noun	11.6%					

[69]   The term *WHSV* occurs in brackets after the full form in both the ST and TT. In the case of the TT, the English full form is given as well to make the English abbreviation - which is used in the course of the text - intelligible.

b) noun+noun	9.4%				
c) noun+linking element+noun	5.8%				
d) other types	0.7%	0.7%	2.9%		
iii) Hyphenated composites				**2.9%**	**(2.9%) 3%**
iv) Others[2]	**9.4%**				**(9.4%) 9%**
	82.6%	10.1%	4.3%	2.9%	(99.9%)[3]
rounded to	**83%**	**10%**	**4%**	**3%**	**100%**

[1] 14% of the word groups in category 5.2.2.1 include extensions either of the nucleus or the determinant (e.g., by an adverb).
[2] Such as verbal solutions, 2:1-solutions, 2:3-solutions, etc.
[3] Any discrepancy due to rounding off.

As the above result shows, the most frequent translation solution in the TT for the categories investigated are word groups (57%) of different types, with a clear lead for the adjective+noun group. As has been discussed and exemplified under 5.2.2.1, these are by no means always simple 1:1-correspondences. Constraints imposed by knowledge of the subject matter and its specific register may come to the fore and may have to be taken into account in achieving equivalence at the terminological-phraseological level. The composite translation solution is the second most frequent solution and, accounting for 34%,[70] is also quite substantial. It includes a variety of composite types, with adjective+noun, noun+noun, and noun+linking element+noun composites being the most frequent solutions. As the overview summarizes, although not all translation solutions occur equally in all categories (see, e.g., 5.2.2.4), word groups and composites do - if with differing percentages - in categories 5.2.2.1-5.2.2.3. The translation solutions under "Others", such as register-induced verbal solutions or explicitations, which may become necessary for reasons of cohesion and coherence, demonstrate how pragmatic considerations come into play and modify equivalence at the terminological-phraseological level. The fact that these translation solutions only appear in category 5.2.2.1 certainly has to do with the very low frequency of items in categories 5.2.2.2-5.2.2.4, and should not be taken to mean that pragmatic aspects do not come into play in the latter categories as well.

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[70]   This figure includes the hyphenated composites.

More research would have to be carried out on the basis of a larger corpus to identify further translation solutions showing how the compounds in these categories may be influenced and modified by pragmatic aspects.

A summary of the main translation solutions and their percentage distribution for all categories investigated, i.e., 5.2.1+5.2.2, is given below:

(Figures under 5.2.1 and 5.2.2 rounded to the first place after the decimal point. Total figures rounded off.)

Table 62   Overview of translation solutions for all 2-element compound structures investigated (categories 5.2.1 and 5.2.2)

Categories	5.2.1	5.2.2		Total
Translation solutions				
			(sum)	
i) Composites	59.6%	7.9%	(67.5%)	68%[1]
ii) Word groups	10.4%	13%	(23.4%)	23%
iii) Others	6.9%	2.2%	(9.1%)	9%
	76.9%	23.1%	(100%)	
rounded to	77%	23%		100%

[1] This figure includes the hyphenated 2-element composites, which account for 19% of the composite translation solution and 13% of all translation solutions.

As the above result shows, composites and word groups are the two most frequent translation solutions for the categories investigated. However, the percentage distributions differ distinctly for each category. In category 5.2.1, the different types of composites account for roughly 60% and word groups for roughly 10%, whereas in category 5.2.2, word groups account for 13% and composites for roughly 8% (for a more detailed account of the percentage distribution of translation solutions established see individual categories 5.2.1 and 5.2.2 above, including the

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corresponding sub-categories). However, this total result is still helpful in that it verifies that the level of compactness of expression of the TT is 'equivalent' to that of the ST. This compactness of expression is achieved, first, by having different types of composites (68%), which - from a structural point of view - are similar to, but not identical with, their English compound counterparts, and, second, by employing terminological word groups, which should not be misinterpreted as instances of 'translational explicitation', since they are merely a reflection of the 'non-systematic' way in which the two languages express the same conceptual reality. The translation solutions under "Others" (9%) include 2:1-correspondences (3%), which also contribute to compactness of expression, whereas the remaining translation solutions (6%) include instances of explicitness, which have become necessary strictly for systemic reasons or reasons of TT cohesion and coherence. This result also aptly demonstrates that translators fully exploit the linguistic potential of the TL to achieve an 'equivalent' compactness of expression using the different linguistic means available. They explicitate only on systemic grounds or in those cases where this is necessary for establishing cohesion and coherence, which is an indispensable prerequisite for safeguarding smooth knowledge transfer. Therefore, "equivalence in difference" (Jakobson [1959]1992) for the categories investigated can be deemed to have been achieved not only at the terminological-phraseological level, but also at the overall textual level.

5.3   Summary of this chapter

On the basis of the investigation of 2-element compounds this chapter has demonstrated how equivalence is established at the terminological-phraseological level and how this level may influence and modify the lower levels of equivalence, i.e., the syntactic and lexical-semantic levels, but may itself by influenced and conditioned by pragmatic aspects, i.e., register considerations and aspects of specialized knowledge. In the process, regularities in translation solutions have been established for the 2-element compound noun and adjective+noun compound structures. In the case of the compound noun structures, the translation solution of TL composite formation brought about by different linguistic means accounts for 77%, while word groups account for 14%. The remaining 9% include 2:1- and 2:3-

correspondences and few cases of explicitation. In the case of adjective+noun compound structures, word groups account for 57% and composites for 34%,[71] whereas the translation solutions under "Others" (9%) include verbal solutions or instances of explicitation. The translation solutions under "Others" in the two categories, such as register-induced verbal solutions or domain knowledge-induced 2:1-correspondences or explicitations that may have become necessary for reasons of cohesion and coherence, demonstrate how pragmatic considerations come into play and modify equivalence at the terminological-phraseological level, so that equivalence is achieved not only at this level, but also at the overall textual level.

On the basis of the results obtained from this research into 2-element compounds, it may be concluded that the optionality in translation solutions is higher in some semi-technical terms and lower in highly terminologized items (here composite formation in German is more likely to occur as the one equivalent terminological solution). Optionality here refers to two or three (but no more) different ways in which a compound term is dissolved to be integrated into a particular sentence, without a change of meaning (see the example of *FCC performance* in 5.2.1.4). Such optionality may also occur with multi-element compounds, e.g., 3-element compounds. For instance, whether the semi-technical term *bench-scale test* is translated by a composite *Laborversuch* (with the element *scale* being considered redundant) or a word group *Versuch im Labormaßstab* may be a question of intra-sentential considerations of register and/or cohesion. Research into 3-element compounds may yield interesting results both from the point of view of how equivalence works at the terminological-phraseological level, but also from the point of view of establishing trends in translation, e.g., the overall percentage figure for word groups in the TT may be higher[72] compared with that of the 2-element compounds due to the linguistic and register constraints in the TL, when it comes to translating compounds that are semantically and conceptually more complex and involve a greater variety of structural patterns than 2-element

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[71]   See f.n. 70.

[72]   Random sampling of 100 items of 3-element compounds (including all structural-semantic patterns, but excluding eponymic compounds) yields the following percentage distribution in translation solutions: 57% for word groups, 43% for composites (the latter including 3:2-correspondences and some hyphenated items). Certainly, this preliminary trend would have to be underpinned by a thorough and differentiated analysis of all 3-element compounds in the corpus.

compounds. Such research would have to take due account of the structural-semantic interrelations between the individual compound elements (Weise 1972; Gläser and Winter 1975). The structural type N+N+N, for example, may occur with two sub-types, i.e., N+(N+N) or (N+N)+N, as in:

| a) | N+(N+N) | product aromatics content | Aromatengehalt im Produkt |
| b) | (N+N)+N | coal liquefaction residues | Rückstände aus der Kohleverflüssigung |

Since it may be assumed that the number of text-related compounds, i.e., compounds brought about by compression of terminologically-laden syntactic structures, increases with the number of compound constituents (> 2 elements), these compounds would have to be given separate consideration, since they may yield different trends in translation solutions. Of course, such forms of syntactic compression in the production of texts may be on their way to becoming specialized terms, in cutting-edge research in particular. F.n. 37 exemplifies a case of a 2-element compound term formation, e.g., *coke prevention/suppression*. A further step is the formation of a 3-element compound, e.g., *coke suppression ability*. In cases in which such compound terms refer to concepts that are still unkown in the TL, Horn-Helf (1999:120) rightly suggests reproducing the designation in the TT as explicitly as possible. However, the TL term formation stage of paraphrasing may be transferred into a more compact "term-like" stage by recourse to expert advice, which shows how important it is for the translator to work hand in hand with the expert in the field in order to coin terms for novel concepts.

Although, in a first step, technical and semi-technical compound terms should again be considered together, it may even be advisable to go a step further in subsequent investigations of multi-element compounds and try to delimit highly specialized compounds that belong to the terminology proper of the different domains/sub-domains reflected in the ST from compounds that belong to other layers, e.g., semi-technical or more text-related compounds.[73] The hypothesis

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[73] Still, as has been mentioned earlier (see 5.2.1) it may be difficult to distinguish between semi-technical and technical compound terms, e.g., the compound *ebullated bed experiments* consists of a semi-technical nucleus and and highly technical determinant. However, it may be the semi-technical nature of the nucleus that points to a certain optionality in translation, *Versuche im Wirbelbett* or *Wirbelbettversuche*, whereas the technical compound *ebullated bed catalyst*, yields a composite only as TL equivalent, i.e., *Wirbelbettkatalysator*.

propounded here is that highly specialized 3-element compound terms may reveal a clearer trend towards composite formation in the TL (including, e.g., 3:2-correspondences) regardless of certain structural patterns than compounds belonging to other layers. For example, the TL equivalent for the compound term *carbon residence times*, which belongs to the structural type a) above, is *Kohlenstoffverweilzeiten*, i.e., a composite, whereas example a) above (and b), too) can be considered a compound arising due to register-induced syntactic compression in the production of text, which has given rise to a word group in the TT. However, this hypothesis would have to be confirmed by further research on the basis of a more comprehensive corpus to obtain enough items reflecting various structural patterns, e.g., (A+N)+N. The variety in such semantic-structural patterns may go beyond the patterns established by special languages research (Weise 1972; Gläser and Winter 1975), because from the point of view of translation, text-related terminological compounds with their greater and/or more varied allocational potential would also have to be considered in such research. Such research would also have to include further sensible sub-categorization of 3-element compounds, such as compounds containing proper names or abbreviations, because these may yield different trends in translation solutions (such as hyphenated TL composites).

As far as is reasonably possible, text-related 3-element compounds should be given separate consideration, because the hypothesis considered here is that there is a tendency towards dissolving them to fit them into a particluar co-text. Due to ellipsis, such compounds may be highly dense and implicit and may give rise to explicitation via longer syntactic word groups in the TT, as in:

a) low coal residue   Rückstand aus dem Einsatzmaterial mit geringer Kohlekonzentration

b) high severity results   die bei scharfen Verfahrensbedingungen [...] erzielten Ergebnisse

The above compounds are used elliptically for the following complex conceptual entities: a) "a residue deriving from processing a low coal concentration feedstock"; b) "results obtained at high severity operation". These instances of syntactic compression cannot be reproduced in German, i.e., a 1:1-correspondence would be completely unintelligible. Explicitation[74] is necessary to establish cohesion and coherence in the TT to ensure smooth knowledge transfer.

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[74]   In the paraphrase of the German example a) the aspect of "deriving from processing" is

Since the ST under investigation shows a leap in the degree of hybridization with compounds greater than/equal to 4 elements, giving rise to subject matter plus text-related syntactic compressions, it may be assumed that there is a very clear trend towards complex syntactic and terminologically-laden word groups in the TL for such compounds. Knowledge of the structural-semantic allocational pattern in tandem with domain knowledge may help translators understand, dissolve and translate such compounds and fit them into a particular TL co-text, taking due account of specific equivalents for technical terms contained in such compounds, e.g., *coal mineral matter level - Gehalt an mineralischen Bestandteilen in der Kohle*. It is the TL equivalent for the technical compound term *mineral matter*, i.e., *mineralische Bestandteile*, that governs the way the remainder of the compound is translated and integrated into its TT syntactic environment.[75] Although, according to Gläser and Winter (1975), certain regularities in semantic-structural patterns can still be ascertained with specialized 4-element compound terms, these may no longer yield regularities in the linguistic representation of TL equivalents for reasons of conceptual complexity. Of course, this would have to be verified on the basis of a more comprehensive translation corpus. What can be assumed on the basis of this corpus is that there is a very clear trend towards different kinds of word groups in the TL involving different degrees of composite formation, e.g., *high sulphur content residues - Rückstände mit hohem Schwefelgehalt*, and a much lower share of composites, e.g., *high-volatile bituminous coal - Gasflammkohle* or hyphenated composites, e.g., *bench-scale CSTR studies - CSTR-Laborversuche*. Although the hypothesis here is that TL composite formation may occur rather more often with highly specialized 4-element compounds (see example above), the overall trend in TL composite formation may clearly be lower relative to that with 3-element compounds and much lower relative to that with 2-element compounds. Further translational research into the question of whether TL word groups or composites are used for English 3- and 4-element compounds alone would be a fruitful task in that it would give some indication of the number of composite constituents that are tolerable in a

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implicit in the preposition *aus*. In the paraphrase of example b) the term *operation* is
extended to form "Verfahrensbedingungen" in German.

[75] In general, SL paraphrase of complex compounds taking due account of semantic and conceptual aspects may be a first step in translating such compounds. The above example can be paraphrased as follows: "the level of mineral matter in the coal".

TL text-in-context of a particular genre and type. From the point of view of translation and on the basis of this research, we can rightly assume an increase in TL word group formation for English compounds ≥ 3 elements with a leap in word groups for compounds ≥ 4 elements. The fact that German can indeed produce 3- or 4-element composites does not imply that such composites are the key to equivalence for English 3- or 4-element compounds. On the basis of this research it may be assumed that the tipping point for TL composite formation is reached with 4-element compounds.

For reasons of complexity, compounds > 4 elements may no longer be conducive to the establishment of regularities in ST structural-semantic patterns and to the establishment of regularities in translation solutions. As Gläser and Winter (1975:750) rightly claim in this context, the increase in the number of constituents also increases the semantic allocational potential between the constituents and thus the ambiguity of the overall expression. Recourse to the co-text, context and subject matter is necessary to monosemize and translate such compounds and integrate them into the TL co-textual environment in such a way that equivalence can be achieved at both the terminological-phraseological and overall textual levels. Although it can be assumed that the number of text-related compounds increases with an increase in the number of compound elements, we still find highly specialized compound terms with compounds > 4 elements, too, e.g., *industrial-scale circulating fluidized bed combustors*, that have to be dissolved in translation to fit into a specific TL co-text, taking due account of TL terminological equivalents, e.g., *großtechnische Verbrennungsanlagen mit zirkulierender Wirbelschicht*. Although these compounds are no longer amenable to the establishment of translation regularities, they should be given greater consideration in translational research - even if they can 'only' be described and discussed on the basis of one particular text-in-context - to serve as examples of a particular translational challenge in the classroom. Students would certainly benefit from an elucidation of the steps necessary for their translation from an analytical, i.e., understanding-related, transfer-related (for example translation in multiple stages), and synthetical, i.e., TT production-related, point of view, with due regard to terminological-phraseological and pragmatic constraints in the TL.[76]

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[76]   Dopleb (2002:46), too, claims that compounds should be given greater consideration in translator training, precisely due to the fact that dictionaries are not very helpful in this

Further research into multi-element compounds, and here into 3- and 4-element compounds in particular, would also have to take due account of ellipsis, polysemy and redundancy aspects both in the ST and its translation. In the following examples, the term *plant* and the suffix-like element *-type*, respectively, are considered redundant in the TL:

pilot plant testing   Pilotversuche

dealuminated Y-type zeolite   entaluminierter Y-Zeolith

Gläser and Winter (1975:741) found that the element *-type*, mostly remains either untranslated or requires a paraphrase in the TL in chemical expressions. In the present corpus, *-type* was considered redundant in all cases in the TT. An example of a paraphrase is given by Gläser and Winter (1975:741), the TL paraphrase being triggered by the proper name:

Ostwald-Fenske-type viscometer   Viscosimeter nach Ostwald Fenske

Although knowledge of the different allocational systems (Franck 1980:34) and term formation/creation processes in English and German (Sager 1990:61 ff.; Fluck [2]1997:46 ff.) is extremely helpful in achieving terminological equivalence with multi-element compounds,[77] TL norms and conventions as reflected in the particular lexicon of a specific domain/sub-domain may yield equivalents that deviate from allocational patterns or involve redundancy aspects, which shows that terminological-phraseological equivalence takes priority over lexical-semantic equivalence. Again, in a specific text-in-context the terminological-phraseological level may itself be influenced and modified by pragmatic aspects, i.e., specialized knowledge and register considerations, as this research into 2-element compounds has shown.

It should be noted that - although the establishment/creation of a terminological equivalent may often be difficult enough for the translator - specifically with concepts that do not exist in the TL due to different emphases in scientific and technological research and development activities - it may occasionally

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[77] respect.
Schmitt's (1999:294) statement that the determinatum in German and English multiple compounds is on the right and that such compounds should be read from the right to the left may be considered too overgeneral to be helpful. Moreover, it ignores the different allocational systems in English and German (Franck 1980:34).

be even more difficult to establish equivalence at both the terminological-phraseological and the overall textual levels in what have been called here text-related compounds (including terminological word groups in *of*-relation and conjunctive compounds), which may be very ambiguous due to their double co-textual and contextual nature, often showing a complex semantic-conceptual allocational potential and involving ellipsis.

This research has also shown that translators explicitate only in those instances in which explicitation has become necessary strictly for reasons of cohesion and coherence, establishment of which is an indispensable prerequisite for safeguarding smooth knowledge transfer. Therefore, it is the motivation behind the explicitation rather than the explicitation itself which is of relevance in the translational context. The translation solutions subsumed under "Others" in this investigation, but also some of the more common translation solutions, also cast some light on the difference between translation and terminology which according to Sager (1992:113) can be described "by saying that translators deal with acts of 'parole', whereas terminologists may use acts of 'parole' but record facts of 'langue'". As this research has shown, awareness of this difference is essential when it comes to achieving equivalence not only at the terminological-phraseological level but also at the overall textual level. How equivalence is established at the latter level, will be demonstrated in the next chapter.

6 Equivalence at the overall textual level
Cohesion and coherence in translation:
The case of the English demonstrative determiner/pronoun *this* and its German potential equivalents

> Although the majority of cohesion studies have been characterized by a surface bias, it is becoming increasingly more common in translation studies to assume that cohesion has to be examined in terms of underlying coherence if it is to yield any useful insights
> [...] Cohesion implies coherence, and it is the motivations behind the use of a particular cohesive device, rather than the device itself, that ought to be taken into consideration in the act of reworking a text [...]   (Hatim 1998:265)

Studies of cohesion and coherence have so far not been linked to or integrated into an equivalence-relevant theoretical framework. Although Baker (1992) discusses cohesion under "textual equivalence" (op. cit.:180 ff.) and coherence under "pragmatic equivalence" (op. cit.:217 ff.), she says that "the term **equivalence** is adopted in this book for the sake of convenience - because most translators are used to it rather than because it has any theoretical status" (op. cit.:5-6). That equivalence is, in fact, a valuable theoretical concept has been shown throughout the foregoing chapters and will be demonstrated again in the present chapter, since overall textual equivalence can only be deemed to have been achieved, if cohesion and coherence are established in target texts. The previous chapters have already shown how aspects of cohesion and coherence come into play and modify equivalence at the syntactic, lexical-semantic and terminological-phraseological levels (see Chapters 3 to 5), but a more systematic study would be necessary to investigate cohesion as a typical feature of the text level, taking due account of the underlying coherence, to demonstrate how equivalence relations operate there and how patterns in translation trends can be established. Certainly, the investigations of equivalence at the syntactic, lexical-semantic and terminological-phraseological levels have all been carried out against the background, and in due consideration, of the overall text-in-context level, but the following analysis will show how the textual level itself may be the subject of our study in an equivalence-relevant theoretical framework.

Cohesion and coherence are defined differently in text linguistics (see, e.g., Schlorke (1983) for a brief overview) and translation studies (see, e.g., Vermeer 1984[1], Baker 1992). According to de Beaugrande and Dressler (1981), cohesion and

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[1]   Vermeer (1984) (and Kußmaul (1986), too, following Vermeer 1984) uses "Kohärenz" or "intertextuelle Kohärenz" to supersede "Äquivalenz", in a somewhat debatable use of the

coherence are "the most obvious standards of textuality" (op. cit.:113).[2] Cohesion refers to the way in which the surface elements of a text, such as lexical or grammatical elements, hang together and display continuity (cf. also Halliday and Hasan [14]1995). Coherence refers to the way in which continuity of sense is established and upheld:

> A text "makes sense" because there is a CONTINUITY OF SENSES among [sic!] the knowledge activated by the expressions of the text [...] (de Beaugrande and Dressler 1981:84)

These two concepts are closely interrelated, because a well-motivated selection of cohesive devices will help establish coherence, which is maintained "by continual interaction of TEXT-PRESENTED KNOWLEDGE with PRIOR KNOWLEDGE OF THE WORLD" (de Beaugrande 1980:19). Consequently, Dressler (1998), referring to de Beaugrande and Dressler (1981), describes coherence as the way in which a text hangs together semantically, pragmatically and thematically and claims that the constitution of coherence is not text-immanent, but performed by inferencing. The latter aspect is of particular importance in scientific and technical discourse, where highly specialized texts may be lacking or poor or even defective in cohesive devices.[3] If lacking or poor, this may be due to register constraints, such as compactness of expression brought about in English, e.g., by the frequent use of the non-finite verb forms (see Chapter 3) or compounding (see Chapter 5) involving ellipsis and synonymy, and, if defective, to a certain carelessness on the part of the author.[4] However, such texts may still be made coherent by relying on specialist readers' domain knowledge or experience and their ability to build what Clark and

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concept, since it is equivalence that refers to the special relationship between an ST and a TT and to the process and the product of a language transfer, whereas coherence as a standard of textuality (de Beaugrande and Dressler 1981) is a property of a text-in-context within one single language.

[2] The remaining standards of textuality are "intentionality", "acceptability", "informativity", "situationality", and "intertextuality" (de Beaugrande and Dressler 1981).

[3] Certainly, there may be other types of text which are not fully cohesive and coherent, but they are still both "intended to be a text and accepted as such in order to be utilized in communicative interaction [...] These attitudes involve some tolerance toward disturbances of cohesion or coherence, as long as the purposeful nature of the communication is upheld [...]" (de Beaugrande and Dressler 1981:113). From the point of view of translation it is important for the translator to establish the author's intentions underlying a lack of cohesion, for example, to properly deal with the phenomenon in translation. An example of a case of an inappropriate ST cohesive device which has been corrected in translation is given in 6.1.2, iii).

[4] So we could talk of an intended and unintended lack of cohesive devices, which may have different implications for translation.

Haviland (1977:6) call "an inferential bridge" (see also Weissberg 1984).[5] From the point of view of translation such texts are particularly challenging, because they require a sound domain knowledge on the part of the translator, who may have to consult experts in the field engaged in cutting-edge research to perform the necessary 'bridging task' and enable her/him to use the TL register-bound cohesive and other devices to re-establish TT coherence.

The relevance of these two concepts in the translational context has been discussed and described by various scholars and from different angles (e.g., Blum-Kulka 1986, Hatim and Mason 1990, Baker 1992, and more recently Gerzymisch-Arbogast 1999[6]). In an equivalence-relevant investigation based on a proper delimitation of translation from other forms of text production (1.4.1), it may be safely assumed that coherence, i.e., the set of conceptual relations underlying the surface text, would remain constant in translation (Hatim and Mason 1990).[7] However, the ways in which this coherence is reflected on the textual surface, i.e., the cohesive devices employed, may be quite different for reasons related, e.g., to specific languages, text types and genres. Coherence in the present research is taken to mean intended sense interacting with informed inference, rather than "intended meaning" (Hatim and Mason 1990:194) or *"the realization(s) of the text's meaning potential"* (Blum-Kulka 1986:23), since according to de Beaugrande and Dressler

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[5]   Weissberg (1984:493-494) found that the need for 'inferential bridging' in Methods/Materials sections in English experimental research reports was much more noticeable than in other sections. It would be interesting to investigate how such instances are dealt with in translation.

[6]   Gerzymisch-Arbogast (1999) is a new and systematic approach which tries to represent coherence in semantic networks by "concretization" (i.e., tying implicit knowledge systems/world knowledge to textual information/text passages) in a computer-assisted process (cf. also Gerzymisch-Arbogast and Mudersbach 1998). However, the question arises as to whether this procedure can be applied to longer texts of a highly specialized nature in a practicable way, since representability of the knowledge of different subject fields plus world knowledge, which can all be reflected in one and the same text, may be limited due to complexity in the relationship between textual information and extra-textual knowledge systems. ·

[7]   According to Hatim and Mason (1990:195), the "sequence of coherence relations" under normal circumstances remains constant in translation. This view is challenged by Gerzymisch-Arbogast (1999:80, f.n. 2) who claims that it is outdated, because coherence relations may change for intercultural reasons. However, the short example text she gives, i.e., the translation of a pharmacy ad from German into American English, is clearly a case of adaptation, which yet again points to the need for a delimitation of translation from other forms of text production (Schreiber 1993). This delimitation is also lacking in Hatim and Mason (1990), so that the question arises as to what they mean by "under normal circumstances". May this be interpreted to read as "in the case of translation proper"?

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(1981:84), meaning describes "the *potential* of a language expression" for representing and relaying knowledge ("*virtual* meaning"), whereas sense designates "the knowledge that *actually* is conveyed by expressions occurring in a text." They continue that "many expressions have several virtual meanings, but under normal conditions, only one sense in a text." This aspect has direct implications for translation, because translators do not translate isolated expressions, but expressions in texts-in-contexts, which requires them to discover the intended sense of a particular expression in a particular text-in-context. This is particularly important in instances in which the textual surface may make it difficult to establish the intended sense. It is this intended sense that has to be maintained and replicated in translation, i.a., by deploying cohesive devices which, as our research shows, may differ considerably between languages. The use of TL cohesive devices that are equivalent to their ST counterparts will help relay the intended sense of the ST in the TL, so that TT coherence can be established through interaction between textual knowledge/information and the TL expert reader's domain knowledge, world knowledge and experience.

The demonstrative determiner/pronoun *this* and its potential equivalents will be analyzed and discussed in the next section as a feature of cohesion. For the purpose of this investigation, cohesion, which is analyzed at the textual level, and coherence, which is understood as operating at the text-in-context level, i.e., in the realm of pragmatics, are considered to be closely linked. This means that cohesion is analyzed by taking due account of the underlying coherence or intended sense, a step which is necessary if the investigation is to yield equivalence-relevant findings (Hatim 1998:265).

6.1 The case of demonstrative determiner/pronoun *this* and its German potential equivalents

The previous chapters of this thesis have already shown how aspects of cohesion and coherence come into play and modify equivalence at the syntactic, lexical-semantic and terminological-phraseological levels in isolated cases (see, e.g., 5.2.1.1). However, a more systematic study would be necessary to investigate cohesion as a typical feature of the text level in order to show how equivalence relations operate there and to identify patterns in translation solutions. For this purpose, the

demonstrative pronoun/determiner *this* as a cohesive device of reference, and its German potential equivalents will be examined. According to Halliday and Hasan ([14]1995:57-76), demonstrative reference is basically "a form of verbal pointing" (op. cit.:57), i.e., the demonstratives have a deictic function. They have definite meaning, and "their reference depends on the context shared by speaker/writer and hearer/reader" (Quirk et al. [13]1995:6.40 ff.). They may be used in situational reference (reference to the extra-linguistic environment), anaphoric reference (reference to an earlier part of the text) and cataphoric reference (reference to a later part of the text) (Quirk et al. [13]1995:6.40 ff.). The demonstrative determiner/pronoun *this* is of particular importance in this context, first, because it is the most common demonstrative in the corpus (see Table 63 below), so that statistically underpinned trends/regularities in translation solutions can be expected. Moreover, this high and somewhat unusual frequency may yield interesting shifts in translation for register reasons in the TT. Second, an investigation of the demonstrative pronoun *this*, in particular, and its translation solutions is itself a worthwhile task in view of its intricate referential function (6.1.2). The percentage distribution of the demonstratives occurring in the corpus is given in the following table:

Table 63 Distribution of demonstratives occurring in the ST

	Percentage	Occurrences
this (DD)*	42%	41
this (DP)**	29%	28
	(Sub-total: 71%)	
these (DD)	20%	19
these (DP)	2%	2
	(Sub-total: 22%)	
that (DD)	--	
that (DP)	3%	3
	(Sub-total: 3%)	
those (DD)	2%	2
those (DP)	2%	2
	(Sub-total: 4%)	
Total: 100%		97
* DD = demonstrative determiner	** DP = demonstrative pronoun	

As the above table shows, the demonstrative *this* accounts for 71% of all demonstratives in the corpus, with the determiner making up 42% and the pronoun 29%. These two categories will be investigated in greater detail in what follows.

6.1.1 *This* used as demonstrative determiner and its potential equivalents

The demonstrative *this* in the above function accounts for 42% (41 occurrences) of all demonstratives counted and is the most frequent demonstrative in the corpus. The demonstrative, which occurs as "modifier" (Halliday and Hasan [14]1995:58) within the nominal group, refers either to a concrete entity or to an abstract phenomenon participating in the reported research. Concrete entities are, e.g., documents, *this report*, chemical substances/properties, *this VGO, this stability*, concrete objects, *this unit*, etc. Examples of abstract phenomena are *this problem, this question*, etc. The demonstrative may be used in situational reference (i.e., it refers to something in the extra-linguistic context, e.g., *this report*) and anaphoric reference (it refers to a part mentioned earlier in the text, e.g., *this problem*). In the latter case, the noun modified by the determiner *this* may be an exact repetition of an antecedent noun/compound/nominal group, an elliptic repetition, especially in the case of highly technical compounds, e.g., *raw coprocessing VGO* (*vacuum gas oil*) - *this VGO*, a reduced, modified and/or differently worded repetition in the case of compounds occurring in the production of text, e.g., *another linear and much better correlation* - *this correlation* (see example i) below), or headings (see end of section for an example), a co-textual synonym, e.g., *x* (figure) *BPCD* (*barrel per calendar day*) - *this amount*, or a noun referring to a differently worded more comprehensive antecedent propositional content (see example iii) below). Since there are not enough instances of the demonstrative determiner plus noun used in situational reference, e.g., *this report*, demonstratives in situational and anaphoric reference are dealt with together here, though the demonstrative in situational reference will be considered separately in the discussion of our findings. On the basis of a larger corpus containing more instances of situational reference a distinction between situational and anaphoric reference might yield more specific results, although there may be cases in which it is difficult to distinguish between the two. Also, depending on discourse complexity, anaphoric reference may have its intricacies, if, e.g., several engineering/chemical

tests are mentioned synonymously with the nouns *studies* or *approach*, it may occasionally be difficult to establish referential clarity in instances such as *this study* or *this approach.*

The distribution of translation solutions for this category is as follows:

i)   German demonstrative determiners *dieser, diese, dieses*   63%

Example:[8]
[With this assumption [...] another linear and much better correlation for [...] can be generated as shown by the solid line in Fig. [...]]
This correlation indicates that the process that results in [...] will be the most economical.

Nach *dieser* Korrelation ist das Verfahren, das zu [...] führt, auch das wirtschaftlichste.

ii)   German adjective,[9] definite article+adjective,
(preposition+article)+adj.   17%
(An adverb may be intercalated between def. art. and adj.)

Example:
[These [...] development runs were limited to an upper operational reactor temperature of ≈ [...] due to parametric sensitivity.]
This led to the design [...] of a new reactor hydrogen quenching system to overcome *this* problem [...]

Diese Problematik führte deshalb [...] zur Konstruktion [...] eines neuen Wasserstoffquenchsystems am Reaktor, um *besagtes* Problem zu lösen [...]

iii) German definite article   5%

Example:
[The use of coprocessing residues as [...] for the production of X was evaluated.]
Based on the results of *this* study, the production of X does not seem feasible with coprocessing residues.

Auf der Grundlage *der* Untersuchungsergebnisse erscheint die Erzeugung von X mit Coprocessing-Rückständen nicht durchführbar.

iv)   Others   15%
Such as: adverbial phrasing (see example below), adverbs, 1:0-correspondences due to redundancy considerations.

Example:
A related study on the detailed characterization of distillate fractions by advanced NMR techniques was summarized *earlier in this report* [...]

Über eine damit zusammenhängende Untersuchung bezüglich einer detaillierten Charakterisierung von Destillatfraktionen mit Hilfe moderner NMR-Verfahren wurde *weiter oben* zusammenfassend berichtet [...]

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[8]   For reasons of confidentiality, the ST antecedent cannot always be given or given in full; otherwise it is indicated in square brackets.
[9]   The term adjective is understood to include participles used in adjective function.

The above figures favour a trend towards German demonstrative determiners (63%) in the search for equivalence at the textual level. Like the English determiner, the German determiner helps the reader reidentify and refocus a piece of knowledge introduced earlier in the text. The nouns modified by the German determiner may be exact, modified or differently formulated and/or co-textually synonymous repetitions of the antecedent noun/compound/nominal group, or refocus a differently formulated more comprehensive propositional content (cf. Graefen 1997:218-220). However, in as many as 37% of the cases a range of translation solutions may contribute to equivalence at this level, such as adjectives, definite articles+adjectives, adverbial expressions, 1:0-correspondences and other solutions. This shows that cohesion in the TT may be established in different ways as compared with the ST by having recourse to the above linguistic means. In translating this demonstrative, therefore, the translator has to be aware of the variety of potential translation solutions, the actual choice depending on semantic considerations in a specific co-text/context involving, e.g., the need to use an adjective in the TT with a view to emphasizing the deictic function, or on pragmatic considerations, such as those of register, with a view to avoiding excessive and/or monotonous use of the demonstrative determiner in the TT, or to establishing greater referential clarity. Use of one of the above solutions may also depend on how other demonstratives in the same sentential co-text have been translated.

The variety of translation solutions established (the 37%) may be regarded as an apt reflection of the difference between the use of the English and the German demonstrative. Like the English article, the demonstrative, too, may be considered to be semantically stronger than its German counterpart (cf. Franck 1980:97-99), so that it may be necessary in translation to place an emphasis at a particular text location by deploying other linguistic means, other pronouns, adjectives or adverbs. Hence, such cases of explicitation are due to this difference in the semantic potential between the two languages involved, rather than proof of the 'explicitation hypothesis' (Blum-Kulka 1986; Baker 1996:176-177; Laviosa 2002:51-54). As mentioned before, pragmatic aspects, too, such as register considerations, may come to the fore and trigger the use of other linguistic means, such as adverbial phrasing operating as cohesive devices in the TL, which may lead to instances of implicitation, too, in the

TT (see example under iv) above). Shifts in both explicitness and implicitness may occur in the process of translation for systemic, register and other translational reasons (cf. Salama-Carr 2001)[10] and it is the motivation behind the explicitation rather than the explicitation itself which is of relevance in the translational context.

This research shows that the translator has to examine thoroughly each occurrence of demonstrative determiner to be able to select a TL equivalent. Context may have a 'levelling effect' ("nivellierende Wirkung", Franck 1980:99), and there may be no need to explicitate the systemic difference in the semantic potential to establish cohesion (see translation solutions under i) accounting for 63%). Other textual locations may need such an explicitation for the same reason. It is the interplay of the above linguistic means, some of which are quite different from their English demonstrative counterparts, that help establish not only cohesion, but also coherence or continuity of sense in the TT.

In view of the results for the demonstrative in situational reference, e.g., *this report*, there is a trend towards using the German definite article+adjective, viz. *der vorliegende Bericht*, (but see the above example under iv)) to establish referential clarity. This result tends to correlate with some of the findings of German monolingual research (Graefen 1997:216-223), where it was found that a definite article+adjective phrasing may often be used instead of the demonstrative determiner to counteract referential misunderstanding in situational reference, e.g., "die vorliegende Untersuchung" (op. cit.:218).[11] However, as our results have shown, this translation solution may also occur in the case of anaphoric reference for various reasons, see example below:

[Feedstock preparation and characterization] (heading)
This area focussed on the coal part of the feed and how its treatment affects general process performance.
Der hier angesprochene Themenkreis bezog sich im wesentlichen auf den
Kohleanteil des Einsatzmaterials und die Frage, welchen Einfluß seine Aufbereitung
auf die allgemeine Verfahrensleistung hat.

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[10]   As a result of her research into implicitness in translation of scientific and technical
discourse, Salama-Carr (2001) states that implicitation and explicitation in translation may
be due to systemic constraints, stylistic constraints and translational factors.

[11]   "Im Vorgriff auf § 6.7. ist aber schon hier festzustellen, daß zwar darin keine deiktische
Einheit vorkommt, auf einem 'Umweg' aber doch eine deixisähnliche Prozedur
durchgeführt werden muß, denn es handelt sich um die Untersuchung, die *dem Leser* als
Adressat der Sprechhandlung vorliegt." Graefen (1997:218)

On the basis of this research, we may also rightly assume that a similar variety of translation solutions would occur in an investigation of the plural form *these*.

6.1.2 *This* used as demonstrative pronoun and its potential equivalents

The demonstrative *this* in the above function accounts for 29% (28 occurrences) of all demonstratives counted and is the second most frequent demonstrative in the corpus.[12] It occurs in subject position in a pro-form function and is used either for anaphoric nominal reference (32%) (9 occurrences) or anaphoric textual reference (68%) (19 occurrences), i.e., in the first case the antecedent is a single noun/compound noun occasionally plus adjective or a noun phrase, in the second case the antecedent may be the propositional content of a larger part of discourse, e.g., a complex clause, sentence or occasionally an entire section of discourse or parts of these (cf. also Quirk et al. [13]1995:6.44; Halliday and Hasan [14]1995:66 ff.).[13] These two types of reference are dealt with together here, but - as the results will show - may have to be given separate consideration for equivalence reasons when investigated on the basis of a more comprehensive corpus. The relatively high frequency of *this* is somewhat unusual and apart from being motivated by the need for economy of expression, points to a certain stylistic carelessness on the part of the author involving instances of referential vagueness, i.e., it is not always unequivocally clear what specific antecedent is referred to by *this*. In such instances the establishment of referential clarity in the TT may require recourse to domain knowledge involving expert advice. Such cases of stylistic carelessness are not atypical in the scientific and technical field, where researchers are pressed for time to present and publish their latest results, which may be considered more important than the language describing them. How such an instance of stylistic roughness involving an occasional referential vagueness can be counteracted in translation[14] and how overall textual equivalence be achieved is reflected in the following result.

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[12]   This category includes the *this*-subject in 'secondary subjectification' (4.3.2.4), which accounts for 54% of the *this* pronouns investigated here.

[13]   In this context Quirk et al. ([13]1995:6.44) talk of 'sentential antecedent'. Halliday and Hasan ([14]1995:66 ff.) distinguish between "extended reference" (to an "extended passage of text") and "reference to 'fact'", a distinction which may become relevant in the translational context, too. However, in the context of the present research, it seems to be advisable to follow the distinction suggested in 6.1.2 above, though further sub-categorization may be necessary for a more comprehensive investigation of this subject.

[14]   Of course, there may be instances of deliberate vagueness, e.g., in cases where researchers do not want to disclose too much of their findings for confidentiality/proprietary reasons,

The distribution of translation solutions for the category examined is as follows:*

*(Any discrepancy in the figures due to rounding off.)

i)   **Use of pronominal (prepositional) adverbs and other adverbs[15]   43%**
      (Duden vol. 4, [5]1995:626 ff.)
      Such as: *damit, hiermit, daraus, hierbei*, etc.

      Example:
      This allowed construction of two dimensional statistical response models for different process results including [...]

      Hiermit konnten zweidimensionale statistische Verlaufsmodelle für verschiedene Verarbeitungsergebnisse, wie [...], konstruiert werden.

ii)   **Shift from demonstrative pronoun to demonstrative determiner and introduction of a noun/subject   28%**

      Example:
      [Of particular interest to X was process performance at high reactor throughputs.]
      This was investigated by carrying out some experiments at [...] and at higher reactor temperatures [...]

      Dieser Aspekt wurde durch Experimente bei einem [...] und hohen Reaktortemperaturen [...] untersucht.

iii) **Others   28%**
      Such as: 1:0-correspondences triggered by redundancy considerations and use of different cohesive devices in the TT, neuter *dies*, demonstrative pronoun, relative pronoun *was*, etc. This category contains a few cases in which *this* was inappropriately used in the ST and improved upon in the translation, see example below:

      Example:
      [Processing the same coal sample dried by the different methods at a relatively high severity of [...]°C and a nominal WHSV of [...] resulted in no significant difference in almost all measured process variables.] *This* included: coal and pitch conversions, distillables [...]

      Bei Verarbeitung der gleichen jedoch auf unterschiedliche Art getrockneten Kohleprobe unter relativ scharfen Verfahrensbedingungen von [...]°C und einem WHSV-Nennwert von [...] ergaben sich in bezug auf fast alle Prozeßvariablen, *wie z. B.* Kohle- und Pechumsätze, destillierbare Anteile [...] keine nennenswerten Unterschiede.

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15   and in such instances referential vagueness may be transferred into the TT.
      There are two instances of temporal adverbs as TL equivalents for a SL *this*-subject+ passive construction, e.g., "This was followed by [...]" - "Anschließend [...]". The German adverb *anschließend* has a pro-form function, since it refers back to the content of the foregoing sentence, though somewhat more implicitly than the English *this*-subject+passive construction.

The above results show a varied pattern of translation solutions for the demonstrative pronoun under investigation. Pronominal and other adverbs, such as temporal adverbs, e.g., "This was followed by" - "Anschließend", account for 43% of the translation solutions. Pronominal adverbs belong to the relational adverbs and, therefore, like the English pronoun *this* have a pro-form function and may be used in anaphoric reference, with the antecedent being a noun, noun phrase or entire sentence (Duden vol. 4, ⁵1995:628). The use of these pronominal adverbs is particularly frequent in the case of English *this* referring to the propositional content of a more complex clause, sentence, several sentences or parts of these, though also other solutions occur, e.g., translation solution ii) or relative pronoun *was*, involving the integration of one sentence into the foregoing one. The frequent use of pronominal adverbs established above tends to agree with monolingual research (Rehbein 1995) and more recent translational research (Baumgarten et al. 2001:34; Böttger and Probst 2001:11 ff.), which found that these adverbs, referred to by Rehbein (1995) as "zusammengesetzte Verweiswörter", are a common feature of German discourse and contribute to cohesion by refocussing and condensing knowledge.

A shift from demonstrative pronoun to demonstrative determiner and the introduction of a noun/subject in German occurs in 28% of the cases. This translation solution, which tends to correlate with the findings of German monolingual research (Graefen 1997:219), suggests that a noun helping the reader reidentify and refocus an antecedent noun or "propositional content which has already been mentally processed, but is formulated differently" (Graefen 1997:219, my translation), may be required to establish cohesion in the TT. In most cases, this noun is an abstract noun, such as *Zusammenhang, Sachverhalt, Problematik, Aspekt*, which brings about a naming and refocussing of the content/ideas in the English antecedent by abstraction. This noun then becomes the thematic subject of the following sentence. The use of these nouns helps refocus knowledge and, at the same time, contributes to formality of expression with nominalization and abstraction in German, which is known to exhibit a higher, i.e., more formal, level of discourse formality than English in scientific and technical context (cf. Gerzymisch-Arbogast 1993). This shift in cohesion, which may be interpreted as an instance of a certain explicitation, is register-induced and thus contributes to overall textual equivalence.

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The translation solutions under iii), which account for another 28%, include 1:0-correspondences triggered by redundancy considerations, involving shifts in implicitness, and the use of further different cohesive devices in the TT, such as the neuter *dies*, demonstrative pronoun, relative pronoun *was*, etc. This category also contains cases in which *this* was inappropriately used in the ST and corrected in the translation. In the example under iii), *this* is improperly used for *these* referring to *all measured process variables*. In German, cohesion is established by integrating the second sentence into the first by *wie z. B.*, functioning as a connective and explanatory expression.

The German 1:1-correspondence, i.e., the neuter *dies*, which may also refer to an entire sentence (Duden vol. 4, [5]1995:562) and/or more complex propositional content, only occurs once in the TT as a potential equivalent for *this*. In this case, reference to a specific antecedent is left as vague as in the original. Since nominal *dies* may be difficult to refer to a specific antecedent, it may be expected to be used much less frequently (cf. Graefen 1997:220-223) in scientific and technical texts, owing to the need for greater precision in German in this kind of discourse.

It was also found that the variety in translation solutions is most pronounced in the case of *this* referring to a single noun/compound noun or noun phrase, with pronominal adverbs accounting for 11%, demonstrative determiner+noun for 33% and other solutions for as many as 56%, which reflect, above all, pragmatic considerations, such as register and domain knowledge needed to establish both cohesion and coherence in the TT.

The findings of this analysis suggest that in the case of *this* used as demonstrative pronoun in subject function, there is a host of different translation solutions available, one of which must be carefully chosen taking due account of semantic and pragmatic aspects to establish cohesion in the TT. This specific translation solution is not chosen at random; the selection may be motivated by considerations of domain knowledge and register, which serve, e.g., to remedy a carelessly used instance of *this*, to establish greater referential clarity or to control

and compensate the ST's excessive use of this pronoun in translation by deploying those TL cohesive devices that may be considered potential equivalents for the SL item in specific co-textual and contextual circumstances. It is the interplay of the linguistic devices found that establishes TT cohesion which, in its turn, contributes towards preserving the intended sense and the informed inference, so that coherence may be deemed to have been established and upheld, and equivalence at the overall text-in-context level achieved.

6.2   Summary of this chapter

The investigation of *this* used in demonstrative reference has revealed a variety of translation solutions, all of which contribute to cohesion and coherence and, hence, to the overall textual equivalence of the TT. In the case of *this* used as demonstrative determiner, the German demonstratives account for 63%, while the remaining 37% involve a variety of solutions, such as the use of adjectives, definite article+adjective, and other solutions, including 1:0-correspondences. It should be noted that most of the shifts reflected in the 37% of translation solutions may be due to systemic differences, i.e., the stronger semantic potential of the English demonstrative as compared with its German counterpart. Whether this difference has to be made explicit or not is influenced by semantic and pragmatic considerations. Such considerations may involve the need to use an adjective in the TT with a view to emphasizing the deictic function, the need to avoid tedious repetition in the TT or establish greater referential clarity. On the basis of this result, it may be hypothesized that a similar trend in translation solutions can be expected for the demonstrative determiner *these*. Certainly, this hypothesis would have to be underpinned on the basis of a larger corpus. Also, the remaining determiners *that* and *those* would be an interesting subject for further research in this context. On the basis of a larger corpus, further categorial distinctions may yield more specific results.

In the case of *this* used as demonstrative pronoun there is a host of translation solutions. German pronominal adverbs, which have a similar referential function as their English counterpart, account for 43%. A shift from demonstrative pronoun to demonstrative determiner along with the introduction of a noun/subject and the translation solutions under 'Others' account for 28% each. The shifts in translation

may be due to semantic, but, above all, to pragmatic aspects, such as domain and register considerations involving the need to establish greater referential clarity, compensate the ST's excessive use of this pronoun, and/or bring about the requisite level of formality and precision in the TT. Also, they include instances in which an inappropriate use of the pronoun is corrected via translation, a step which may involve further shifts. Redundancy considerations may come into play and are reflected, above all, in 1:0-correspondences, but, occasionally, also in the integration of one sentence into the foregoing one. As in the case of the translation solutions for the determiner, the potential equivalents established for the demonstrative pronoun have to be selected in each case by taking due account of co-textual and contextual considerations. While there is a trend towards the use of pronominal adverbs for the English *this* referring to the propositional content of more complex clausal, sentential or sectional antecedents or parts of these, the widest variety in translation solutions can be established in the case of *this* used in anaphoric nominal reference, which suggests a need for separate consideration of this category on the basis of a larger corpus, involving further sub-categorization.

As this research has shown, cohesion and coherence in the translational/equivalence-related field are worthy of special study. More text-in-context-based investigations of demonstrative reference - and other cohesive devices - in scientific and technical discourse would be a fruitful area of further research. Such research would not only help underpin the results of this investigation (if based on a similar text genre/type and domain), but also allow us to gain more specific insights into the way cohesion and coherence are established in source texts and their translations in a variety of scientific and technical text genres and types.

To sum up the result of this analysis it can be stated that coherence - established by the interaction of intended sense and informed inference - is maintained and upheld in the German TT by cohesive means which, though occasionally quite different from their ST counterparts, contribute toward achieving "equivalence in difference" (Jakobson [1959] 1992) at the overall text-in-context level.

7   Conclusion

Down the ages, scientific and technical translation has always played a pivotal role in disseminating knowledge. Today, specialist or LSP translation (*Fachtextübersetzung*) accounts for the lion's share of the total volume of translation (Wilss 1996:viii), with the domain of science and technology forming the main arena for translation work (Schmitt 1998a). Growth in the exchange of information and in the transfer of knowledge due to the internationalization of science and technology, the globalization and diversification of industry and commerce, and the greater sophistication of industrial products has also led to a growing demand for high-quality translation (Wright 1993, Schmitt 1999). Still, there is a discrepancy between this growing need for high-quality translation and the short supply of competent technical translators to produce them (Schmitt 1985, 1998a), a situation which may itself be due in part to the recent neglect of the equivalence concept in the theoretical/descriptive and applied branches of TS.

This thesis has set out to redefine, reassess and reinstate the equivalence concept as a useful concept in TS by adopting an approach based on the English-German language pair and on one specific text genre, i.e., the research report, and one type, i.e., the "informative text type" (Reiß and Vermeer [2]1991:206 ff.). Since any investigation into equivalence crucially hinges on the delimitation of translation proper to allow a systematic description of syntactic, semantic and pragmatic regularities in the ST-TT relationship and to work out the conditions which govern the selection from among potential equivalents at the various textual levels (Koller [4]1992:205), a working definition of translation has been provided (1.4.1) which will help us delimit translation from other forms of text production. Following Albrecht (1990:79), we posit functional constancy as being the *conditio sine qua non* for the presence of translation, and, by extension, for the presence of equivalence (cf. Wotjak 1997:139).

The low status accorded to equivalence as a theoretical concept in TS today (e.g., Baker 1993; Munday 2001) - an aspect which is discussed in greater detail in the **Introduction** and in **Chapter 1** of this thesis - may be due to several interconnected fundamental misunderstandings. The first, and a somewhat dated, idea

perceives equivalence as a 'narrow linguistic' concept concerned with sameness, identity or even symmetry (Snell-Hornby [1988]1995:22), a view which may be rooted in the concept's original emergence in writings on translation, i.e., in the development of MT (Zenner 1971:2-4) with its mathematical and logical background. However, as early as 1978, van den Broeck (op. cit.:32-33) pointed out that the precise mathematical definition of equivalence is "the main obstacle to its use in translation theory", because the properties of a mathematical equivalence relationship, i.e., symmetry, transitivity and reflexivity, do not apply to the translational relationship. In 1969, Wandruszka (op. cit.:528) concluded from his multi-lateral translation comparison that languages are characterized by, and to be admired for, their non-systematic availability (*asystematische Disponibilität*), a circumstance that may involve considerable asymmetries in translation (cf. also Pym's (1995) criticism of Snell-Hornby) at various textual levels, as our research has shown.

The second misunderstanding arises when correspondence as a concept of *langue* is equated with equivalence as a concept of *parole* (Koller 1978) with regard to ST-TT pairs actually occurring in context (see also Neubert 1994:414). Instead of trying to objectify and dynamize equivalence as a concept of *parole* involving an extra-linguistic dimension, many translation scholars have opted to dismiss the concept altogether on the grounds of its having an allegedly 'narrowly linguistic' slant and its disregarding the contextual-situational dimension, a view which is reflected in the paradigmatic shift from translational issues to a preoccupation with culture-specific, 'translatorial action'-based and *skopos*-oriented approaches to translation, in which the actual language transfer plays only a subordinate role or is, at most, an upstream activity in the overall translation process (Snell-Hornby et al. 1998 fairly accurately mirrors this trend). However, early German research into equivalence, which is often criticized for having adopted such a narrowly defined notion of equivalence, would not have yielded its meaningful insights (see, e.g., the contributions in Spitzbardt 1972) if it had set its sights on something such as identity or symmetry.

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The third misunderstanding equates translation with equivalence. Such an idea not only involves the problem of definitional circularity, but also presupposes that equivalence always exists, as in many descriptive and corpus-based approaches (see Chapter 2), which, in the descriptive case, has the drawback of establishing 'default findings'- given the poor quality of so many translations - as reflected, for example, in Toury's (1995:275) "law of interference" or, in the corpus-based case, statistical findings of an unknown quality, since the motivation behind the so-called "universals of translation" (Laviosa 2002:43 ff.) is rarely accounted for. The findings of our research have cast some doubt on the so-called "explicitation hypothesis" (Blum-Kulka 1986; Baker 1996; Laviosa 2002), in that is has shown that shifts in explicitness may occur in translations for various reasons, such as systemic, but also pragmatic reasons - here register considerations, in particular - and they may occur along with shifts in implicitness on similar grounds (cf. Salama-Carr 2001).

A fourth misunderstanding is that of trying to retain equivalence in the applied areas of TS, such as translator training, while denying it its theoretical status (Baker 1992:5; Munday 2001:50), a standpoint which ignores the interdependence of the theoretical/descriptive and applied branches of TS and amounts to relegating equivalence to the realm of mere subjectivity.

In addition to the above misunderstandings, equivalence is often interpreted in different ways and used without prior clarification of the intension and the extension of the concept (Albrecht 1990:71; Wotjak 1997:137). Since - as Salama-Carr (1999:5) rightly claims - TS "can boast rather more terms than actual concepts"[1], in a first step the concept of equivalence has been redefined for use within the terminology of TS. Proceeding from its Latin origin, equivalence is about *being of equal value*, and not about sameness and identity. In our context, the question then is in what respect a TT is equivalent to its ST counterpart. To answer this question, we have to define the factor(s) to be kept invariant in translation, i.e., the *tertium*

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[1] To quote just a few of the different labels that have been attached so far to the ST-TT relationship, such as in English *"similarity, analogy, adequacy, invariance, congruence"* (van den Broeck 1978:29) and in German "Angemessenheit", "Adäquatheit", "Gleichwertigkeit", "Übereinstimmmung", "Korrespondenz", "sinngemäße Entsprechung", "Wirkungsgleichheit" (Stolze 1994:95) and even "Kohärenz" (Vermeer 1984, Gerzymisch-Arbogast 1999).

comparationis, in relation to which equivalence is aimed at (cf. Albrecht 1990:74). In moving away from the basic misunderstanding that equates translation with equivalence, we have defined equivalence as a qualitative complete-text-in-context-related concept. It refers to a translational relation between a complete source text and a complete target text, both of which are embedded in a specific domain-related context, and implies the preservation of ST sense/intended sense or 'das Gemeinte' (the invariant) in the TT using TL linguistic means, the best possible selection of which must have been achieved at the syntactic, lexical-semantic, terminological-phraseological, and textual levels. These levels are hierarchically interrelated and subject to pragmatic aspects. In this way, the TT fulfils the same or - in the case of ST defect correction - an improved informative-communicative function among specialists in the TL culture, i.e., equality or even improvement of 'communicative value' (*kommunikativer Wert*) (Kade 1977:35-36) may be deemed to have been achieved. Equivalence has been investigated here on the basis of equivalence-relevant features (for a definition see 1.4.2) - which have been allocated to the above levels - to establish patterns in translation solutions, i.e., potential equivalents, in order to gain insights both into the conditions that govern the process of selection from among potential equivalents at the various textual levels and into the way equivalence relations operate between STs and TTs.

Although it is widely accepted today by those scholars who still believe in the usefulness of the concept that a text-based notion of equivalence is the most promising basis (Hatim 2001; Koller 1995; Neubert and Shreve 1992; Neubert 1988) for obtaining meaningful insights, we consider it necessary to stress the text-in-context-based approach employed here. In STT, the context refers mainly to the domain(s) underlying the text and reflected in it. It cannot be stressed enough that contextual, here domain, knowledge is of the utmost importance both in the process of translation and in its analysis and has to be taken into account in translation theory to a much greater extent than has been done hitherto,[2] since it is contextual knowledge in tandem with linguistic-translational knowledge that allows the translation scholar to make an informed judgement on the data under analysis and on translational shifts, in particular.

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[2]   In this respect we must disagree with Wilss (1997:145) who claims that "the domain-specificity of knowledge is a highly delicate topic in translation practice and translation teaching (probably less so in translation theory)."

Since any investigation into equivalence hinges on this concept being embedded in a sound and rigorous methodological framework, an equivalence-relevant methodology has been developed. The methodological issue is a much neglected subject in the discipline (Holmes 1988, van Leuven-Zwart 1992, Toury 1995) - especially for equivalence-related comparative investigations of ST-TT pairs in context on the basis of high-quality specialized corpora - but is of the utmost importance, if our investigations into translations are to yield meaningful insights which can be put into use in the applied branches of the discipline. A review of the literature that deals with methodological issues **(Chapter 2)** shows that the translational approaches in question may be considered either 'too wide' and located somewhere downstream of our own investigation (descriptive and corpus-based approaches) or 'too narrow' and located somewhere upstream of our investigation (approaches offered by comparative stylistics). We have therefore developed an equivalence-relevant methodology which is based on two methodological pillars, the first being a theoretically well-founded translation comparison and the second a highly refined translation corpus. Our theoretical approach is based on a taxonomy of text levels, viz., the syntactic (Chapter 3), lexical-semantic (Chapter 4) and terminological-phraseological levels (Chapter 5) to which equivalence-relevant features have been allocated. These levels are hierarchically interrelated in descending and ascending order and may be conditioned and modified by pragmatic aspects which underlie the ST-TT pair and are reflected in it. Pragmatics as a contextual dimension and as understood here involves knowledge of domain(s), encyclopaedic or 'real world' knowledge and also knowledge of the registers appropriate to specific domains/sub-domains involving knowledge of genre conventions. Since equivalence at the text-in-context level is more than the sum of these three levels and is, in fact, the cohesive and coherent final result of all the relations operating between them, the comparison has been extended to the overall textual level (Chapter 6). The translation comparison also presupposes the prior establishment of some comparative parameters, such as the completeness of written real ST-TT pairs in 'communicative function' (Schmidt 1972:10), a comparison procedure that is both 'linear' and 'selective' (as distinguished by Reiß 1981:316-317), a well-defined translation unit, viz., the text, a reliable *tertium comparationis*, viz., the sense/intended sense or 'das

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Gemeinte', the bidirectionality of the comparison and the competence of the analyst, including the requisite, though by no means arbitrary, evaluativeness.

A threefold set of selection criteria, viz., general, qualitative and quantitative criteria, with special emphasis on the qualitative aspect has been devised to create an equivalence-relevant translation corpus containing only what Kade (1964a) calls "druckreife Übersetzungen" (*publishable translations*), i.e., translations of the highest possible quality. The general criteria include both corpus attributes, viz., full text, synchronicity, bilinguality, central corpus and reference corpus, and text attributes, viz., register and genre considerations, functional constancy, text typology, text status, degree of technicality, geographical considerations and the relevance criterion. The qualitative criteria are based on textual and extra-textual data. The textual data constitute the reference corpus (Bibliography II) containing, e.g., SL and TL parallel texts, scientific encyclopaedias, glossaries, etc. Extra-textual criteria which refer to contextual-situational aspects involve typicality in terms of the range of ST authors and translators and translator's competence, the conditions under which the translations were produced, the publication aspect, homogeneity vs. heterogeneity in the range of translators, genres and domains, exclusion of idiosyncratic translator behaviour, recourse to ST authors, translators, and/or experts in the field, and knowledge of the communicative effect of the translations on the receptors. The textual data of the reference corpus together with the extra-textual data have helped us refute or confirm and substantiate equivalence-relevant findings at all levels and have therefore contributed to intersubjectifying the results of this analysis. As regards the quantitative aspect, a good 20,000 words are considered sufficient (cf. also de Haan 1992:3; Bowker and Pearson 2002:45 ff.) to exclude "accidental exemplification" (Swales 1981:9), while being representative enough to provide a sound basis for generating well-underpinned regularities and generalizations. Both regularities and generalizations should be capable of implementation in the applied branches of TS. At the same time, we have been able to test out the theoretical framework within which this research has been carried out.

As regards equivalence at the syntactic level (**Chapter 3**), the investigation of the non-finite verb forms, which - in their sentence/clause-reducing function, in

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particular - contribute to syntactic compression and condensation of meaning in scientific and technical discourse and are a typical feature of the SL register (e.g., Gerbert 1970:61 ff.), shows that there is a clear translational trend towards employing 'equivalent' clause/sentence-reducing devices in the TT. These are mostly prepositional constructions functioning, i.a., as adverbial phrases and as attributes in premodification or postmodification, which are a typical feature of the nominalized register in this type of discourse in German (Göpferich 1995a:420-422) because they establish closer intra-sentential relations than their corresponding clause variants. Moreover, they help designate and differentiate more precisely the various conceptual relations in the TL (Beneš 1976:93-94). (For a detailed overview of the findings for the main categories see 3.4). As our research has shown, syntactic equivalence in STT is dependent on and interwoven with register requirements, in particular. These requirements call for the use of a high degree of syntactic compression or condensation and conciseness of expression (Kretzenbacher 1991), involving formality and abstraction, and a high noun-based lexical and terminological specificity in German which may be implemented, i.a., by nominalization (e.g., roughly one third of all infinitives have been nominalized in translation, see 3.1.3) and prepositional constructions of different kind mostly functioning as sentence/clause-reducing devices. These requirements also call for a reduced monotony of expression in order to prevent the excessive and repetitive use of specific non-finite constructions (see, e.g., 3.2.1.3.1 and 3.2.1.3.2) - which may occur, e.g., due to a certain carelessness on the part of the author - from being transferred into the TT. This procedure must not be misinterpreted as an instance of "normalization" (Baker 1996; Laviosa 2002), but is one that contributes to "equivalence in difference" (Jakobson [1959]1992) at both syntactic and overall textual levels. This shows that technical translators do, in fact, correct defective STs in their search for equivalence, as they are expected to do (Schmitt 1987b; Horn-Helf 1999). The fact that the grammatical, i.e., implicit, non-finite constructions in the English ST are rendered with lexical, i.e., explicit, means in the German TT is certainly not a case of a 'translational universal', viz., "explicitation" or "simplification" (Baker 1996; Laviosa 2002), but one of systemic explicitness. As we have demonstrated, increases in the degree of explicitness may also and specifically occur on register grounds.

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Apart from the translation trends established, it has also been shown how further higher-ranking semantic, terminological-phraseological and pragmatic aspects involving cohesion and coherence may influence the syntactic level (see translation solutions in the 'Others' categories). So, whereas register is the main factor influencing equivalence at the syntactic level, these other aspects may additionally come into play and trigger specific translation solutions which also contribute to equivalence at both syntactic and overall-text-in-context levels.

Chapter 4 has demonstrated how equivalence can be achieved at the lexical-semantic level. It has been shown how this level may influence and modify the syntactic level, but may itself be influenced and modified by pragmatic considerations. Apart from syntactic and semantic considerations, it is again register that strongly influences the lexical-semantic level. The TL register requirement of a higher degree of verbal specificity (with the features *have* and *be*, in particular) versatility (to reduce tedious repetition) and formality is fulfilled by the textual distribution of the translation solutions established and discussed in the various categories (for an overview see 4.4), so that overall textual equivalence can be deemed to have been achieved. Our analysis of *have* and *be* as main verbs has shown that there is a clear trend towards more specific verbs in the TT. The verbs in question - though more specific than German *haben* or *sein* - still belong to what Pörksen (1986:188) calls 'pallid' verbs, which are a typical feature of German scientific and technical register. It has also been shown that consideration of the semantics of the complement, with copular *be* in particular, and of the clausal and sentential co-text plays a pivotal part in achieving lexical-semantic equivalence.

The analysis of the modal auxiliaries yields a wide variety of potential equivalents in the German TT including nonmodal and other solutions, depending on the semantics of a particular modal in a particular category and on pragmatic considerations. We have not only established trends in translation solutions (see table below), but also shown how equivalence at the level under analysis may be achieved and be influenced by pragmatic aspects. It has been found that nonmodal forms are used in the TT for modal counterparts in the ST on both semantic and pragmatic, i.e., register, grounds. The results indicate a somewhat reduced need for hedging in the German TT as compared with the English ST, an aspect which would be a fruitful

area of further translational and LSP research. The main translation trends for the modals examined are given in the table below (for frequencies see the various categories in Chapter 4):

Table 64 Overview of the main translation trends for modal auxiliaries in the ST

E:	G:
E: 'uncertainty' *may* E: 'rhetoric' *may*	G: modal adverbs G: nonmodal impersonal construction
E: 'present relative to past axis' *might* E: 'hypothetical' *might*	G: modal adjective, modal *können* G: past subjunctive (with or without *u.U.*), others, e.g., adjective
E: modals of necessity, i.e., *must* (*have to/had to*), *need*	G: *müssen*
E: *should* of logical expectation	G: past. subj. of modals *müssen*, *dürfen*
E: *should* of recommendation/advisability E: 'rhetoric' *should*	G: past subj. of modal *sollen* G: past subj. of modal *sollen* modal construction *sein+zu+*infinitive
E: *should* of instruction* *(not in the corpus)	G: modal construction *sein+zu+*infinitive
E: 'objective' *can* E: 'rhetoric' *can*	G: modals *können*, *sich lassen* G: *sich lassen*, nonmodal reflexive verb construction
E: 'deep past tense' *could*	G: past tense of *können*, past tense of *sich lassen*, others, e.g., modal full verb
E: 'present relative to past axis' *could*	G: present tense of *können*, present tense of *sich lassen*, others, e.g., nonmodal or modal
E: 'hypothetical' *could*	G: past subjunctive of *können* past subjunctive of *sich lassen* others, e.g., nonmodal or modal
E: 'regularity' *will*	G: nonmodal solution, i.e., present tense
E: 'futurity' *will* E: 'intentional' *will** * (not in the corpus)	G: present tense G: German modal *sollen*
E: 'hypothetical' *would*	G: past subj. of *werden*, *dürfen* and other verbs, nonmodal solutions, other solutions
E: 'present relative to past axis' *would* (including one instance of 'deep past tense' *would*)	G: nonmodal and modal solutions[3]

The analysis of instances of 'secondary subjectification' yields a trend towards prepositional phrasing in the German TT. Retention of the subject-oriented structure

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[3] Some of the translation solutions in this category reflect inconsistency in the use of *would* on the part of the author.

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as the second most frequent solution invariably requires considerable transposition and/or modulation of predicate, except for the occasional 1:1-correspondence, as do many other translation solutions, which is an important aspect in the search for equivalence with this structure. In the case of the remaining translation solutions, further aspects of cohesion and coherence involving supra-sentential translation solutions come into play and modify the syntactic and lexical-semantic levels of equivalence. The results of this analysis confirm the observation that German scientific and technical register favours adverbial qualifications instead of subjects at the beginning of the sentence (Beneš 1976:95) and also correlates with findings from contrastive LSP research indicating that this specific syntactic-semantic pattern in English not only contributes to economy of expression but also to the arrangement of information in the sentence by stressing the thematic function of the subject (Gnutzmann 1991:13). In those instances in which prepositional phrasing occurs at the beginning of the sentence, it fulfils the same thematic function as the English subject. But also in other sentential positions it contributes as "equivalence in difference" (Jakobson [1959]1992) to cohesion and coherence in the TT. Since translation of this structure is associated with the acceptable degree of anthropomorphization of the subject in the two languages involved - and pending further pre-translational LSP research work in this context - translators are well advised to consult TL parallel texts to establish the acceptable degree of anthropomorphization in a specific domain as expressed via the register used. However, sets of English verbs were established (4.3.1, 4.3.4) the presence of which may point to such instances. Since this structure is often the reason for interferences in German (Gnutzmann 1991:12), translators in their search for equivalence have been shown at the same time to adopt a corrective approach.

On the basis of the investigation of 2-element compounds **Chapter 5** has demonstrated how equivalence is established at the terminological-phraseological level and how this level may influence and modify the lower levels of equivalence, i.e., the syntactic and lexical-semantic levels, but may itself by influenced and conditioned by pragmatic aspects, i.e., register considerations and aspects of domain knowledge. In the process, regularities in translation solutions have been established here for the 2-element compound noun and adjective+noun compound structures. In

the case of compound noun structures, there is a very clear trend towards TL composite formation brought about by different linguistic means, while the remaining solutions include word groups, 2:1-/2:3-correspondences but few cases of explicitation (for an overview see 5.2.1.7). In the case of adjective+noun compound structures, word groups are the most frequent translation solution, followed by composites and other solutions. Composites and word groups are the two most frequent translation solutions for the categories investigated (for an overview see 5.2.2.5). However, the percentage distributions differ significantly for each category. This overall result is still helpful in that it confirms that the level of compactness of expression of the TT is 'equivalent' to that of the ST. This compactness of expression is achieved, first, by having different types of composites, which - from a structural point of view - are similar to, but not identical with, their English compound counterparts, and, second, by employing terminological word groups, which should not be misinterpreted as instances of 'translational' explicitation, since they are merely a reflection of the 'non-systematic' way in which the two languages express the same conceptual reality.

The remaining translation solutions include 2:1-correspondences, which also contribute to compactness of expression, and further translation solutions, such as instances of explicitness, which have become necessary strictly for systemic reasons or reasons of TT cohesion and coherence.

On the basis of the results obtained from this research into 2-element compounds, the hypothesis is that the optionality in translation solutions is higher in some semi-technical terms and lower in highly terminologized items (here composite formation in German is more likely to occur as the one equivalent terminological solution regardless of structural-semantic patterns). Optionality here refers to two or three (but no more) different ways in which a compound term is dissolved to be integrated into a particular sentence, without a change of meaning. We have found that such optionality may also occur with multi-element compounds, e.g., 3-element compounds.

This research has shown that in addition to highly technical compounds that belong to the particular domain terminologies, nomenclature and semi-technical terms, there are hybrid compounds, i.e., mixed semi-technical/technical compounds and other terminologically-laden compounds that occur in the production of text

(text-related compounds) including eponymic, acronymic or elliptic compounds. Such compounds are rarely accounted for in terminological and LSP studies, because they are difficult to integrate into the more or less rigid structures of conceptual systems, but may pose translation problems on syntactic, semantic, or pragmatic grounds.

Research into compounding has to take due account not only of a meaningful categorization of the different compound types that belong to the different layers identified above, but also of the structural-semantic interrelations between the individual compound constituents. The variety in structural-semantic patterns may go beyond the patterns established by LSP research (Weise 1972; Gläser and Winter 1975), because from the point of view of translation, text-related terminological compounds with their greater and/or more varied allocational potential would also have to be considered in such research. Although knowledge of the different allocational systems (Franck 1980:34) and term formation/creation processes in English and German (Sager 1990:61 ff.; Fluck [2]1997:46 ff.) is extremely helpful in achieving terminological equivalence, TL norms and conventions as reflected in the particular lexicons of specific domains/sub-domains may yield equivalents that deviate from allocational patterns or involve redundancy aspects, which shows that terminological-phraseological equivalence takes precedence over lexical-semantic equivalence, but may itself be influenced and modified by pragmatic aspects.

It should be pointed out that, although the establishment/creation of a terminological equivalent may often be difficult enough for the translator, specifically with concepts that do not exist in the TL due to different emphases in scientific and technological research and development activities, it may occasionally be even more difficult to establish equivalence at both the terminological-phraseological and the overall textual levels in the case of text-related compounds. The latter may be very ambiguous due to their double co-textual and contextual nature, often showing a complex semantic-conceptual allocational potential and involving ellipsis. Since the corpus shows a leap in the degree of hybridization with compounds ≥ 4 elements, giving rise to domain plus text-related syntactic compressions, knowledge of the allocational pattern in tandem with domain knowledge is vital for the translator to help her/him understand, dissolve and translate such compounds and fit them into a particular TL co-text, taking due account of specific equivalents for highly technical terms contained in such compounds.

Although highly specialized compounds with 3 and 4 elements may reveal a clearer trend towards composite formation in the TT - regardless of certain structural-semantic patterns - than compounds belonging to other layers, we may rightly assume an increase in TL word group formation for English compounds ≥ 3 elements with a leap in word groups for compounds ≥ 4 elements, due to the linguistic and register constraints in the TL, when it comes to translating compounds that are semantically and conceptually more complex and involve a greater variety of structural-semantic patterns than 2-element compounds. The fact that German can indeed produce 3-/4-element composites does not imply that such composites are the key to equivalence for English 3-/4-element compounds. On the basis of this research it may be assumed that the tipping point for the TL composite formation is reached with 4-element compounds.

Although compounds > 4 elements are no longer amenable, because of their complexity, to the establishment of translation regularities, they should be given greater consideration in translational research, to serve as examples of a particular translational challenge in the classroom. Students would certainly benefit from an elucidation of the steps necessary for their translation from an analytical, transfer-related and synthetical point of view.

Although it is widely held that the terminology in STT is not 'translated', but replaced (e.g., Horn-Helf 1999), this research has shown that replacement - which implicitly presupposes that 1:1-correspondences become potential equivalents on a regular basis - may not always be the way to achieve equivalence at the terminological-phraseological level, since the translation of terms and phrases is influenced by co-textual and contextual conditions pertaining to the specific relationship of an ST-TT pair in context, as *parole* event. Therefore, our translation solutions have also cast some light on the difference between translation and terminology which, according to Sager (1992:113), can be described "by saying that translators deal with acts of 'parole', whereas terminologists may use acts of 'parole' but record facts of 'langue'." As our research has shown, awareness of this difference is essential when it comes to achieving equivalence not only at the terminological-phraseological, but also at the overall text-in-context level.

A more general comment should be made regarding the high degree of borrowing of English abbreviations in the TT (5.2.1.4). Since there is an ever growing trend towards English becoming established as "a global language" (Crystal 1997) and the international language of science (Ammon 2001, 1998), German authors tend to take over English terms and technical abbreviations into their mother tongue. This may well lead to an impoverishment of the German scientific and technical register (cf. also Meier 2002). Trabant (2000:3, 10), too, points to the diglossia of German vs. scientific English in Germany and rightly claims that the cultivation of the scientific register in a national language is an important cultural task. Translators working in close cooperation with TL experts in the field could make an important contribution in this respect by helping coin German terms and abbreviations, specifically in cutting-edge research, in order to develop and advance the various registers of their own national languages. Moreover, as this research has shown, translation may not only assume a language/register developing function, but also a corrective function as regards interferences[4], in particular (see our discussion of 'instances of secondary subjectification' (4.3) and Gnutzmann 1991). The latter aspect is all the more important, since - as the great scientist Chargaff (1986) has pointed out - English as the *lingua franca* of science "is much easier to use badly than was Latin" (op. cit.:109). In fact, publications in English by non-native speakers have been criticized by English native speakers for their lack of linguistic quality (Ammon 2001:354). The findings of research into equivalence on the basis of high-quality specialized translation corpora may then help improve the linguistic-translational knowledge of scientists, too, since scientists today are more or less forced to publish in English (either directly or via translations) if they want to make their contributions known in the international scientific community (Ammon 1998).[5] Therefore, promotion of translation work in both translation directions is a valid desideratum (cf. also Trabant 2000:16).

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[4]   Translational interference in general has an ambiguous value, since it may reflect a breach of TL norms and conventions, but also a 'foreignizing' approach, thus contributing to linguistic innovation (cf. Kupsch-Losereit 1998), its value depending on the mode of translation, of course. In STT as a highly TL-oriented mode of translation, it would clearly be a breach of TL norms and conventions.

[5]   Ammon (1998:162) goes so far as to claim that their mother tongue has become a 'barrier' for German scientists with regard to international communication.

Chapter 6 has demonstrated how equivalence can be achieved at the textual level on the basis of one feature of cohesion and coherence, viz., demonstrative reference. Our analysis of the demonstrative determiner/pronoun *this* shows that in the case of the demonstrative determiner there is a trend towards German demonstratives, although there is also a variety of other solutions, such as the use of adjectives, definite article+adjective, etc. It is found that the latter solutions may mostly be due to systemic differences, i.e., the stronger semantic potential of the English demonstrative as compared with its German counterpart. Whether this difference has to be made explicit or not is influenced by semantic and pragmatic considerations, which may involve the need to use an adjective in the TT with a view to emphasizing the deictic function, the need to avoid monotonous repetition in the TT or to establish greater referential clarity.

The investigation of *this* as pronoun has revealed a host of translation solutions, with German pronominal adverbs, which have a similar referential function as their English counterpart, being the most frequent translation solution. A shift from demonstrative pronoun to demonstrative determiner plus the introduction of a noun/subject and the translation solutions under 'Others' have equal shares. The shifts in translation may be due to semantic, but, above all, to pragmatic aspects, such as domain and register considerations involving the need to establish greater referential clarity, to compensate the ST's excessive use of this pronoun, and/or to bring about the requisite level of formality and precision in the TT. Also, they include instances in which an inappropriate use of the pronoun is corrected via translation, a step which may involve further shifts. It has been shown that the potential equivalents established for the demonstratives investigated have to be selected in each case by taking due account of co-textual and contextual considerations. While there is a trend towards the use of pronominal adverbs for the English *this* that refers to the propositional content of more complex clausal, sentential or sectional antecedents or parts of these, the widest variety in translation solutions can be established in the case of *this* used in anaphoric nominal reference, which suggests a need for separate consideration of this category on the basis of a larger corpus, involving further sub-categorization. Some of the results established for the feature under investigation tend to correlate with monolingual (Rehbein 1995; Graefen 1997) and more recent translational research (Baumgarten et al. 2001; Böttger and Probst 2001).

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As our research has shown, a detailed categorization has proved necessary for all features investigated, since the specific syntactic/semantic structures within which the individual features occur may lead to specific trends in translation solutions. Detailed categorization helps us not only establish trends in translation of a greater and more meaningful degree of sophistication, but also demonstrate more exactly how syntactic, semantic, terminological-phraseological and pragmatic considerations, both domain knowledge and register aspects, come into play and may influence and modify equivalence at the various textual levels in order to achieve equivalence at the text-in-context level. Since the features investigated are not only relevant from an equivalence point of view, but also typical of scientific and technical discourse in general, some of our findings may be valid beyond the text genre and type, and even the language pair investigated (see 3.2.4).

While this conclusion summarizes, above all, the main trends in translation solutions, it should be pointed out that the translation solutions which are subsumed in this research in the so-called 'Others' categories, all contribute to equivalence at the various levels, and aptly demonstrate how and why further higher-ranking aspects, too, may come into play and govern equivalence at particular textual levels. Our research has brought to light the nature and extent of transposition, modulation and other procedures required to achieve equivalence at the text-in-context level and has helped us understand the motivation behind the shifts occurring in the TT, since it is the motivation behind a shift that is of relevance in the translational context, rather than the shift itself. Therefore, as a 'side effect', this research points to the need to revise the so-called 'universals of translation' (Baker 1996; Laviosa 2002), and here in particular, the hypotheses of 'explicitation' and 'normalization'. Both these 'universals' may occur on well-motivated or on unmotivated grounds. In the latter case they may simply betray a debatable translation quality.

7.1 Outlook

As this research has shown, equivalence is not an "illusion" (Snell-Hornby [1988]1995:22), but a dynamic, intersubjective and realistic theoretical concept. It is dynamic, since it is prospectively negotiated in the process of translation via translators' decisions which are constrained by, e.g., syntactic, semantic and

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pragmatic aspects. Retrospectively, it is used - as demonstrated here - to replicate the process as well as the translational decisions and their constraints in the analysis of the product. It is realistic in that it helps us unearth the conditions which govern the selection from among potential equivalents and helps us explain *which* aspect takes precedence over the other, and above all, *how* and *why* this is so with a specific translational feature at a specific textual level in a specific text-in-context. Also, it helps us establish trends in translation solutions, i.e., potential equivalents, which are intersubjective in that they can be underpinned or amended by further equivalence-related research if based on a similar text genre/type and domain. Certainly, other scientific and technical text genres and types may exhibit other equivalence-relevant features, an aspect which has to be taken into account in the analysis of such discourse.

What is more, our findings may be regarded as a first basis for a "repertory of features always to be analysed" (Holmes 1988:89) with specific text genres and types. This may lead to a higher degree of intersubjectivity between the results of individual researchers proceeding according to the same repertory of features.

At the syntactic level a detailed account of English adverbial/subordinate clauses would be highly interesting in that it may show a trend towards prepositional phrasing in the TT. Also, the varying degrees of discourse formality in English and German, which are often reflected in specific syntagmatic shifts such as a shift from English verb/predicate to German noun plus semantically weak verb, would be worthy of special study.

At the lexical-semantic level a study of collectives, plural abstract nouns, back-formation, affixation and noun-to-adjective class shifts (for examples see Krein-Kühle 1995a:83-85) would reveal regularities in translation. Certainly, polysemy is a very fruitful area of research at this level, although its findings may not be amenable to establishing trends in translation solutions.

At the terminological-phraseological level, further research into compounding is an urgent concern, and our research has pointed to the avenues - involving the detailed categorization of the various compound types including text-related compounds - which may lead to meaningful findings. At this level, too, polysemy and fuzziness (Krein-Kühle 1995a:96) are fruitful areas for further research, as are

abbreviations and acronyms which may be both domain-conditioned and text-conditioned. The proliferation of these types of compression, which may be complete inventions and therefore very cryptic at times, requires systematic inclusion in any domain/sub-domain terminologies. As regards phraseology, a detailed account of collocations and their co-textual surrounding can often help establish phraseological equivalents, which may be documented post-textually in databases and termbanks. Also, the different kinds of specialized prepositional word groups or other technical phrases ranging from expressions of a more general technical nature to highly specialized domain/sub-domain-related expressions are worthy of special study.

This research points to the need for a more strictly translation-oriented terminologization including phraseology (Hohnhold 1990), which may yield translation-relevant results of a *parole* quality.

Also, the pronounced trend towards the various kinds of prepositional phrasing in the German TT for some of the ST features investigated (see 3.4) points to a fruitful area of further corpus-based research in the German-English translation direction. A detailed and well-categorized account of these prepositional constructions would very likely yield equivalence-relevant regularities in translation.

Further equivalence-related research could have a twofold emphasis. On the one hand it could investigate further features that are amenable to regularities, thus contributing to the 'repertory of features' and to the establishment of further regularities in translation solutions. Since time is of the essence in professional translation (Wilss 1992:59), consideration of such regularities and internalization of these regularities as routines will help trainee translators and practising translators alike to speed up their translation work and leave more time for the very varied and more intricate cases in which equivalence is more difficult to achieve. On the other hand, such research could focus on features which - though not amenable to regularities - still allow insights into how equivalence relations operate at specific levels, thus contributing individual potential equivalents for specific units at the various textual levels. Both types of research will be helpful in further elucidating equivalence from a theoretical and applied point of view.

We would like to stress the need for TS to re-focus on its central object of study, viz., translation, since only TS can explain the specificity inherent in its subject matter (Kade 1977:39). Moreover, this research has pointed to the need for "a theory of good translation" (Halliday 2001), and we have shown that equivalence here is a promising theoretical candidate, since its employment may yield results that can be put into use in both the theoretical/descriptive and applied branches of TS. Instead of contributing to further 'default findings', our research has yielded findings on the basis of which a positive translational law can be formulated, viz., the law of 'non-corresponding availability'. This is a potential that is inherent in languages in contexts, when 1:1-correspondences are unable to establish equivalence, as is so often the case, and which must be fully exploited by translators in their search for equivalence. Equivalence, though, is a demanding concept, in that it presupposes a sound linguistic-translational and contextual, here domain-related, knowledge and - it cannot be stressed enough - experience in translating. Such knowledge and experience belong to what Salama-Carr (1990:105) so aptly calls "tout un bagage cognitif" with which any translator, translation teacher and scholar should optimally be equipped - prospectively to bring about a high-quality translation product and, retrospectively, to describe and explain the conditions and constraints that govern the making of the product.

The aim of translation is not "absolute" or "total" equivalence which is, as Albrecht (1990:74) has convincingly argued, a *contradictio in adiecto*, unless we define the factor(s)/invariant(s) for which equivalence is being aimed at. After such a definition, an ideal of absolute equivalence may be a useful guideline for orientation that may help us achieve - if not absolute equivalence - at least, equivalence to the greatest possible extent. Defining the aim of translation as the achievement of equivalence to the highest possible degree is - as this research has shown - a realistic objective.

Moreover, re-focussing our research efforts on equivalence as a realistic objective and a valuable theoretical concept embedded in a sound methodological framework may help us bring about the urgently needed paradigmatic shifts from an overemphasis on interdisciplinarity to contextuality, from atomization to wholeness, and from an unbridled search for innovation to complexity. In this way the links between the methodological, theoretical/descriptive and applied branches of TS (see

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triangle in Fig. 1, 2.2.1) may be more firmly established and the unproductive confrontational tension between the theoretical and applied branches may give way to a more productive dialectic tension to their mutual benefit.

We would like to conclude with the motto of this thesis, i.e., Catford's (1965:21) famous words which have lost none of their validity or their topicality: "The central problem of translation practice is that of finding TL translation equivalents. A central task of translation theory is that of defining the nature and conditions of translation equivalence" - against a text-in-context-related research background, of course. It is hoped that this thesis may be regarded as a valid and worthwhile contribution towards fulfilling this double task.

Appendix I

Wotjak's (1997) multi-level model (*Mehrebenenmodell*) of equivalence

diskursiv - illokutive Makrostrukturen

(Teil) Illokutionszuweisung aus Ego - Hic - Nunc - Deixis ⇨ Senderkenntnis
Situationskenntnis

kommunikative Makrostrukturen

a) Satzmodi für SsM$_{1...n}$
⇨ b) LE - Selektion
c) textindizierte Illokutionszuweisung

Mitteilungsgehalt des Sprachtextes

gespeichertes, gelerntes (enzy-
klopädisches) Weltwissen

syntagmatische semantische Makrostruktur SsM$_{1...n}$

Allosememe   Allosememe   Allosememe
AS$_{1...n}$ von S$_1$ X   AS$_{1...m}$ von S$_2$ X   von S$_3$

Systemäquivalenz = Wortschatz
weitgehende semantische
Kongruenz S$_1$ ≈ S$_2$
partielle semantische
Funktion S$_1$ ⊙ S$_2$
strukturelle Äquivalenz

extensional-   intensional-
semantisch   semantisch

syntagmatische semantische Makrostruktur
⇨ kotexturelle Makrosem(em)isierung der systemhaften
Mediostrukturen der LE : SsM$_{1...n}$

Mitteilungsgehalt des Textes über Referenzen angereichert

EBENE I

EBENE II = Vorstufen der semantischen Inhaltsäquivalenz

EBENE III = kommunikativ textuelle Äquivalenz

EBENE IV = translatorische Äquivalenz

kommunikative Makrostrukturen mit Übernahme des kommunikativen Potentials
(= diatopische, diaphasische, diastratische Markierung)

diskursiv - illokutive Makrostrukturen

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Appendix II

A brief discussion of the methodological approaches adopted by
some of the descriptive scholars
(Holmes 1988; Lambert and van Gorp 1985; Toury 1980, 1995;
van Leuven-Zwart 1992)

Holmes, who laid the foundations of a framework for descriptive methods, claims that the main aspect of the analyst's task is to try to replicate "the translator's two maps and the correspondence rules determining their relationship" (Holmes 1988:87). By applying a "set of derivation rules" to ST and TT, the analyst will obtain the "maps" of the two texts. On the basis of a "set of comparison rules", the two "maps" will be compared with a view to establishing "the network of correspondences between their various features" (op. cit.:87). Finally, by means of a "set of abstraction rules" the analyst "derives a set of correspondence rules and a correspondence hierarchy from the network of correspondences" (op. cit.:88). Holmes, however, does not tell us what these rules look like and how the analysis is actually carried out, and thus the notion of the two "maps" remains rather abstract. Holmes goes on to distinguish between two basic working methods. In the first, the scholar, "upon studying the two texts, will derive from them a list of distinctive features which strike him as significant and deserving of comparative analysis; frequently he will also determine a hierarchical ordering of the features" (op. cit.:89). The problem here is that - as Holmes himself admits - there is no "generally accepted intersubjective method for determining distinctive features in a concrete text, so that their selection remains to a large extent an *ad hoc* operation" (op. cit.:89). To avoid this problem, the second method suggests "determining beforehand a required repertory of features always to be analysed, regardless of what specific text is involved" (op. cit.:89). This method has the drawback that the repertory would have to be quite comprehensive, "but also complex enough in structure to accommodate a number of parametric axes" (op. cit.:90) to furnish acceptable results and that scholars in the field have to agree on the elements which are to be included in the repertory. Although Holmes underlines the importance of the "microstructure-mesostructure-macrostructure" axis, which is intersected by other axes, notably by the axis of "form-meaning-function" and that of "contextuality-intertextuality-situationality" (op. cit.:90), he

does not provide any concrete tools for describing these structures and axes and their hierarchical interrelations.

Similar problems arise from the theoretical and hypothetical "Synthetic Scheme for Translation Description" developed by Lambert and van Gorp (1985:42-53) which sets out to cover the complete context of the situation in which literary translations function, to enable the scholar "to make general descriptive statements on all levels of both the translational and the surrounding literary system" (op. cit.:50). The authors claim that the straightforward comparison of T1 and T2, "*to the exclusion of other factors*, has often been responsible for the reductionist approach we have been criticizing" (op. cit.:47, italics added). In their view, this 'reductionist approach' is traditionally reflected in translation criticism which "has been reduced not only to (some) linguistic aspects of the equivalence problem, but even to the particular question whether or not certain linguistic features in T2 are (appropriate) equivalents of corresponding linguistic features in T1" (op. cit.:46). However, the latter point is of the utmost importance in an investigation of equivalence in STT, which should be carried out against a co-textual/contextual background. Since equivalence constitutes a desirable and, in our view, achievable goal in the STT field, even though its achievement certainly cannot be taken for granted, any analysis of scientific and technical translations can never be purely descriptive, but must - to a certain extent - be evaluative as well. The authors go on to argue that this 'reductionist approach' fails "to respect the complex nature of equivalence" (op. cit.:46). However, the important aspect of the complexity of the concept is not explained in greater detail. Since the emphasis is on the context of translated literature rather than on translated texts themselves,[1] the systematic comparison between ST and TT plays only a subordinate role. This is reflected, in particular, in step 3 of their scheme, i.e., the 'micro-level', which fails to tell the analyst how s/he can carry out the comparison or identify and classify the shifts mentioned.

The latter problem, in particular, is also evident in Toury's (1995:70-86) methodological approach. According to Toury, the nature of a comparative analysis is partial only and indirect, so that the comparison can only be performed on certain

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[1] "Our object is translated literature, that is to say, translational norms, models, behaviour and systems." (Lambert and van Gorp 1985:51)

aspects of the objects to be compared and can only be carried out by means of some intermediary concepts "which should be relatable to the compared aspect(s) of *both* texts" (op. cit.:80). These concepts in turn "should also be relatable to the *theory* in whose terms the comparison would be performed" (op. cit.:80). In 1980, Toury introduced the notion of *adequate translation* as a *tertium comparationis* which is defined as follows:

> a *hypothetical construct*, impure in nature, in the methodology of descriptive translation studies, serving as an intermediary invariant for any actual comparison of TT [target text] and ST [source text].
> (Toury 1980:116)

This means that the *adequate translation* (AT) is not an "actual text" (op. cit.:116), but the result of a textemic analysis of the ST. This reconstruction of ST textemes consists of an "explicitation of ST textual relations and functions" (op. cit.:116). The TT is then compared with the AT with a view to establishing the shifts between TT and AT on the basis of which the "distance between TT-ST equivalence and AT" (Toury 1980:117-118), and, eventually, the underlying translational norms can be determined, since "**it is norms that determine the (type and extent of) equivalence manifested by actual translations**" (Toury 1995:61). Apart from the questionable double usage of the term *adequate translation*/AT (i.e., both as counterpart to acceptability and as methodological concept),[2] the problems involved in this approach refer to the unsolved questions of how ST textemes can be identified, how an AT can be produced and how shifts and what kind of shifts can be ascertained. In his latest book Toury (1995) has obviously given up the notion of the *adequate translation* as a *tertium comparationis*. However, whether the new method suggested is "a workable replacement" (Hermans 1995:220) may be doubted, since the method is hardly explained in detail and thus remains somewhat vague. According to this method "the analyst will go about establishing a segment of the target text for which it would be possible to claim that - beyond its boundaries - there are no

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[2]   Cf. also Hermans's (1995:219-220) criticism as regards the AT: "There was a connection between the AT and the (lower-case) adequate translation, in that the AT too was meant to be an explicitation of source-text textual relations and functions. The AT needed to be based on the source text, Toury argued, because of the original's logical and chronological primacy. But it should be formulated in the language of the translation [...] From this point onwards the oddities piled up. The AT, as a construct at the meta-level, was source-text-based but phrased in the target language (one of the object-level languages, that is). It had to be squared with a generally target-oriented approach. In addition, the transposition from object-level to meta-level would obviously entail a translational operation, and, equally obviously, an act of interpretation by the researcher - which would be likely to render the invariant pretty unstable."

leftovers of the solution to a translation problem which is represented by one of the source text's segments, whether similar or different in rank and scope" (Toury 1995:79). The chosen units of comparative analysis, i.e., the "**coupled pairs of target- and source text-segments**" (op. cit.:89), "should be *relevant to the operation which would then be performed on them*" (op. cit.:88). However, it is neither explained how their relevance to the operation can be established nor, in concrete terms, how the analysis is performed. Toury merely notes that these coupled pairs will be further analyzed in the course of the investigation and that "it is the relationships found to obtain between their members which would underlie any generalization concerning the pertinent kind of translation equivalence" (op. cit.:89). In Toury's view, equivalence is always assumed to exist between an assumed translation and its assumed source, so that "what remains to be uncovered is only the way this postulate was actually realized, e.g., in terms of the balance between what was kept invariant and what was transformed" (op. cit.:86). The establishment of equivalence which is considered to be "of little importance in itself" (op. cit.:86) is regarded as useful only in the discovery of the 'overall concept of translation', but also, after all, for

> the explanation - in reverse order - of the entire network of translational relationships, the individual coupled pairs (as representing actual translation units under the dominant norm of translation equivalence) and the textual-linguistic representation of the translational solutions, which has made them into (surface) translational phenomena, in the first place.
>
> (Toury 1995:86)

Thus, equivalence is regarded merely as a means for discovering other and, in Toury's view, more important aspects of translation, such as translational norms. Whereas Toury applies his methodology to text fragments to describe diachronically individual translational phenomena such as the higher distribution of "Hebrew Void Pragmatic Connectors" (1995:210) in translations from English relative to original texts, van Leuven-Zwart's methodology (1992:78) is designed to permit 'integral' comparisons, i.e., comparisons of the entire source and target texts. Van Leuven-Zwart (1992:86) criticizes Toury and Holmes for being more descriptive than comparative in their analysis and for defining the relationship between an ST and a TT on the basis of a description of *a priori* established features. Van Leuven-Zwart suggests proceeding precisely the other way round, i.e., by taking the relationship as the basis for the establishment of features. She introduces the notion of 'architranseem (ATR)' (op. cit.:80) as an ST- as well as TT-oriented comparative

unit at the microstructural level which functions as the *tertium comparationis* and serves to determine "the differences between the ST- and TT-transeme and thus to establish the shifts in the translation" (op. cit.:80, my translation). What van Leuven-Zwart is interested in are 'vertalergebonden verschuivingen' (translator-bound (optional) shifts) (op. cit.:79), whereas 'taalgebonden verschuivingen' (language-bound (obligatory) shifts) (op. cit.:80) are disregarded (for a critical discussion of this dichotomy see 2.2.1.), since they do not reflect an interpretation or strategy on the part of the translator.[3] However, the latter shifts cannot be ignored in an investigation of equivalence, because structural differences between languages certainly present translation problems and can obstruct equivalence at many levels.[4]

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[3]   See Bakker et al. (1998:230-231) for a brief and Koster (2000:105-117) for a more detailed overview of van Leuven-Zwart's methodology.

[4]   Cf. also Coseriu (1981:190) who argues as follows: "[...] ähnliche oder sogar identische Inhaltsunterschiede werden von verschiedenen Sprachen nicht selten in verschiedenen Bereichen ihrer Strukturierung gemacht: von einer Sprache z. B. in ihrer Grammatik, von einer anderen eventuell im Bereich des Wortschatzes oder mittels der Phonetik."

Appendix III

Macro-structure of the ST-TT pair:
The research report[1]

English ST	German TT
I Title page	Titelseite
Title (of the research report)	Titel (des Forschungsberichts)
Name of Author and Research Laboratory	Name des Autors und des Forschungslabors
Work performed for: [...]	Die Arbeitsdurchführung erfolgte für: [...]
Date: May 1993	Datum: Mai 1993
This work was supported in part by [...]	Diese Forschungsarbeiten erfuhren eine teilweise Unterstützung durch [...]
Division Report [...]	Abteilungsbericht [...]
II Table of Contents	Inhaltsverzeichnis
III Disclaimer	Verzichterklärung
IV Executive Summary	Zusammenfassung
V Introduction	Einführung
VI Methodology	Methodik
VII (The report)	(der Bericht)
VII.1 sections [...] (including figures)	Abschnitte [...] (einschließlich Bildern)
VIII Conclusions	Schlußbetrachtung
IX Acknowledgements	Danksagung
X References	Literaturhinweise

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[1] The macro-structure of this research report coincides to a certain degree with that of conference proceedings/journal articles examined by Göpferich (1995a:235 ff.).

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