PROJECT KNOWLEDGE MANAGEMENT AND BROKERING IN VIRTUAL TEAM-ENVIRONMENTS: APPLICATION OF BEST PRACTICES FROM MODERN E-LEARNING MANAGEMENT

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Contents

Declaration

This thesis is submitted in compliance with the requirements from the University of Salford for the award of a PhD degree by research. The researcher declares that no portion of the work in this thesis has been submitted in support of an application for another degree or qualification to the University of Salford or any other institution.

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Abstract

Despite its criticality, there is still insufficient evidence pertaining to project knowledge brokering in virtual team-environments. Paradoxically, virtual set-ups are increasingly used to facilitate the access, transfer and application of knowledge that is dispersed and stuck globally within company-silos and social-networks. These temporary set-ups actually restrain aspects of knowledge-management as teams never or rarely meet. Accordingly, this thesis contributes to the enhancement of virtual project knowledge brokering practice in response to knowledge-based-theory, stating that knowledge is a vital asset to survive in super-competitive and rapidly changing business environments, obliging companies to effectively apply and yield knowledge.

Besides creation and interpretation of knowledge, this thesis extends the discipline via an identification of most relevant and suitably applied best practices from well advanced e-learning management. These best practices have the potential to enhance the effectiveness of virtual project knowledge management, as they successfully overcome similar constraints around virtual knowledge brokering within e-learning. Our contribution is achieved through an extensive literature review that distils 25 potential e-learning best practices.

These practices are assessed in a Delphi study, which is an accepted group communication methodology applied to gain consensus from experts of certain domains regarding real-life problems. The process includes structured interrogations of well-chosen experts from related areas (project, knowledge, e-learning, and virtual team management) to achieve consensus on priorities of e-learning practices. Lessons learnt are transferred between transient virtual project-teams, our analysis suggests that companies should focus on transferring selected e-learning best practices that may have the strongest improvement-impact. Ranked with the highest importance were *Ease of Use/Usefulness*, *Required Management Buy-In/Incentives*, and *Team Cooperation*. Likewise, the Delphi experts also mostly agreed that those best practices of e-learning are easily transferable: ranked with highest feasibility is, besides *Ease of Use/Usefulness* and *Team Cooperation*, the easy *Procurement of* (suitable) *IT Tools*. In line with knowledge-management-theory, our findings support the claim that besides investments in information systems, companies will only succeed in leveraging the learning gained across virtual projects if they focus on the strategic management of related cultural, managerial, and organisational elements of project knowledge management and brokering.

1 Introduction

1.0 Background and Aims of Research

This thesis considers the current state of research on the topic of project knowledge management (PKM) and knowledge brokering in virtual project teamwork. The fundamental issue for modern organisations is that the transfer of knowledge and lessons learnt between different projects is limited, particularly when projects are carried out by so-called virtual project teams, that is, teams that do not meet in person (Alavi and Tiwana 2002). The idea is that e-learning (EL) theory can aid as it has very advanced practices that overcome similar challenges, like successfully managing and exchanging large volumes of data. E-learning theorists have thus, for example, developed a better understanding of the importance of the way in which learning content is used and distributed by learners. The e-learning theory informs us that use and distribution amongst learners is more important than how the learning content is designed. This focuses this thesis on knowledge transfer and the accessibility and usage of existing knowledge from previous finished virtual project teams rather than on the generation or capturing of (new) knowledge.

While the half-life of knowledge is decreasing, the overall amount of global knowledge is increasing immensely and the time available to manage and communicate this increasingly complex knowledge is becoming a rare and expensive resource (Kornwachs 1999). Accordingly, science has to find ways to support companies and their employees who not only have a limited working memory but are also required to enhance their (processing) capabilities (Meyer 2009). In spite of the importance of managing this knowledge, especially at project level, the gained understanding of the actual knowledge-transfer process and its impacting aspects remains limited even today (Zhao et al. 2015).

Hence, the first aim of this study is the review of not only the knowledge management (KM) and the project management (PM) literature but also the related interdisciplinary practices with a particular focus on e-learning as a potential opportunity to improve complex project knowledge management (PKM) in virtual environments.

Various researchers contend that value creation within companies is derived primarily from intangible assets like knowledge (Tseng 2008). In contemporary project environments of global multinational companies with their virtual teams, managing this knowledge effectively has become increasingly challenging. Consequently, old-fashioned methods for knowledge-exchange are no longer sufficient, thereby, creating the need for new research

to emerge (Meyer 2009). Although the theory seems advanced in principle, for example, in regards to the necessity of knowledge being updated or applications being user-friendly, reality still shows deficiencies in traditional PKM. The significance and effect of these deficiencies is thus magnified in an international virtual-team setting (Tseng 2008). Therefore, this thesis sets out to promote an improvement of PKM for multinational companies with dispersed teams that are competing in highly competitive and challenging environments. Challenges are stemming from on-going innovations, deregulation, globalisation, technological convergences, and dis-intermediation or blurring of industry boundaries (Pahalad 1998).

The value of knowledge increases and multiplies via sharing, which is in contrast to physical resources that have to be split across users (Cabrera & Cabrera 2002). Success of PM is based on a combination of acquired knowledge, collective and individual skills. The ability to identify critical knowledge and exploit it effectively, however, remains challenging, especially for virtual project team set-ups.

This is why the second aim of this study is the improvement of the related PKM and brokering via the application of best practices from modern e-learning management (Garrison 2011, Kasvi et al. 2003). This thesis, thus, argues that e-learning provides potential solutions to many of the challenging facets of PKM across virtual teams.

The potential of EL to enhance PKM in virtual-projects and the challenges faced by companies, form the main motivation for this research, done by a thorough analysis of distinctive EL features assessed by experts involved in a Delphi study to correlate informed judgements and gain consensus on the most important and feasible aspects for an improvement of knowledge brokering in virtual project-teams.

1.1 Research Objectives

The following section describes the research objectives, one per sub-section and signposted by bullet points within their respective sub-sections.

1.1.1 Improving Knowledge Brokering

The research focuses knowledge brokering in virtual business project teams in which social aspects have to be surrogated as individuals never meet, which is a supportive aspect in physically meeting teams. Brokering is the transfer of knowledge through individuals of projects in this case (Ajmal and Koskinen 2008). The main objective is

- to improve knowledge brokering in geographically dispersed project teams via the application of appropriate best practices from e-learning.

Current KM conditions in virtual projects negatively impact a company's absorptive capacity, defined as the capability to leverage value of new knowledge (Bresnen et al. 2003). Documentation and interactions with co-workers are the most important source, but the collation and dissemination remains unsystematic and challenging as it requires a rigorous KMS to effectively learn from experiences (Kasvi et al. 2003). This supports the focus on knowledge brokering, which is even more complicated in virtual set-ups. To facilitate improvements, the right set-up and culture are imperative to facilitate continuous systematic learning and to enable employees to bring learnings back into the organisation, inhibited by distrust or lack of absorptive capacity (Marsick and Watkins 1999). This results in a continual 'reinvention of the wheel' in future projects without capitalising on opportunities from lessons learnt (Scarbrough et al. 2004). Mistakes are repeated (Gazeau 1998), which incentivises improving KM in virtual projects.

1.1.2 Extension of Research on PKM and Learning From Projects

Focusing on social, IS and KM literature reveals a demand for KM including context along the entire project-process via systematic PKM to establish learning-organisations to enable lessons learnt to become deliverables for future projects via appropriate practices and tools (Kasvi et al. 2003). The second objective is therefore

- to contribute to the extension of research on PKM and learning from projects, which is still relatively sparse

As an end result, a learning organisation is skilful at KM and related behaviour-adaption aimed at reflection of new knowledge to sustain the ability to build its own future (Garvin 1993). This is an integral part also of KM theory, as it demands a process for OL, not exclusive to education and training but also to knowledge brokering (Wild et al. 2002). Considering virtual and social aspects of EL, this is an opportunity for the enhancement of the persistent issues in PKM pertaining to virtual teams. The relevance of EL is supported by the immense growth-rate of EL and that it is becoming increasingly considered as a useable tool for KM due to similarity of its attributes with basic KM processes (Garrison 2011, Wild et al. 2002).

1.1.3 Gaps in Other Studies

The still inefficient PKM is not a new area and PKM literature ranks learning from project experience as a vital factor for success of companies. Total project performance is linked with how PM knowledge is supported by learning activities in connection with inter-project learning and knowledge-exchange (Williams 2008). The third objective is therefore

- to address gaps identified by other related studies.

An example is the examination from Kasvi et al. (2003), outlining that more than 75% of their participants highlight persisting issues with PKM but mainly still fail to perceive KM competencies as a critical success factor. These remain mainly unsystematic and weak, although there is a clear requirement for outstandingly effective KM, especially in projects. A major motivation for this research is the fact that continuous improvements and learning is set as a top objective of PM theory.

1.1.4 Focus on Transfer and Brokering of KM

Best practices and lessons learnt are also building blocks of both KM and OL. Although a lack of OL increases the risk of im-maturing, challenges in PM reality persist and increase with virtualisation, where non-routine necessitates focus on learning (Williams 2008). Despite differences of every project, not all projects are entirely different, which may mislead conceptual solutions or recommendations (Williams 2008), which this thesis sets out to develop. The necessity to improve PKM is supported by the various potentials like leveraging experiential experience, improvements of new projects, risk mitigations, benchmarking and auditing (Williams 2008). The fourth objective of the thesis is therefore

- to focus the study on the transfer and brokering of KM.

This is supported by Snider and Nissen's (2003) emphasis on the critical aspect of the three defined knowledge flows for successful organisations: *knowledge as solution* **(**real-time transfer to resolve issues via IS), *knowledge as experience* **(**shared usage in future for avoidance of reinventing lessons learnt) and *knowledge as socially created* **(**knowledge as a cultural issue, shared via informal communication).

1.1.5 Contributions to Business and Science

As this PhD thesis is an inductive research consisting of quantitative-qualitative work, it is not required to present a formal hypothesis as this study employs a discovery approach.

Based on the review of relevant literature the following focus research questions are derived: As EL evolved into an established discipline effectively capturing trends so that resulting solutions and processes may also help to improve KM and brokering of virtual project teams, which deal with similar constraints and environments like EL: 1. What are the key issues and status quo in PM, KM, PKM / brokering and virtual project teams? 2. Which characteristics make EL state of the art and successful? 3. Which areas (from EL) can potentially be applied (feasibility) to improve knowledge brokering in virtual teams (structures, processes, systems, strategies, enablers)? 4. Which areas will have the strongest impact (importance)? This concerns avoiding re-development of valuable knowledge in the context of virtual project-work. Accordingly and finally, our fifth, sixth and seventh objectives are

- to contribute to business in the form of recommendations that will enable companies to improve competitive advantage and strive to become more efficient.
- to contribute to science through a thorough critical appraisal of current literature and theory in PKM with an enhancement of underdeveloped niche theory and identification of potential areas for future research
- to promote the use of the Delphi method in this field of research.

1.2 Underlying Theory and Principles for the Study

This section develops an understanding of the underlying principles and theory that govern this PhD study. Initially, deciding to conduct research for such a management topic required careful consideration of philosophical assumptions, which underpin academic research. This was decided in synchrony with the author's comprehensive understanding of the area of interest and its related issues, wherein avoidance of bias was carefully observed. This is also in line with the selected and later explained research methodology and related reflections and considerations like used theory or enquiry-levels and potential implications of the chosen critical and pragmatic approach for the review of the subject of this study. This is done in order to create new knowledge and relevant outcomes for both practitioners and academics. The presented focus and extend of analysis also cause a framing of the research and related questions. Here the selected theoretical approach clearly influences the examination of the subject and supports the identification of the research method that is most adequate for achieving the stated aims. As outlined by Winter et al. (2006c), in new PM theory studies, more creative research strategies and methods are

required and, accordingly, this is also the rationale for the reflective approach of this study.

Another rationale for examining this young but important field is the fact that the body of knowledge represented in the literature has yet to mature. This is evidenced by the fact that the first papers discussing PKM were published only in 1987 (Gulliver 1987). Further support for the research can be found within the Project Management Body of Knowledge (PMBOK), the Project Management Institute's (PMI) attempt to collate best practice, in which PKM is not yet systematically approached. Gasik (2011) draws attention to this very fact, observing the lack of adequate contributions from research and praxis when compared to other more mature areas like risk, communication and quality management (Gasik 2011). The rationale of this study links also with Gasik's (2011) assertions for a systematic and interdisciplinary approach due to the wide range of influential factors and targets of PKM. From a theoretical standpoint, the majority of the referenced publications on PKM show inconsistencies and do not systematise the topic sufficiently – this is seen as a major barrier in the development of PKM (Brookes et al. 2006).

Similarly as far as the practitioner domain is concerned, the actual level of learning that takes place within conventional face-to-face projects is limited and only within very few numbers of projects is knowledge systematically captured and high-value knowledge assets brokered. This knowledge brokerage is even less likely to occur when one factors in virtual team project environments (Disterer 2002). This connects also with the important examined KM theory, as one study outlines about one fourth of the participating companies have an entire absence of a KM strategy (Carrillo et al. 2011). Insufficient research and especially practice of knowledge transfer in global PM as well as that improvements from other related research fields are not or only limitedly transferred into the area of focus accordingly present a potential for future improvements that this research follows. With a tendency towards expert orientation of solutions, literature from the KM domain also supports the direction of this research, by requesting more integrated methods from different technologies and cross-interdisciplinary research together with both qualitative and quantitative aspects as an important aspect of future improvement in the area and to broaden the limited horizon (Liao 2003).

The relatively slow rate of progress means that observations made by Davenport et al. (1998) regarding the problems of managing the capture, sharing and application of knowledge are still valid. In a sense there is a dichotomy in managing highly unstructured knowledge with extremely structured KMS, which becomes even more difficult when one

considers the geographically dispersed nature of both modern project teams and knowledge as well as increasingly virtual nature of said project teams. Whereas geographic dispersion and electronic communication of experts actually facilitates information exchange whilst ensuring the confidentiality and success of Delphi studies, it is found to hamper the exchange of knowledge between virtual project-teams (Hsu and Sandford 2007). By contributing to the increasingly important but under-explored cross-project KM, this study contains an approach with special attention to the added complexities of often confusing or controversial virtual project set-ups. This is done in light of existing studies on PKM that are often limited to the projects themselves rather than considering the brokering of knowledge across projects (Scarbrough et al. 2004).

Existing studies are available that outline success-factors of KM, such as Davenport et al. (1998) that determine key factors for success as being for culture, processes and the development of a common approach. Indeed, culture is often cited within the broader literature with there being a general consensus as to its level of importance. There are however other important aspects that have to be considered by companies that mostly do not cater sufficiently for the global context of projects and related virtual team aspects (Desouza and Evaristo 2003). Herein lie the potential and rationale for this study that necessitates research, as companies constantly reinvent the wheel when it comes to project knowledge. The status quo in companies, as described in the literature review section, indicates that there is an insufficient management of personal experience, technical, and procedural knowledge as well as organisational knowledge.

More precisely, in the context of this thesis, insufficient management of project organising knowledge, describing the lessons learnt and how project results were obtained, which are an entry point to become a learning project organisation. If these findings continue to be only captured in decentralised artefacts and individuals' minds, tacit and explicit knowledge will not be shared and subsequently be lost or forgotten (Davenport et al. 1998). Tacit knowledge is defined as personal, context-sensitive, internalised, undocumented and dynamic, as it is embedded and related to human experience, behaviour, feelings and perceptions (Nonaka 2007). Tacit knowledge requires practice and skills as it evolves via human interaction and its articulation is often challenging (Siemieniuch and Sinclair 2004). This impedes sustainability and increases competitive pressure, particularly in quickly evolving high tech industries. Included in parts of the conceptual framework that is introduced in the literature chapter, this is also constrained

for example by risks like big data, lack of motivation or governance leading to a lack of coordination or standardisation to which e-learning has advanced responses. This is valid for both:

- **Personalisation strategy**: Challenged in virtual areas with focusing on soft personal interaction via friendships, informal one-on-ones, team spaces or visual aspects etc.
- **Codification strategy:** Hard focus on storing knowledge in databases etc.

Using knowledge brokering for the facilitation of knowledge exchange and the adoption of insights is one strategy in the broader field of KM. As further outlined in the literature review, standard KM itself is a work in progress, not even taking into account project or virtual aspects, which is another underlying motivation for this research. According to Davenport (1999), categorisation and organisation of knowledge should become a core-competence of companies. Most companies are undertaking KM directions but mainly without linking it to the overall strategy of the firm. Furthermore, the fixation on the short-term outcome results often in weak KM initiatives that are not implemented company-wide, thereby impacting upon the success of cross-divisional projects and related knowledge brokering (Lang 2001).

Besides focus on the KM-side, the principle and necessity for research is also supported by an impressive attention on rethinking PM theory in order to cope with real-life challenges of both practitioners as well as academics, as current solutions and theories prove to be insufficient (Maylor 2006). Accordingly, it is the responsibility of research, as followed in this thesis, to generally challenge these common but seemingly insufficient theories and practices, provoke necessary questioning and consider new unconventional solutions, such as best practices transfer from another more enhanced field. The reviewed UK-based EPSRC network that analyses contemporary PM theory and practice in order to promote an evolution of both, is a key motivator for this study. This is because it depicted great relevance not only for the academic world by developing a future research agenda but also to practitioners by developing a fundament for the generation of new ideas. This helps to start tackling persisting challenges in the field and “opening up opportunities for new perspectives and ways of thinking” (Winter et al. 2006b).

The main findings from this forum do not only justify and stimulate this PhD research, but also support the case for the adopted Delphi methodology with various experts that adopt traits in continuity of the evolutionary approach from the EPSRC network research

(Maylor 2006). That is the first documented research project in PM consisting of co-produced knowledge from practitioners, consultants and academics. In a similar way, such a complex intellectual community to support reflection, critical dialogue, and a multidisciplinary learning set-up (Winter et al. 2006b), will also be the target of the literature and Delphi research of this thesis.

According to the PMI (2008), projects are overall contemporary endeavours which incorporate work of heterogeneous professionals to create unique products or results. This view of a project as an impermanent and diverse activity ultimately results in an interesting but challenging environment for sustainable KM. Sustainable KM means effective conservation of the knowledge from the findings of these temporary projects. Hence we deduct the need for research related to this problem. A supporting fact is that projects, which are temporary and often short-term set-ups, focus mainly on immediate deliverables, rather than organisational learning (Lindner and Wald 2011).

In the globalised business world, projects and their participants have to deal more and more quickly with diversity in terms of backgrounds, levels of skills and project agendas (Ruuska and Teigland 2009). Accordingly, and beyond the level of individual project work, companies increasingly face challenges related to innovations and transfer of knowledge between the projects. The development project for a new global product for instance requires sharing of existing knowledge from previous and maybe local lessons learnt (Goffin et al. 2011). Therefore, companies have to develop processes and policies for cross-project knowledge transfer. Such processes and policies are currently and predominantly lacking or insufficiently applied (Uffmann et al. 2006). New processes will, on the one hand, have to capture knowledge created in individual teams. This has to guarantee knowledge retention to in turn gain the necessary competitive advantages to ensure continuously the delivery of successful project results (Snider and Nissen 2003). On the other hand, duplication has to be avoided by ensuring thorough transfer, between similar projects, of tacit knowledge and lessons learnt (Schmickl and Kieser 2008). Both of the latter remain major takeaways for the rationale of this study.

The importance of KM in a business world that increasingly utilises project set-ups to achieve targets is expressed by the fact that almost all of the Fortune 500 have KM staff and many even installed a Chief Knowledge Officer (CKO), who is from a top management position in charge of building a suitable culture and infrastructure to encourage sharing of knowledge (Bontis 2002). One step further in the ambitious direction

of this thesis, some companies have also set-up catalyst for PKM in the form of full-time project-experienced managers or knowledge harvesters (DeVoss 2000). What is important here is to understand the underlying principle and reasoning for the focus of this study on the concept of knowledge brokering. Corresponding models of knowledge brokering are elaborated in the literature review. Knowledge brokering is interpreted in different styles and the theories are not yet clearly developed with regards to functions of knowledge brokers as well as the participants in the actual transmission of gained knowledge especially in virtual teams, which is leading to the contribution of this study. This is important as the lack of developed theory has impacted this research project positively and as it gives another justification for the research rationale. Thus, the major motivation of this thesis is to develop a solution for improvement of knowledge brokering in virtual project teams. It is the idea to do this by preparing the application of identified best practices from modern e-learning management. An additional major motivation and justification for this study is rather personal. The author has observed the mentioned advanced practices of modern e-learning during a decade of working in multinational companies. It is also here where the mentioned negative implications and all the multi-facetted limitations due to the lack of suitable knowledge brokering solutions were observed. This is especially found being insufficient but highly relevant for modern PM in the focused virtual teams.

1.3 Outline of Thesis

This section develops the thesis outline in relation to the later introduced conceptual framework. The starting point is the literature review of KM, PM, PKM and brokering to provide both evidence and an analysis of the relevance and gaps in knowledge, theory, and practice. This ultimately brings up various advanced aspects from e-learning that will be used as initial arguments for the analysis. Examples, which will be listed in table form in the final research instrument, are learning objects (reuse, interoperate, access), virtual worlds, outsourcing, data management, governance, visualisation/imagination, innovations (e.g. web 2.0 or mash-ups), trends (cloud, edutainment), interactivity/integration, focus on ease of use/usefulness, ownership of learner, new trainings (pedagogic/technologic), incorporation of society's paradigm shift for knowledge society, required management buy-in, sustainability, creation of the leaning manager role to guide/mediate as broker to facilitate/catalyse (teaching how to learn) or so-called consumerisation that will be explained within the course of this thesis. It is emphasised that generally, e-learning theory

has effectively accommodated society's paradigm shift away from traditional learning and towards electronic and personalised training needs. This is one example of the advanced stage of e-learning that is further evaluated in the following chapters.

The research methodology utilised is a Delphi study that comprises of qualitative and quantitative aspects. The usage of this exploratory methodology that separates from interviews or case studies includes a collection of anonymous feedback from a virtual expert panel via a series of questionnaires to promote collection and distillation of rich data and re-administration of feedback until a satisfactory degree of consensus is reached. This methodology is particularly well suited to this study given the gap in knowledge and the goal of improving our understanding of the opportunities and solutions afforded by e-learning in order to develop forecasting recommendations and expertise-based speculations for the context of virtual project teams' knowledge brokering. In addition, more recent (P)KM literature specifically requests research which is more exploratory in nature than the traditionally exploitative focus approaches which tend to focus expressly on the elicitation of existing knowledge in traditional ways which are not suitable for modern KM requirements by potentially having constraining effects and insufficiencies for dealing with the uncertainty of projects (Berends et al. 2007).

In general, the Delphi study, as a useful investigation lens, is becoming a widespread research method in IS research which also contributes to the relevance of IS research for practitioners (e.g. Brancheau et al. 1996). Especially the used ranking-type version, which is sometimes referred to as a Delphi derivative, is applied expansively in IS research for identifying, ranking and prioritising core topics for management-decisions (e.g. Dalkey 1969). This ranking modification for developing relative importance and group consensus for topics is also applied in other areas such as operations management (Malhotra et al. 1994). However, it requires a thorough compliance with design choice principles, expert-selections etc. to ensure a valid study (Okoli and Pawlowski 2004), as presented in this PhD thesis. This is especially important in the ranking-type Delphi. Compared to forecasting Delphi, where consistent research approaches are executed, in this relatively new type, only slow standardisation attempts and uniformity in approaches become visible and promoted in literature (Schmidt 1997).

Based on the findings of the literature review, that discusses contemporary focus and limitation of the elements of the later discussed conceptual framework, 25 precise and current e-learning practices are developed and logically grouped into four categories that

provide the basis for the Delphi study. The execution and analysis of the study is described in detail in the research methodology chapter. The Delphi approach involves the presentation of the synthesised established e-learning practices aspects to fourteen experts from related areas in order for them to assess feasibility and importance of each aspect in a table-form with additional space for comments. Throughout the data collection, general survey design characteristics apply and two to three feedback rounds are targeted using an online questionnaire.

In terms of data processing, a manual evaluation of the feedback will be conducted. The anticipated result is a support for the closing of the knowledge gap. This is to be achieved by reaching a consensus amongst experts on priorities and feasibilities from the identified e-learning practices and topics. Also, the results are discussed, distilling a guideline with defined (top) aspects that are able to relatively easily and/or highly impact knowledge brokering in virtual projects. Through this, the study provides solutions and recommendations on how to enhance knowledge brokering in virtual project teams. The final section also reviews and summarises the main results by providing further insights into new contributions and future research requirements. This chapter, with the outline of the thesis set-up, was included to illustrate the interesting aspects of the complexities and dynamics of the intended research connected with processes like communication, knowledge creation and collaborative learning. Overall, this approach is relevant, as the focus on PKM has a significant relevance due to its contribution to the overall project and organisational performance and the significance of KM for competitive advantage in the project environment that is receiving increasing attention in the literature (Bresnan et al. 2003).

1.4 Summary

The introduction section outlined this study's backgrounds, aims, objectives and principles as well as the overall approach. In today's rapidly evolving knowledge-based economy companies are required to effectively apply and yield knowledge in the same way they deal with other tangible resources. Teams working together virtually is developing into almost a de-facto standard amongst global companies, paradoxically also for the purpose of integrating, harvesting and applying knowledge that is spread across companies globally and often stuck in silos of social-networks (Alavi and Tiwana 2002). Despite that the fact that virtual set-ups offer accessibility to specialised and dispersed experts and their knowledge, they actually restrain parts of KM, and relating it to crucial PKM is presented

in literature as a promising avenue for future research (Alavi and Tiwana 2002) and will therefore also be pursued by this thesis.

2 Chapter Two: Literature Review

2.0 Chapter Overview

The following literature initially synthesises and analyses the relevant theories' status quo of the fields included within the conceptual framework. Related definitions of relevant and important terms are outlined as supporting material in the back-up. In order to guarantee that the research has a sufficient theoretical foundation, it is important to define and review the basic concepts - to the extent to which the scope of this thesis allows. Although many of the reviewed aspects are interrelated it is critical not to use terms synonymously and important to create clear distinctions which are supported by the depicted definitions. The back-up section will provide scientific definitions explaining how certain terms will be used in the context of this dissertation.

Naturally, most of the aforementioned technical terms will be further elaborated upon within the chapters, with said chapters also demonstrating how and why the included terms are pertinent to this research. The chapter will aim to define key terms to the reader as a means in a bid to provide the reader with more foundation as far as the research topic is concerned. In this respect, the literature review has been developed upon extensive review of key publications relating to PM, KM and knowledge brokering both from a strategic and tactical level. Consequently persisting gaps within the literature are highlighted explicitly whilst focus is given to developing an insight into the relationship between PM and virtual teams.

The second half of the literature review consists of a thorough analysis of potential best practices from e-learning, which is initially explained by a handful of reviewed prominent publications to provide the reader with the necessary background understanding required. Following this, e-learning will be explored in greater depth as each topic will be reviewed and summarised in line with the intended Delphi study.

The potential e-learning best practices are divided into four main sections. As already outlined, during the course of research in and around the conceptual framework, the field of e-learning has been identified as having certain communalities, in addition to being far more advanced than current knowledge brokering. This does not only refer to generic similarities, for example, the reality of "lifelong-learning" in the area of e-learning applies to individuals and within the field of this thesis, rather it refers to the learning process of companies (Monahan et al. 2008). More specifically, e-learning theory is much more

advanced and mature in comparison to KM and brokering practices in virtual project teams. This, therefore, facilitates the transfer of e-learning best practices to the domain of virtual teams and PM. Based on the analysis and critical review of contemporary theories and findings from e-learning, a list of the distinct possibilities emerged. It is prudent to note that this is not only based on the review of said literature but also personal experience of the author in both fields.

Although these aspects will be discussed in detail, it is important to once again highlight an essential finding in terms of explaining the scope of this thesis. E-learning recognised early that the process and manner in which learning content is applied and distributed by learners is more important than its actual design. The creation process itself is regarded as being relatively straightforward and not fraught with complexities and this is supported by the existence of models such as the established spiral of knowledge. Furthermore, the maturity and current speed of further enhancements in e-learning is due to factors such as the acknowledgement of the importance of blended learning, web 2.0 technologies, educational blogs and open source solutions, demand for suitable corporate training and student-centred solutions (Regueras et al. 2008). Said topics will be discussed in the literature review and the following chapters will be used as a foundation for developing improvements for knowledge brokering and thus knowledge-distribution processes of virtual project-teams. Modern e-learning literature examines the domain from a number of perspectives which include IS, governance, management as well as how it can be harnessed to gain a source of competitive advantage.

To reiterate, certain specific sub-aspects of these practices' fields such as ERP and Data Warehousing necessitated more complex review and explanation in the subsequent chapters. These items were selected as a result of thorough literature review and consultation with industry and field experts and the assessment of their potential impact and feasibility will be a key deliverable from the intended research of this PhD project. It also includes analyses of modern practices like potential trends (Enterprise 2.0, Consumerisation and Cloud Computing) as well as management of risks such as excess data and information-creation as well as escalations of IT projects that are relevant for establishing the proposals that will be developed and discussed in the course of this research. The e-learning practice overview culminates in the fourth section with related management theory, models and management of social aspects. All factors above have been chosen after careful consideration and in keeping with the research objectives and

have thus been considered appropriate due to their general relation with PKM.

Accordingly, topics and areas which have advanced as a result of e-learning developments have been given due consideration. The potential best practices are summarised in key words to be used as the building blocks to form a competent argument and explanation provided to the participants of the Delphi study. This approach also proves that e-learning management theory has much better understood the paradigm shift in our economy and society towards the current information or knowledge society. This is arguably also the main reason why e-learning emerged via the transformation of conservative learning models into the evolutionary derived current state that is based on the usage of ICTs (Kahiigi et al. 2008). E-learning has in effect ushered in a new paradigm as far as learning is concerned and as a phenomenon in itself, continues to herald a vast number of opportunities for organisations in particular. Perhaps this is most suitably put into context by Garrison and Anderson (2005) who on the topic of e-learning assert that it is "a serious commitment to understanding the different features of this medium and the way it can be used most advantageously to impart learning" (Garrison and Anderson 2005).

2.1 Contemporary Focus and Limitations of Related Management Research

The following sections will present the underlying ideas around the changes of PM and KM as well as further introducing the defined knowledge brokering and its current insufficiencies for virtual project teamwork. Furthermore, the reasons why e-learning is identified as a source from which best practice can be drawn to improve the exchange of knowledge relates to the fact that it is an advanced field with context in learning and communication from a distance. In addition to synthesising the related literature, the conceptual framework underpinning this thesis will emerge, following an in-depth and critical analysis of the topics influencing this thesis.

These related fields are chosen upon careful consideration and are derived from both IT as well as management theory. Pertinent topics such as current trends or principal governance problems are also given due consideration. The analysis of modern e-learning within the literature review will underpin the development of best practice solutions for application onto virtual project teams and improving related knowledge brokering. Overall, the following sections around PM, KM and virtual teamwork contain descriptions and critical discussions relating to the opposing perspectives that exist within the academic domain. The key issues that will emerge from this literature discussion will feed into the

development of the conceptual framework. The framework will serve to act as a roadmap, providing a visual conceptualisation of the research in terms of how the different threads of literature come together to address the problem at hand.

2.2 Project Management

A more robust definition of PM is provided within the appendices (See Appendix I), however, in short, it can be regarded as a set of processes or steps that have to be taken and fulfilled in order to produce a specific product (Turner 1999). However, PM is influenced by continuous developments and changing paradigms as discussed within the research chapter, justifying the approach of this study. Related PM theory, literature, and practice are very diffuse however extensively impacted by the PMI's guide to the PM Body of Knowledge (PMBOK) (Project Management Institute 2008). Over the last two decades, the PM area has been subject to a vast degree of attention and this is best reflected by the ever-increasing amount of related publications (Soderlund 2002). The theoretical foundations of PM are rarely discussed and seem rather implicit, whereas recent trends have signalled some change, as there has been a new wave of research which has sought to scrutinise existing PM theory. This has, in turn, resulted in the expansion of existing theoretical frameworks thereby resulting in a greater degree of diversity and maturity as far as the domain is concerned, thus ushering in new opportunities for both academics and practitioners (Pollack 2007).

Winter et al. (2006a) state that companies operating in today's modern business environment find themselves exposed to a new generation of projects in which the focus tends to be on value rather than simply output and product creation. Within this context, projects are expected to exceed the latter as the notion of value creation is one which goes beyond limits of an individual project initiation and closure. The authors of this paper emphasise the organisational paradigm-shift away from concerns around capital assets and more towards conflicts around realisation of strategies, effectiveness, and stakeholder interests. According to Winter et al. (2006a), the shift towards value-centric approaches generates more and more integrated business solutions. These can more suitably be defined as strategic initiatives rather than conventional projects. Cohen et al. (2000) describe this with the compulsory transferal from "meeting fixed specifications to satisfying customers […] [,] fixed budget to […] cash flow […] [,] fixed deadline […] to best time to market […] and […] getting the project done to helping to implement organisational strategy". In line with these overall changes, Eskerod (2010) also rightly observes that project managers

themselves have to adapt continuously by enhancing their important management competencies.

PM theory is, thus, undergoing a fundamental evolution. The traditional PM literature defined projects as being a physical system or product, which has to be (re-) engineered. This should be done in accordance with stated costs, time and other resources. Turner (1999) defines: "[The management of projects as] an endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives".

In accordance with the abovementioned arguments, this traditional concept of projects has to be developed further by enriching it with other business disciplines in order to cope with the changed requirements in modern business environments. This supports the rationale of this study. For example, Love (2005) mentions an excellent example of how the traditional conceptual framework of PM theory is enlarged, by combining it, in this case, with KM, as discussed in the PKM review chapter. It has to be emphasised that this is not a totally novel concept and as in part, already been addressed by selected research initiatives such as the mentioned "Rethinking PM Network" from the network Engineering and Physical Sciences Research Council (EPSRC) (Winter et al. 2006).

Interestingly, the same council has also funded another research project aiming at gaining better understanding social processes and their impacts on KM in project environments and related project-based learning (Bresnen et al. 2003). Overall, the new ideas in PM theory have been supported by the referenced Rethinking PM research network funded by UK's EPSRC to "define a research agenda aimed at enriching and extending the subject of PM beyond its current conceptual foundations" (Winter et al 2006c). This initiative was launched due to the increasing demand for new, relevant research due to the ever-increasing criticism around existing PM theory and its inadequate support for PM practice. Here, it is important to mention that emphasis is not on abandoning existing theory, rather the impetus is on extending and enriching existing PM theories and tools beyond common underlying areas by merging it closer in line with real-life challenges (Winter et al 2006c). The main outcome of the Network was the development of a practical framework for field-researchers consisting of five principle areas (project complexity, social process, value creation, project conceptualisation and practitioner development). The purpose of which was to highlight areas in which new approaches were required and how existing PM

concepts need to be developed around new insight and research to remain a guide to the evolving PM praxis (Winter et al 2006c).

This is also a rationale in which this PhD is steeped in. Recent streams of literature suggest a more holistic approach to problem solving, one which goes beyond simply recommending tools and concepts. Rather it is suggested that the focus should be on asking why the problems occur in the first place; to do so, a deeper understanding and insight into PM is required. More specifically, an improved understanding of actual PM reality and practice is required, along with the development of new epistemologies and ontologies. These are emerging from structured intercourse of practitioners and academic researchers to develop useful models that are focusing on becoming relevant to the terrain instead of continuously trying to develop theoretic approaches that claim to be the models of an entire area (Winter et al 2006c).

In conjunction with this, new expectation is also to develop tools, concepts and images *for* practice, encouraging the usage of *multiple* images instead of just a single all-encompassing theory as before, in order to allow a better understanding of all the different issues that are going on simultaneously in a project (Winter and Szczepanek 2007). Another relevant example that has a gap between theory and practice is the social process component. This emerges in-line with the Network as one of the most significant themes where it is obvious that real project interactions contain far more complexities and unpredictability than the dominating theoretic models with their grounding in rationalism and determinism (Cicmil et al. 2006).

From a generic point of view, both the Network and this research also promote the conceptualisation of PM by the facilitation of focused action via a multi-purpose, disciplinary, and perspective-based approach. This provides unique opportunities for insights via new combinations using not only hard methodologies but also soft methodologies, especially in the front-end part of projects (Winter et al 2006c). This is especially valid as organisations are getting away from factory approaches to value-creating networks and abstractions. Thus, there emerges a need to have adequate conceptualisation skills, as nowadays companies' services and products, away from solid parts, are perceived as knowledge and connections, ideally enabled via free information flows (Normann 2001). Overall, the Network's constructive re-examination of the relationships of PM research and practice, as well as its inspirations for enrichment and extension of PM theory beyond the current scopes provoked future research ideas. These

aim at enhancing the relevance of the academic knowledge generated for actual improvements in the field by also conceptualising and theorising PM practice (Winter et al 2006c).

Initial obvious constraints for the following KM analysis arose from the characteristics and differing backgrounds of projects and their respective members, such as non-full-time allocations and working in other projects simultaneously, invisible members or stakeholders, lack of social awareness, norms and varying degrees of responsibility and the outcomes thereof (Ajmal et al. 2010). As effective PM becomes increasingly vital to success, the knowledge gained in these projects for resolving interdisciplinary and innovative topics becomes key. However, it is constrained by the decentralised knowledge fragmentation of project-documentation being spread and stored anywhere without retention (Disterer 2002). This provides reason for the next two chapters reviewing the (P)KM part of this. Interestingly, Japanese PM-standards set experience and knowledge at the core of project value-sources and accordingly, projects can be viewed as a KM process (Ohara 2005). As KM is regarded critically important, especially for the concerned virtual and complex projects' success, related KM will be reviewed in the following chapter (Gasik 2011).

A new class of projects is emerging, conceptually moving away from the traditional product creation and engineering perspectives, and positioning itself more toward value creation and integrated business subjects. These deal with various areas such as strategy implementations and continuous improvements, as well as supporting relationships and stakeholders interests (Winter et al. 2006a). This is in-keeping with related literature, which cements the notion of accounting for stakeholder perspective, thereby supporting the position of this study (Kolltveit et al. 2007). However, common PM literature has previously mainly neglected new developments in other theoretical disciplines and therefore, has been perceived as inward looking (Winter et al. 2006a). Not only according to the EPSRC, but also in general, various modern PM research is claiming the need to extend traditional PM practice and theory with new relevant perspectives and concepts by looking beyond mainstream PM literature to other related management disciplines, as done in this PhD study (Winter et al. 2006a).

Although a single theoretical base for PM is yet to emerge, the following three major methodologies have been developed over time:

- **System model**: Bases itself on hard determinism, universalism and rationalism and centres on planning and control. The system model is normally considered to be the most popular of the major methodologies, although it receives criticism for handling all projects as the same, not sufficiently coping with the evolving front-end of projects, as well as not focusing satisfactorily on social and humanistic aspects of project work.
- **Scandinavian schools' theme**: Focuses on organisational structure and considers projects as contemporary organisations.
- **Review of projects from different sectors**: Attempts to gain a broad understanding of the relevance of managing both endogenous and exogenous factors by also stressing front-end topics, strategy, learning, and context (Cicmil and Marschall 2005 and Winter et al. 2006c).

From these holistic approaches that demonstrate vital aspects that influence this study, various other methodologies or perspectives have emerged, focusing on the intercourse of strategic directions and projects, the relevance of context, experience and capabilities for project performance (Winter et al. 2006c). Further themes are also emerging and due to its relevance, noteworthy ones go in directions like uncertainty, consider projects as information-processing systems or review critical management perspectives. This differentiation and development is not unusual as a growing area like PM involves ambiguous and plural aspects, and is concerned with combinations of various disciplines as a project itself (Söderlund 2000).

Referring to perspectives in PM, theory also supports the argument of newly added perspectives. However, likewise, still a few main perspectives dominate. Kollveit et al. (2006) summarise the following six main perspectives as:

- **Task**: Coined by rationalism, this perspective focuses on issues like budget, time, results, targets and planning and control.
- **Leadership**: This important view is catering for the human aspect by considering issues such as learning, communication, uncertainty, change and feedback.
- **Stakeholder**: Considering the relationship between project(s) and stakeholders as vital, this view is dominated by the agency, power/resource and industrial network theory, applied to review dependencies, communication and influences.

- **System**: By looking at the project as being a management system with sub-systems for control, information, evaluation etc., this model claims that issues should be resolved by viewing the complete picture and its boundaries and dynamics.
- **Transaction-cost**: Projects are portrayed as economic transactions and centres around related costs and governance factors, as well as innovation, incentive and mainly contract theory.
- **Business by project**: By assuming that an organisation's business is achieved via projects, this perspective focuses on project investments and benefits by considering marketing, portfolio(s), financial theory and investment theory.

Besides some literature heavily touting the stakeholder perspective, the most dominant theories in literature are the task and leadership perspective(s); the latter is clearly emerging as the most relevant theory (Kolltveit et al. 2007) in line with the direction of this PhD research. However, concentrating on one perspective can also impose a risk of limitation. PM practitioners have to cope with multifaceted and dynamic challenges from various fields including strategy, culture, control, communication, technology, social and human resources. Accordingly, project managers have to find a way to integrate all factors successfully, which cements the fact again, that gaining understanding of the plurality of projects is paramount (Morris 2002).

Consequently, the claim from the literature supports the argument of this thesis as to go beyond the original hard approach to refocus on interlinked aspects by assuming a totality where company-wide development of knowledge, learning and competencies becomes the key for future success (Morris 2000). Comprehensive examination of mainstream PM literature supports the understanding that PM theory has developed into a mainly purposeful means-end oriented strategy/theory. This is connected with the aforementioned hard paradigm by focusing on objectivity, control, performance and data links rooted within the assumption that complex projects may be explained via a reduction to simple broken-down parts (Remington and Crawford 2004). Accordingly, the traditional PM principles also promote that human destiny can be controlled. Therefore, they focus primarily on the idea of control creation versus ideally also on encouragement on individual learning (Thomas and Tjader 2000), which will be centred in this thesis.

Focusing on the structure, control, and outcome, PM literature also questionably promotes a metaphor of considering projects and organisations as machines (Thomas and Tjader

2000). Another previously outlined limitation of PM theory is the narrowly-focused approach. Here, PM theory often fails to embrace other theory fields, as principally done in this PhD thesis, by the incorporation of organisational learning topics, for example. A good example is that in contrast to most regular management scenarios, project members usually encounter extremely stressful situations. However, surprisingly, general PM theory only limits itself to relatively elementary HR practices and refers even in the PMBOK guide only to extensive externally available HR literature (Project Management Institute 2008).

The literature review has found low emphasis on participation and interpersonal topics and an approach that focuses more on problem solving rather than problem structuring. Thus, criticism in literature arises, as traditional PM theories are most appropriate only for simplest problems and not applicable to the complex and stochastic nature of projects (Daniel 1990). There are various research papers that point out accordingly limitations around tools being primarily quantitative and having limited applicability in non-traditional PM areas such as the important change management and restrictions of theory to address complexities (Pollack 2007). Accordingly, PM theory is finally broadening its scope and enhancing itself by reviewing soft paradigms and other research fields. This PhD thesis will contribute to this theme by embracing the same trend. A good indicator for this evolution is the changed view of project managers from the traditional expert role into a facilitator that is briefed to encourage participation (Pollack 2007).

Recent PM literature also promotes the fact that many project successes are the result of enhanced human relations and communication, with failure often resulting from cultural issues between project members, communication breakdown, and primary focus on technology, which is also reviewed by the universal approach of this study. It is prudent to note that the progressive soft paradigm theory seems already more penetrated on (a) practical level, which supports again the approach of this research project to also embrace practical expertise via the research methodology. Here, the literature claims traits of flexibility, embracing change and uncertainty, shaping and continuous redefinition, which seem to be already partially applied (Richardson et al. 2000).

What is important is that, this evolution requires learning, which is becoming the secret of success for PM. This is especially relevant for situations of ambiguity and ill-structure, where problem structuring methods which concentrate on facilitated participative learning, increasingly involve stakeholders, even in target and planning-processing, and boost shared learning (Yeo 1993). Here, the chosen e-learning best practice approach of this

thesis is supported by the general theme to optimise PM theory and practice with an aim on learning. In light of this, it is also required to enhance these by new perspectives like understanding and supporting the social processes with the overall tools and techniques, which requires both learning and un-learning (Pollack 2007). This section discussed contemporary focus and limitations of the evolving PM literature by providing an understanding of key topics and creating justifications for this thesis.

2.3 Knowledge Management

In keeping with PM, knowledge, and its management are both complex and multi-facetted (Alavi and Leidner 2001). Accordingly, the literature argues (McBriar et al. 2003) that selected concepts within this domain are not yet explored to a full extent, as also visible in the scope of this PhD thesis. Overall, KM consists of much more than the obvious knowledge archiving and retrieval concepts. As such, KM literature promotes raising appropriate questions relating to availability and mobility of knowledge as recent developments now enable to ask questions that did not emerge previously (Alavi and Leidner 2001). The importance of knowledge and its management is supported by the interest of related innovation, organisational research, as well as the dominant knowledge-based theory that claims that knowledge of a company has strategic importance as a source of effective organising (Berends et al. 2007). In this respect, IS has since moved away from being limited to (top) executives. KM solutions now aim to support decision-making and general work of all employees by focusing on increasing both the effectiveness and efficiency of managing knowledge by dealing with a massive amount of different knowledge resources and technologies (O'Leary 1998). In this regard, Walsham (2001) rightly summarises that enhanced abilities for data collection and processing as well as electronic communication across locations and time do not automatically improve human communication and action.

A number of views surrounding knowledge dominate the literature, and in keeping with PM, distinct perspectives for KM also emerge from the literature. Although various other views exist, such as object, process, or capability-focus, the main perspectives are the *information-based, technology-based and culture-based perspectives* (Alavi and Leidner 2001). The latter is connected with learning and communication; the literature correspondingly suggests that only a minority of KM issues derive from the information and technology perspective (Alavi and Leidner 1999b). This is in line with the focus of this thesis. Alternatively, the managerial concerns mostly demand for clear responsibilities

and metrics for connecting players, and validating value adding leverage points of knowledge via cost-benefit analyses (Alavi and Leidner 1999b). An interesting thought-process emerges in the information perspective. This states that while avoiding overloading, the management has to be very careful as omitting of insignificant aspects may be as imperative as focusing on the significant ones (Courtney 1997).

As there is no single or optimal approach to KM, different perspectives and issues will be reviewed in the following part, which hints at the direction that only a holistic and varied approach should be applied to resolve this diversified field (Alavi and Leidner 2001). Referring to the stated definition of KM, this deals with more than information flow management. More specifically, ideally enabling free knowledge flow to discover new paths and stimulate creative and self-questioning approaches as well as knowledge partnering improves flow management (Desouza and Evaristo 2003). Apart from some literature that considers knowledge as a commodity, modern KM postulates that the actual process of knowledge transfer is not as easy as depicted in the "commodity-view", which involves complex aspects such as sense-giving and sense-reading (Polanyi 1969). In order for the previously described concepts of knowledge to become useful, the personalised dimension of knowledge requires an accessible and interpretable communication. Furthermore, the extent to which knowledge is made valuable is dependent on reflective processing of an individual mind (Alavi and Leidner 1999b). In connection with this, KM as a management-perspective is defined as a systematic and process-driven approach to acquire, organise, and communicate explicit and tacit knowledge in an organisationally specified way. The aim of which is to improve productivity and the effectiveness of staff (Alavi and Leidner 1999a). KM literature has been subject to longstanding criticism for emphasising the conversion of tacit knowledge into explicit knowledge and its deficient empirical basis for its recommendations (Pan and Scarbrough 1999). Emphasis over the years has shifted on collaboration, as in essence KM is concerned with the encouragement of individuals to share knowledge (Chase 1997). Whilst the referenced literature in general discusses generating socially constructed knowledge, Glaserfeld (1995) states that knowledge is actively built by the individual rather than passively received via communication.

In the newest era of ICT and KM, the human mind has become a productive force and knowledge is acting on its own across flatter, decentralised, de-bureaucratised and virtual organisations. This virtual organisation and lack of physical proximity poses challenges for

the sharing of knowledge and information and teams are increasingly losing opportunities to do so (Prusak 1997). Organisational theory is of considerable importance in this context as it promotes the understanding that knowledge is constructed and embedded in and via social interactions and links. This knowledge cannot be easily transferred like information, as it has to be re-constituted and re-created continuously via social, self-motivated, and interactive networking activities (Nonaka 2007).

Fullard (2006) also provides important indications with regards to knowledge retention and transfer. The author rightfully posits that retention relies on the ability of users to add new knowledge onto existing records and that the possibility of aggregation of knowledge contributes positively to the overall performance of the transfer. This already proves the potential of e-learning as the best practice tool of Web 2.0, for example, allows for the process of knowledge aggregation to be captured, especially in the mentioned changing and virtual organisations. With regard to KM, e-learning theory also includes some further advanced aspects that will be considered as outlined in the following sections. Confirming the intended link and transfer of practices, Chen and Hsiang (2007) suggest that the capabilities of KM are a key requirement for success of e-learning concepts and shall include both the internal as well as the external view.

On the topic of risk consideration, the literature also refers to organisation specific situations such as resignations or downsizings as an area, which compounds knowledge gathering. This means that often the knowledge required already exists within a company however there are no formal systems or processes, which allow for this knowledge to be captured. This tends to be further compounded by cultural factors, which do not support the accumulation and sharing of key knowledge (Alavi and Leidner 2001). This underutilisation is in an ideal theoretic view improved via externalisation, collection and dissemination of knowledge in order to make all knowledge available to all employees or at least, the right knowledge to the right staff at the right timing (Berends et al. 2007). Here, KM theory discusses solutions like intelligent agents, which can be applied to link employees with available knowledge (O'Leary 1998). In reference to the mentioned gap, progressive KM literature also suggests that while common knowledge-systems require complete information sets for their highly formal processes, reality should look at supporting also with incomplete but therefore timely information. This is because resourceful users may be able to close the gaps and even produce new knowledge from the existing forms (Alavi and Leidner 2001).

Recurring issues arise from cultural and change-management aspects, which intensify when KM solutions of companies are extended globally across countries, languages and behaviours (Desouza and Evaristo 2003). Of course, knowledge sharing and application differs between cultures, and this serves to increase the difficulties for an effective global standard for knowledge sharing to emerge. This is obvious, for example, in Eastern cultures, with more group emphasis and low ambition to store and share knowledge. Here, knowledge brokering relies more on informal networking and exchange versus low context (Western) cultures where knowledge usually moves more freely. Related change involves moving towards continuously sharing new knowledge by breaking old-fashioned behaviours; this becomes more complex for global companies. These have to think globally but act locally and thus, identify knowledge providers or compensate for local informal ties and shared context due to dispersed locations of staff (Walsham 2001). Overall, the culture dimension adds another layer of complexity as cross-cultural engagements tend to be influenced by specific characteristics. More specifically, different cultures tend to be governed by unique practices and approaches to sense-reading, giving and tacit knowledge and are thus, difficult, requiring management attention around compromising and adapting (Walsham 2001).

In summary, four KM process-steps issues emerge from the literature (Alavi and Leidner 2001), namely

- **Creation**: Shared knowledge creation spaces in link with communities of practice with close ties that could also limit creation; culture as catalyst and hindrance; increasing episodic memory for the consequently improving semantic memory's interpretability.
- **Storage and retrieval**: Lack of semantic routine, time, and incentives due to focus on tasks and compilation of own knowledge; unawareness of what knowledge aspects could be relevant for others; inclusion of context; updating and easy access with avoid-ance of information overload.
- **Transfer**: Limited amounts, recipients, locations; balancing push and pull; external dimension.
- **Application**: Close gap of what companies do and know; distrust, risk aversion and absorption capacity.

What is important is that via static repositories such as Intranets, knowledge may never be effectively shared as these solutions fail to deliver the richness of the applied context.

Although ICT remains a foundation for KM, the crucial enabler of it remains the employees rather than the ICT (Tseng 2008). Besides the amalgamation of knowledge across groups, the actual context in which the knowledge exists remains paramount, particularly if the knowledge is to be understandable and this tends to be compounded in small spaces such as virtual set-ups (Alavi and Leidner 2001). Given the different approaches, a singular, standard policy for KM is yet to prevail; it is recommended for companies to use a selection of existing solutions by connecting them with defined knowledge targets and ensuring an effective application (Hall and Andriani 2002). KM ideally harnesses the social and intellectual capital of employees for an enhancement of the companies' learning capabilities (Swan et al. 1999).

Accordingly, it can improve exploitation (knowledge capturing and transferring) in order to apply existing knowledge more effectively (avoiding "reinventing the wheel") and improve exploration (knowledge synthesising to develop new knowledge) to develop new ideas etc. (Swan et al. 1999). With regards to reinventing the wheel, it has to be noted that a dilemma exists, as especially in challenging market conditions, an innovation source does not simply reside in the more efficient transfer of available information but the application of knowledge to knowledge in itself (Drucker 1993).

A shared system of meaning will also improve IT-led KM solutions that mostly fail to resolve issues of tacit knowledge communication. Whereas previously tacit knowledge codification was considered to produce useless, trivial, irrelevant and especially redundant results, this is actually extremely important as redundancy is required in KM in order to engage with and make sense of knowledge of other individuals (Gardner 1998). The *codification strategy* describes the highly structured document-to-person approach and presents dominance with global knowledge repositories due to the efficiencies in terms of access and costs. However, issues around lacking contexts in global settings are referred to in the literature as knowledge becomes only actionable in a suitable context for usage (Hansen et al. 1999).

In contrast, the semi-structured *personalisation strategy* refers to the tacit dimension by not differentiating between knowledge and its provider via person-to-person approaches where IS is used in global companies to facilitate exchange (Hansen et al. 1999). The point here is a clear discrepancy of the fundamental assumptions between the more human-centric personalisation strategy and its counterpart the deliverable-oriented codification approach. Although hybrid forms exist in global knowledge-intensive companies, mainly

the personalisation strategy is applied due to the challenges of explicating tacit knowledge without the socialising process with peer-staff (Desouza and Evaristo 2003).

Overall, tacit (even more than explicit) knowledge is a key aspect that is closely related to most of the elements of this PhD thesis. Therefore it is embedded in various sections of this research, rather than discussed in a separate section. Knowing that varying definitions of tacit knowledge exist amongst the cited studies, the most relevant aspect for the purpose of this study is the distinction to explicit knowledge and the cohesion with the personalisation strategy.

Knowledge is characteristically sticky and therefore, must be actively endowed with meaning via networking processes; these enable exchange and giving meaning to experience of the participating individuals (Weick 1990). ICT networks may even challenge knowledge exchange. This is via the reduction of informal networking opportunities by sometimes even an emphasis of existing organisational and functional boundaries although it could easily also increase an individual's knowledge reach beyond existing reporting lines (Swan et al. 1999). In terms of knowledge codification into semantic memory, neither effective storage nor dissemination is assured (Jordan and Jones 1997). Although highly improved via ICT, it remains also challenging to make individual knowledge and therefore episodic memory meaningful and accessible to others. This is because transfer between individuals and groups may not only be challenged by the non-existence of shared episodic memory, but practically by the information when it has been modified along with guidance on how to validate the information (Alavi and Leidner 2001). It is interesting to note that the ambition of knowledge codification and transmission is not new, as evidenced by the by long-term existence of means such as reports, manuals, routine and procedures as well as staff trainings and developments (Alavi and Leidner 1999b). The important development is the potential of applying advanced ICT for facilitation, systemisation and advancement of company-wide KM (Alavi and Leidner 1999b).

Two major terms to work on persisting issues are (Alavi and Leidner 2001):

- **Knowledge Auditing**: Evaluates what knowledge is where and how available and is therefore applied for knowledge gap-identification, support of knowledge-creation initiatives and becomes a core process of project-planning.

- **Knowledge Mapping**: Looks at structure and linkages of different knowledge aspects, for an assessment of potential risk as a specific lost or downgraded knowledge-part may be vital to other areas of a company.

In relation to the aim of the thesis to improve KM for virtual global project-teams, few specific publications review the new aspects of global multinational companies and their strategies to survive KM in global highly competitive markets (Desouza and Evaristo 2003). Due to the difficulty of integrating silos of knowledge if they are globally dispersed within large-scale and complex companies, Desouza and Evaristo (2003) have determined the following three management strategies for global companies:

- **Headquarter commissioned and executed**: Standardisation of global KM strategies, solutions, processes and policies.
- **Headquarter commissioned and regionally executed**: Permits global solutions to be tailored to regionally distinctive requirements, but global connectivity remains.
- **Regionally commissioned and locally executed**: Thinking regionally but acting locally arises issues for global knowledge sharing.

Conventionally, the creation and transfer of knowledge was facilitated via means such as staff development, job rotations, mentoring as well as planned and unplanned face-to-face interaction. The advent of globalisation and virtual business practices has growingly rendered these practices obsolete. Today, these processes require supplementations such as electronic solutions for collecting, disseminating and integrating knowledge created and needed by virtual (project) teams. This ideally leads to enhanced innovativeness, productivity, and decision-making as well as flexible and timely responses to ever changing markets-demands (Alavi and Leidner 1999a). In summary, there are various interesting but challenging aspects for KM and these include measuring the strength of knowledge of an individual or company, as doing so enables the planning of current and upcoming knowledge requirements for companies and projects (Alavi and Leidner 2001).

Accordingly, O'leary (1998) proposes various enhancements such as strong leadership, which is likely to bring about a culture of knowledge sharing with incentives (O'leary 1998). It does have to be noted, however, that in line with PM, real-life KM situations are not simple and similar, and therefore require adapting specific methodologies and tools. The previous focus of KM publications on (implementation of) IT-systems, has created a

gap by neglecting the potential of applying best practices from (organisational) learning theory that stresses issues such as the development of companies and culture or people-emphasis with topics like motivation, trust and rewards (Cole-Gomolski 1997).

Existing KM publications are yet to transfer theory into the domain of PKM. This angle will subsequently be explored further in the next chapter in light of the discussed distinction of personalisation and focus on codification, which tends to be preoccupied with tools and ICT. Misconceptions surrounding the domain continue to be highlighted, chief amongst which is the belief that all types of knowledge can be codified and that employees wish to share and apply knowledge from these tools. This leads to an over-reliance on ICT and a rigidifying of intuitive and informal routines that are vital in virtual set-ups (Swan et al. 1999). There is no doubt in the business world that KM is important, especially when considering a company's future in changing business environments (Fletcher and Polychronakis 2007). Consequently, according to Siemieniuch and Sinclair (2004), organisations should build capabilities in regards to skills and knowledge and should use these in their adapted and knowledge-driven processes to deliver attractive products and services to their clients.

2.3.1 Communities of Practice

The taxonomies associated with knowledge, whilst complex in nature, have played a significant role in the development of KMS, a discussion of which is to follow. Besides the tacit, explicit, individual, and social dimensions, the pragmatic taxonomy has influenced the rationale of this study, as to focus on useful knowledge for an organisation by means of best practices, business frameworks or project experiences (Alavi and Leidner 2001). As a primary aspect of this strategy, communities of practice are mentioned, which focus mostly on knowledge dissemination rather than collection and externalisation and should be a vital part of any KM strategy (Berends et al. 2007).

Lave and Wagner introduced communities of practices to KM literature in 1991, in response to the demand for the support of both formal and informal processes for KM. Within this context, communities are regarded as being highly effective in facilitating a shared understanding of best practice as well as industry standards, whilst also allowing for closer relationships to be built between various communities. In this respect, the knowledge sharing between different communities of practice is considered as being significantly challenging given the absence of shared symbols etc.; the literature therefore

argues for the importance of organisational translators.

Whilst technology can potentially be used to address the challenges facing collaboration, problematical socio-technical concerns around assumptions or different understandings continue to pose challenges as well. As such, these issues are likely to persist and in some cases, worsen, due to the lack of dynamic face-to-face interactions that include non-verbal hints, for example (Walsham 2001). This further substantiates the arguments made for the need to improve the exchange of knowledge within virtual project teams.

This provides valuable arguments for the researched improved application of knowledge brokering in virtual project-teams. However, the importance of these knowledge-communities is emphasised by the opportunities of an active attempt for horizontal and vertical knowledge sharing within companies (Tseng 2008). In this regard, literature tended to focus IT and the cognitive-based approaches as far as the development of network structures are concerned. This, however, has its limitations to the creation of knowledge networking and sharing through social communities. This is mainly due to the reliance on IS and technology as well as exploitation and knowledge codification for the transfer (Ref. to as first generation of KM; Swan et al. 1999). Hence, innovative papers claim the need for a community-based networking model and interactive sharing of meaning and sense-making to communicate knowledge, by focusing on exploration, trust and collaboration (Ref. to as second generation of KM; cf. Swan et al. 1999). This stream of thought echoes best practices from innovation-literature; consisting of very broad and diversified views and considers innovation as a highly complex decision- and design-process involving simultaneous and interactive networking with heterogeneous communities (Swan et al. 1999). This is very much in keeping with the findings presented by Malhotra (1998) insomuch that no direct correlation exists between business-performance and investments in IT. Here, it is emphasised again, that in line with the focus of this study the main issue of KM persists with the capturing, integrating and disseminating of knowledge rather than its creation (Davenport 1999).

2.3.2 Knowledge Management Systems

As discussed thus far, the emerging issues associated with KM and related maintenance, application and localisation, have sought to shape efforts to increase the visibility of knowledge. The latter has been identified as being central to creating and developing a culture in which knowledge is shared as well as setting up the adequate infrastructure to

facilitate this end (Davenport and Prusak 2000). In keeping with PM, therefore, the success of KM is closely linked to the organisational culture and the staff required to use the system; ultimately allowing them to become not only beneficiaries but also active contributors that are constantly involved in providing actionable knowledge (Alavi and Leidner 1999). Resulting KM systems consist of three layers (Pan and Scarbrough 1999):

- **Infrastructure**: Enabling hard- and software
- **Infostructure**: Formal governance rules for exchange
- **Infoculture**: Base of cultural background-knowledge taken for granted and integrated in social relationships defining obstacles or knowledge-transfer, where learning is a key management lever

This follows the claim of KM theory that knowledge should be portrayed as embedded in context and a property of the system (Williams 2008). KMS publications approve the continuous growth of supporting software solutions and competence databases and so on for KM (Lindgren and Wallstrom 2000). From a systematic perspective, KM targets the following four areas (Wiig 1997):

- Monitor and facilitate knowledge-activities top-down
- Develop and maintain an adequate knowledge-infrastructure
- Organise, renew and transform knowledge-assets
- Leverage realisation of values from these assets

The use of KMSs is no longer confined to consulting- and professional service-companies; KMSs are widely applied to build up support learning and business knowledge in an integrated manner via creating, transferring and applying knowledge in companies (Alavi and Leidner 2001). The emphasis however remains on 'integration' as this allows for KMS to be set-up seamlessly; this in turn involves the inclusion of databases, communication and searching- and retrieval-tools (Alavi and Leidner 1999a). A major objective of KMS relates to structuring knowledge within an organisation and containing it within a system or structured repositories. The latter then allow efficient retrieval of classified micro-knowledge required for particular (project) situations (Snider and Nissen 2003).

Literature from a human-centric point of view of knowledge weighs up the benefits and drawbacks of ICT-based KMS. This is mainly due to the complexities of sense-reading and knowledge exchange via a virtual platform (Walsham 2001). In line with the claim of

this PhD thesis, Walsham (2001) argues that the decisions for technology-based systems should prioritise human-process-considerations over technologic ones. To this extent, a multi-faceted approach of KMS is thus necessary, one that goes beyond technological considerations, and instead also accounts for organisational and cultural factors. For example, this includes transitioning from awards for individual staff performance to those that recognise the merits associated with sharing and teamwork (Alavi and Leidner 1999b). Here, the literature develops an interesting idea that is very much in keeping with the e-learning aspect of this research. If learning is considered the conversion and internalisation of information into knowledge, then information becomes the raw material and employees should be rewarded to transfer it into knowledge, leading ideally to a "pull" system (Alavi and Leidner 1999b). More recent research suggests that rather than knowledge itself, the actual practices and outputs of knowledge workers should be presented in new platforms. Historically, companies have failed to effectively to do so and have therefore been unable to present majority of the produced knowledge in a company (McAfeee 2006).

The tendency to focus on ICT in KM literature is mirrored in KMS publications. The intended research differs in this regard as it embraces management theory and related models, therefore giving greater consideration to social factors. The latter will allow for the oft-highlighted negligence of social cultural aspects to be addressed and subsequently applied to virtual project teams (Davenport and Prusak 2000). The evolution of KMS is linked with ICT and this has served to positively shape KM by enabling the management of exogenous and endogenous knowledge of universalised and expanded scope and raising the transferability-speed (Tseng 2008). Although KM processes such as absorption, diffusion and storage depend heavily upon ICT assistance, many companies have and still experience different issues with KMS and successful implementations are still rare. This latter issue is one which this thesis is specifically focused on, particularly within the context of e-learning to ultimately present solutions from e-learning in order to address issues relating to sourcing and implementation. The problem of why KMSs are partially still not being used effectively by employees, results from various reasons. One interesting theory distinguishes between (Argyris 1998):

- **Espoused theory**: Employees in general are interested in learning and sharing.
- **Theory-in-use**: When espoused theory comes into conflict with theory-in-use, which is coined by an individual demand of unilateral control and aspiration to avoid negative feelings, the theory-in-use normally triumphs.

Philosophical approaches, ontologies, and related considerations are also emphasised as being important for KM. This is due to the vast categorisations of knowledge under KM theory (O'Leary 1998). Another essential element that connects with the PKM and brokering demand and focus of this PhD research is the fact that literature discussing precisely KMS in the context of projects (PKMS), rightly mention the importance of the last two KM process-steps of distributing and utilising knowledge (Kasvi et al. 2003). To summarise, factors for KMS-failures are mentioned by various literature-sources. Chua and Lam (2005) have sought to group these along four key categories, mainly:

- **Technology**: Connectivity, usability, over-reliance and negligence of tacit dimensions and maintenance cost.
- **Culture**: Politics, trustful knowledge sharing, perceived image, management buy-in.
- **Content**: Coverage, structure, non-current or contextualised currency and relevance, knowledge distillation.
- **PM**: User involvement, business and technical expertise, conflict resolution, roll-out approach, project costs.

In addition to barriers and inhibitors, researchers such as Moffet et al (2003) have looked to develop a comprehensive framework that identifies KMS 'enablers'. The researchers therefore outlined eight major factors, which enable successful KMS implementation and adoption, these include:

- Friendly organisational culture
- Senior management commitment
- Employee involvement, training and empowerments
- Trustworthy teamwork
- IS Infrastructure
- Performance-assessment
- Benchmarking
- Knowledge-structure

Both these barriers and also the subsequent enablers have provided guidance for the best practices sections of e-learning, as potential improvement aspects for PKM in virtual environments.

The overall objective of KMS is to enable employees to create, organise and get

knowledge when and where it is required (O'Brien and Marakas 2006). In line with PM literature and this thesis' rationale, the KMS literature also claims that research should focus on building upon the extensive knowledge in literature of related fields in order to be regarded as more effective (Alavi and Leidner 2001). Ultimately, KMS solutions allow companies with an opportunity to improve relevant knowledge domains, internal operations, customer service and business partners, all of which lead to higher profitability and lower costs and inventories (Alavi and Leidner 1999a).

2.4 Project Knowledge Management

Having provided a review of the evolution of the underlying PM and KM theory, as well as the related issues and solutions, the following section focuses on discussing PKM, followed by knowledge-brokering and the virtual team aspect. Doing so will lead to the identification of e-learning best practice. A detailed review of the literature will serve to lay down the theoretical foundations of the research, by not only providing a critical review of existing theory but also identify limitations and gaps in the literature as to substantiate this research. PKM is defined as the processes targeting the generation, utilisation and distribution of micro-knowledge required for accomplishing project processes, executed on macro-knowledge of employees from all levels (Gasik 2001). The purpose of which is to enhance abilities via (indirect or direct) involvement of staff in projects. By equipping staff with the necessary skills, they not only have the ability to successfully take part in projects, rather this also allows them to take a more active role in projects, providing them with an opportunity to positively influence project accomplishments (Gasik 2001).

Interestingly, PKM literature describes conflicting paradigms between KM and PM - for example, long-term KM objectives are contrasted with short-term performance of projects and their insulation from the permanent organisation (Disterer 2002). However, studies have proven that there is a strong correlation between good KM and PM practices and accordingly this interdisciplinary field of PKM will be reviewed as part of this study (Leseure and Brookes 2004). Whereas project organisations are nowadays common, KM of these project organisations remains underdeveloped. This is despite their clear demand for effective and particular systematic KM practices in order not to risk fragmentation or even loss of gained knowledge and learning (Kasvi et al. 2003). With regards to transferring project knowledge, the majority of project managers still believe that the delivery of their projects within time, budget, and stakeholder-targets are their main

responsibility. Here, companies persistently struggle with learning from previous errors, continuous improvements and learning growth (Julian 2008).

While the benefits include factors such as improved project implementations, efficiencies and qualities from PKM and knowledge brokering, the attempts in practice are still not always successful. This is, for example, because finished projects may face barriers to store and disseminate lessons learnt, and new projects may only find outdated or fragmented knowledge (Pemsel and Wiewiora 2013). This hints at the importance of the underdeveloped focus area of this study as to examine knowledge brokering across (virtual) concurrent and sequential projects, and not limit it to the previous main focus of the literature on intra-project KM (for example Joshi et al. 2007).

According to recent research from Zhao et al. (2015), from the context of IT-projects, where this is especially relevant, Zhao et al. develop a claim for being mindful of both the source (project) and recipient (project). This is due to the fact that knowledge transfer consists of the two sub-processes of sending and receiving knowledge. In addition, the absorptive capability of the company and the recipient project has to be considered by highlighting the importance of context. That study is extremely interesting as it examines for example, time-urgency, which has a negative impact on the source but a positive impact on the recipient in PKM. Without the special characteristics of virtual and project-environments and its needed trust bases and so on, this links with the findings of general research on knowledge-transfer that defined the following five key-criteria for it (Gupta and Govindarajan 2000):

- Perceived value of knowledge from source
- Willingness or motivation of the source to share
- Transfer channels and richness
- Willingness or motivation of the recipient to acquire
- Recipient's absorptive capacity to identify a value and make use of existing knowledge

In both ways, KM can also guarantee that useful knowledge is transferred throughout a project and subsequent organisation. This will have an immediate influence on pro-active and timely decision-making as well as project performance in terms of costs, timing and quality (Koskinen 2004). Some researchers within the field also claim that PKM approaches should ideally also differ according to project characteristics (Williams 2008): It is claimed that tacit knowledge-based projects like product-developments should be

supported by personal substitutive approaches whereas explicit knowledge-based projects like constructions should be enabled by additive and IS-based approaches. Liebowitz and Mebolugbe (2003) have developed a KM framework to assist project managers in implementing KM initiatives successfully by setting targets, evaluating risks, overcoming constraints and applying measures:

- **Building blocks**: Awareness, strategy, target areas, taxonomy (structure and vocabulary), benchmarking.
- **Next level**: Tools and technologies, organisational infrastructure, development of communities of practice.
- **Afterwards**: Pilots, assessment, change management.
- **Finally**: Implementation, sustaining, and extending the knowledge sharing culture.

To understand the underlying logic of project knowledge, it is important to understand that it has to be managed differently at global, organisational, project and individual levels along the defined KM steps (Gasik 2011):

- Acquiring knowledge from outside the project to accomplish an assignment
- Creating new or evolved knowledge via combining or adopting (ref. strategy of learning by analogy)
- Applying knowledge to determine value of the new knowledge via elaborating, infusing or thoroughness
- Transferring and sharing of identified and externalised codified or non-codified knowledge to the organisation and other projects

Flows can be top-down and bottom-up across the mentioned levels. An example from this approach is that the requirement for certain knowledge may be identified on the project-level where it is also applied for problem solving, whilst it is actually created at the individual and shared on the organisation or even global level.

In project environments, traditional KM methods are often inadequate, although KM in general is of vital significance for PM and thus, the overall company effectiveness, due to the increasing relationships, interfaces, complexities and team-members' pressure to identify already created knowledge and distribute newly gained knowledge (Ajmal and Koskinen 2008). In this context companies require a distinctive understanding of the three different knowledge bases as well as the division of project-created knowledge in three

types, as defined by Conroy and Soltan (1998):

- **Organisation knowledge base**: Specific to environment and organisation of projects.
- **PM knowledge base**: Specific to application and theory of PM.
- **Project-specific knowledge base**: Specific to knowledge gained during a particular project's implementation
- **Technical knowledge**: Specific to technologies, processes, costs, practices etc. connected with concerns of a particular discipline.
- **PM knowledge**: Specific to procedures and methodologies necessitated for PM implementation.
- **Project-related knowledge**: Specific to knowledge regarding other stakeholders that are important for a company's future.

With regards to the knowledge transfer across project-teams, another distinction is made in terms of the following two knowledge types that are equally important for effective PM (Leseure and Brookes 2004):

- **Ephemeral knowledge**: Specific project knowledge - Rarely modified or created by project-teams and supplied externally, usefulness is limited to the life-time of the project.
- **Kernel knowledge**: Generic project knowledge - Intangible asset-source, use increased by projects and to be kept and applied consistently within and across projects in order to sustain high performance of companies and it projects.

In order to increase the flow of kernel knowledge, companies should categorise it and set-up an appropriate infrastructure to overcome typical project knowledge pockets like general business, specialist technician and craftsman skills as well as the most sacred proprietary product and process technology knowledge (Leseure and Brookes 2004). It is, for example, paramount that the project-related knowledge that is captured with the team-members is identified and shared with the entire organisation. Thus, literature promotes ideal set-ups in which PKM ensures that these project-outcomes are documented and made available to the entities outside of the project for usage in subsequent projects or general tasks (Weiser and Morrison 1998).

Time-pressed and troubled project members are often pushed from one project to the next and do not have the time for extensive, explicit KM initiatives. In terms of potential

solutions, obviously companies are unable to make document archiving and compilations a mandatory practice. As a result, they have to ensure organisation and commitment via adaptations of daily project work practices to warrant knowledge preserving and utilisation (Ajmal and Koskinen 2008). Only a few companies are able to assess projects properly and learn from them via a systematic identification and transfer-management for valuable project knowledge for future projects in order to avoid repetition of errors. Literature highlights that the barriers between projects and the overall organisation are critical boundaries for exchange of knowledge gained in projects referring also to best practices for avoiding knowledge-loss (Disterer 2002). In contrast to the permanent organisation, where established institutions like departments support generating and transferring knowledge, upon a project being completed, no institution resides to retrieve knowledge. This issue is further compounded in large multi-national companies, where a multitude of projects run in parallel at any given time; without a system to manage valuable project-experiences it becomes extremely difficult to trace who was involved with which projects and where that employee may even be based now (Disterer 2002).

The majority of the PKM literature focuses on *formal* and *repository-based codification* or *informal* and *ad-hoc personalisation*. However, Boh (2007) introduces a new framework that also considers the dimensions of *formal* and *in routines integrated institutionalisatio*n and *informal* and *unstructured individualisation*. This is done in order to cater to adaptable combinations related to scales of companies, businesses and dispersion of workforce. A highly relevant example from the institutional dimension that supports remote teamwork set-ups is an institutionalised personalisation approach. This enables knowledge exchange on a collective-level via more systematic personalisation means like in form of subject matter experts to solve “needle in a haystack” issues and reach-and-richness trade-offs (Boh 2007).

As noted, unfortunately, most companies still fail with thorough evaluations and learning from projects as well as avoidance of error repetitions due to a wide-range of causes (Ajmal and Koskinen 2008). This is the case although most PM methods and tools foresee special focus on securing experiences and knowledge by allocating decent resources and responsibility for it during project planning. This is most important at the project-end for ensuring opportunities to capture experiences (knowledge summarisation) and root-causes for issues via so-called debriefings, project profiling, post-mortem reviews, reflection, post project review and so on. (Earl 2001).

Special steps at the end of projects are advised for continuous learning with attention on project documentation that is normally geared towards other stakeholders than future projects' members. This should ideally also include methods used, detailed descriptions of problems encountered and resolutions or success factors, experts approached to fill registers or yellow pages and so on. (Disterer 2002). Besides documentation to capture all relevant project outcomes including lessons learnt, it is important to also use experiences related to applied project tools and methods. Therefore the team-participants as the main knowledge carriers occupy a key role via their user participation and involvement (Disterer 2002). The post project environment is not necessarily analysed and given the due consideration necessary, the reasons for which are two-fold; the first of which relates to the time pressure or demand from new projects which often do not allow for a systematic and comprehensive review and documentation to be produced. In addition to this, social and individual discomforts also act as a barrier as they often impede the existence of a forum, which would allow for a frank and open discussion and analysis of any issues, errors and mistakes that may have been made during a given project. This is due to perceived potentials of negative effects or lack of value for an individual (Disterer 2000).

As learning from complex projects require sophisticated solutions beyond simply writing down items, further and more elaborate proposals also exist such as learning diaries, project history days, micro-articles or even narratives which are in certain forms mediated by a facilitator or broker (Williams 2008). Carillo et al. (2011) go a step further by highlighting text mining as a possible solution for the lack of systems to manage the vast amount of unused knowledge from project documentation. Besides the resource constraints mentioned, Carillo et al (2011) also address additional issues around format, content and dissemination. A detailed description of each of these solutions would extend beyond the scope of this research, but they can be easily found by an interested reader via the references.

Overall, these post-project means have been known in their different guises for over forty years, this is supported by the extensive amount of related literature (Koskela and Howell 2002). This in turn presents a rich source of perspective, all of which can be applied to PKM as issues such as avoiding loss of knowledge, stimulating continuous improvement and assisting collective learning to discuss and debate jointly different perspectives are covered (Carrillo et al. 2011). Obstacles that result in non-compliance as far as these techniques are concerned include a lack of awareness surrounding their existence, time-

constraints, lack of incentivising and adequate culture or bias (Williams 2008).

Common particular issues presented in the literature for PKM in general that disrupt a homeostatic KM equilibrium and consequently create a demand for more formal and explicit management may also arise from special events like re-organisations, staff turnovers, ending of contracts with suppliers or customers, mentioned downsizings or growth (Leseure and Brookes 2004). This stands at odds, for example, with smaller project-focused organisations where originally KM is integrated in human values and collective work-conducts. Besides the risk of over-managing and creating a bureaucracy of knowledge, the key challenges that emerge from the literature is summarised as follows (Leseure and Brookes 2004):

- Collective accretion of a knowledge-base
- Incentives for contribution: Professional culture, personal recognition demand or virtues etc.
- Ownership of knowledge: Structures and rights
- Knowledge life-cycle management: Usefulness development and balance between innovation and stability
- Management of tacit knowledge: Nebulous but important for performance - Experts as bottlenecks or enablers for resolving knowledge laziness

Lack of incentives and absence of suitable IS is still the most significant obstacle for KM in project environments as outlined in recent studies; theorists and practitioners are therefore advised to focus on motivation and adequate PKM tools (Ajmal et al. 2010). While the advantages and importance of PKM are discussed at length in the literature, in a real life setting, the application of PKM continues to face constraints and quality differences in regard to the management of dispersed nature of project knowledge (Ajmal and Koskinen 2008). Nevertheless, in addition to consulting firms companies such as BP and Siemens have set-up initial management for active reflection on content, processes and premises. This aim of which is to foster learning through explicit, tacit, trial-and-error, observing, modelling or socialisation-means with focus on its pre-condition being a constructive and honest atmosphere to capture synergies from projects (Diesterer 2002). As the literature portrays a strong link between KM and overall capabilities, this remains a complex endeavour for projects and their members with varied skill sets that may work together for a limited amount of time, without ever having worked together before (Burns

and Stalker 1991).

Projects were described as complex, flexible, interdisciplinary and innovative, the latter of which received emphasis due to the increasing pressure for projects to be delivered in a shorter period, with little to no (repetitive) defects. Accordingly, as outlined, on the level of other complex management processes like KM, PM has grown into an inclusive practice that has to be ideally integrated into a company's strategy to achieve best utilisation of limited resources as well as customer-satisfaction (Ajmal and Koskinen 2008). Here, it is of utmost importance that companies understand the complexity arising from increasing social and technical links; these are likely to ultimately increase the relative significance of existing knowledge in order to not only cope with this complexity but rather become more effective. Therefore, companies have to ensure to take-in experiences from the routine organisation and previous projects into new ones (Disterer 2002).

Challenges are associated with knowledge accumulation, particularly in projects that tend to be associated with one another. Each project is subject to varying degrees of quality and quantities. This information, therefore, has to be closely noted and managed in order to ensure that it is still applicable to future projects. Furthermore, it is important to manage this throughout the project life-cycle process in synergy with the KM process-steps of creating, administrating, disseminating and utilising (Kasvi et al. 2003). To deal with this, in many industries there is a tendency to increase the usage of project management offices (PMOs), which aim to improve PM performances and prevent runaway projects. PMOs also look to ensure that knowledge gained from previous projects is used again and integrated into PM practices; for example, enhancing the social capital of PMO-staff to improve reflection-practices of employees, within projects (Julian 2008).

PMOs as knowledge-networks are not only concerned with increasing effectiveness of PM via supporting best practices and tools (e.g. for knowledge-acquisitions) but they are also linked with other management areas and units that support the bridging effect (Dai and Wells 2004). Again, this ties into the importance of the discussed social networks and communities of practice and the fact that while certain knowledge may exist without practice other forms of knowledge are deeply dependent on group interaction and sharing (Newell et al. 2006). It is interesting that while companies learn the most within these projects when actively invested in project learning, demands for following projects are out of scope (Disterer 2002). As explained ICT can support to increase the depth and breadth for creating, storing, transferring and applying knowledge and is therefore also used

mainly for PKM.

There is a vast amount of existing literature (e.g. Boh 2007) that discusses the issues associated with KM, with particular focus on complex, exceptional and ambiguous project-based organisations (PBOs). PBOs are regarded as being somewhat different to 'regular' organisations however in recent years this has changed to some degree given that non-PBOs are increasing their application of projects (Ajmal and Koskinen 2008). Besides organisational or methodological topics, root-causes lie within technical and social issues as also focused in the best practice review (Boddie 1987). As Love (2005) rightly states, many of the issues around sub-optimal misplacement after project completions, arise rather from cultural and individual social obstacles instead of technical root-causes. These refer to factors such as motivation or openness and honesty when documenting lessons learnt and dealing with revision of faults. This, in turn, is rarely done effectively, despite the fact that unsuccessful projects have the potential to provide valuable lessons. This, however, is not a standalone issue and instead, is closely linked to the overarching management and leadership (Boddie 1987), given that most project-plans do not allocate sufficient time and resources to this exercise. This is despite the fact that most PM theories foresee even extra work-packages to capture experiences (Ajmal and Koskinen 2008). As previously discussed, technology allows with ease the exchange of explicit knowledge, however barriers emerge as far as the exchange of intrinsic knowledge and new knowledge creation are concerned. As a result of this, success still relies on social and human interactions and an adequate organisational culture that supports the exchange of scattered, unstructured and not coded, inventoried or audited knowledge residing in human resources (Allee 1997).

Accordingly, PKM literature (Gasik 2011) emphasises the importance of awareness for cultures that enable this knowledge transfer and relevance sorting with multidimensional means to question assumptions and promote double-loop learning (Ajmal and Koskinen 2008). Here, the power of understanding and promoting a right culture that can both facilitate and impede knowledge transfer is highlighted. This is because only when the culture is based on enquiry and truth it enables employees' proper reflection on actions, consideration of its problem contributions, recognition for change demand and perception of own roles in a change process (Senge 2006).

As mentioned, social practices and patterns including social networks and capital emerge as a well-recognised influencer as far as KM is concerned. That said, however, they are yet

to be fully resolved in the project context in terms of its trust-based conductivity and connectivity aspects (Brookes et al. 2006). The move to include cognitive codifying and technology-based aspects as well as social concepts around links and potential resources, requires translation into project-contexts (Bresnan et al. 2003). Given the characteristics of projects, in terms of organisation and flow of information, documents and people connected with the one-off nature, Bresnen et al. (2003) also highlight the importance of social processes. These aim at ensuring knowledge dissemination and transfer and consequently, promote a community-based approach to surrogate (in light of difficult to develop steady KM) routines across projects. Their claim is to deploy new explicit management-processes to support organisations' innovative potential and capacity by facilitating knowledge-sharing and cross-project learning. Despite this however, research examining the social constraints associated with project teams remains limited, and the lack of attention paid to this area of research has significantly impacted knowledge relating to project teams and KM (Bresnen et al. 2003). This serves to support the approach of considering existing e-learning practices and topics as key enablers to enhance for example social functions around PKM.

Sharing of values and vision is another vital influencer for effective knowledge creation. The combination of different fields and sub-cultures in project-teams presents a potential threat in regards to unproductivity and misunderstanding. Thus, it is important that PM establishes a culture within the team to promote effective communication and goal-achievement; also in regards to capturing knowledge throughout the project and beyond (Ajmal and Koskinen 2008).

With regards to (project) KM in virtual teams some research has been conducted (e.g. Alavi and Tiwana 2002), most of which argues for a blended approach as the ideal, meaning that knowledge exchange should be supported by both electronic interaction via ICT and more intensive face-to-face engagements (Maznevski and Chudoba 2000). However, in global organisations and their virtual team-environments, often face-to-face meetings are not possible due to resource-, cost- or time-constraints. This renders the blended approach as being unfeasible to some degree, thereby making the case for e-learning stronger, given that e-learning facilitates information and knowledge exchange without the need for physical meetings. An additional stream of thought that emerged from the literature review (Bakker et al. 2011) that supports the potential review of e- learning in the PKM field, is the proposal of a Project Learning Model. This model intends to

systematically repeat workshops and updates of documents to capture hard and soft learning throughout the project life-cycle (Kasvi et al. 2003). Again, however, the importance of motivation and careful definitions of transfer-process and documents including aspects of meta-data, responsibility and adaptability are highlighted.

It is observed from the review of the literature review that a number of schools of thought exist. These range from personal and tacit to explicit and codified theories (while sometimes only believing in the latter or demanding still tacit knowledge for codified input to be valuable) and with solutions ranging from people-based to IS-based set-ups (e.g. Williams 2008, Gasik 2011). It is important that PKM aims at not only aligning the company culture and different team backgrounds with knowledge transfer promotion, but also looks to promote useful methods to warrant that knowledge is captured and shared beyond the project limits (Ajmal and Koskinen 2008). Projects in general are recognised for being knowledge intensive. In keeping with KM theory, again the issue does not wholly relate to the management of knowledge, rather consideration has to be given to communication between persons while considering aspects like personalisation. Thus, project-success relies on an adequate adoption of previously captured knowledge that can only be achieved by adequate learning-efforts beyond single project-scopes in the best interest of sustaining company-success (Diesterer 2002). PM is identified as a prime area in which KM is applicable as it still suffers from the sub-optimal practices and guidance for practices introduced. More publications emerge in both the IS and management domain in regards to PKM (e.g. Leseure and Brookes 2004, Zhao et al. 2015). The comprehensive approach of this study ensures that issues around knowledge application and reuse are considered, for example, the lack of incentives and shared context is on the other side also affecting the absorption of existing knowledge by new projects (Liebowitz and Megbolugbe 2003).

2.5 Knowledge Brokering in Project Environments

In line with PM, KM and PKM, knowledge brokering is also concerned with complexities and social challenges around influencing developments, changing practices and facilitating learning and transactions between entities while remaining still immature and often unplanned or unrecognised (Wenger 1998). Again, knowledge brokering is yet to be sufficiently researched in terms of comprehension, how transactions of knowledge between different locations occur as well as how it can be facilitated. Existing research tended to focus on reviewing the creation of knowledge and its application (Shapin 1998).

Apart from solely transferring and managing knowledge, brokers function as builders of capacity by enabling an increased accessibility of knowledge in forms of connection-agents (Oldham and McLean 1997). In summary, Oldham and McLean (1997) refer to three dimensions related to brokering, namely:

- Creating and building substantive-knowledge
- Employing knowledge-based networks and capacities
- Adapting and developing knowledge

In relation to the defined KM process, knowledge brokering has an equivalent role for every step, linking knowledge creators and users via direct distributing, integrating, and intermediating interfaces (Oldham and McLean 1997). Brokering is already established fully in other fields like the reviewed (e-) learning where brokers act as proactive enablers and catalysts to link networks, people and resources by creating adequate conditions for adding-value (Meyer 2010). The literature review has revealed that the actual knowledge brokering and integration of knowledge into new projects and the permanent organisation remain insufficient and limited as also portrayed in Figure 2.1. This serves to further support the claim of this thesis insomuch that further research is required as far as this important niche is concerned (Williams 2008).

Figure 2.1 Visualisation of project challenge: knowledge dispersion (Fong 2005)

This section reviews the literature relating to knowledge brokering as well as the remaining challenges in the framework of PM and KM and the virtual team environment. Despite the fact that there are papers dating back to the 1990's which discuss brokering knowledge (e.g. Andas et al. 1998, with his "organisational memory approach"), this discipline is fairly new to the science of PM, especially with regards to virtual team work. Nevertheless, the advancement of this discipline are increasingly getting attention and gaining momentum, with more related papers being published in recent years (e.g.

Holzmann 2013). Within a social change framework, brokering is described as consisting of elements like educational systems, ICT, and communication infrastructure as well as the role of media within the community, interactions, communication and maintaining indigenous knowledge plus other cultural aspects (Oldham and McLean 1997). Accordingly, brokering refers to a wide activity range and is generally understood as an individual employed as an intermediary for transactions or negotiations, with different specialisations (Oxford University Press 2014). It is important to understand that brokering is not solely about moving knowledge but also about creating a new kind of more robust locally usable brokered knowledge and also ensuring a comprehensive exploration, identification, gathering, synthesising, redistribution and transformation of knowledge (Meyer 2010). Also, knowledge brokering characteristics diverge substantially in diverse (virtual) environments that are characterised by the differing requirements of individual knowledge-users and related aligning, translating and managing of perspectives and peripheries of different communities of practice (Meyer 2010).

The relevance of knowledge brokering in this thesis' context is strengthened by the publication of Schindler and Eppler (2003); they advocate the installation of project knowledge brokers for assuming responsibility over project-reviews and lessons learnt transfer within and between projects. In link with the introduced PMOs, research for learning across projects also describes the importance of senior management with their broad perspective functioning as brokers, enablers or intermediaries to enable the knowledge-transfer (Newell et al. 2006). Here the establishment of links between communities intensifies the learning potential by brokering between (similar) projects in forms of coordinating, aligning, translating and resolving conflicting interests within and between different communities of practices (Julian 2008).

The importance of knowledge brokering for the facilitation of cross-project knowledge transfer is emphasised because most of the PMO managers apply brokering practices to this means to reach a strong relationship network. This is seen as a key enabler to over-come the portrayed obstacles around lack of time, authorities, staff-retention or culture (Pemsel and Wiewiora 2013). Issues arise for brokering from insufficient authority or legi-timacy for achieving attention and cooperation. This again supports the practices-transfer argument from state-of-the-art e-learning like top management support or set-up of social networks to ultimately leverage the social capital, being the actual and potential resources from a relationship network (Julian 2008). Accordingly, amongst other similar publica-

tions, Ward et al. (2009) discuss the new role of knowledge brokers, which mediate in the process of knowledge transfer between employees and require thorough management support and training. The brokers' objective is the facilitation of knowledge-transfer by linking knowledge possessing individuals or knowledge repositories with individuals who demand it. Also, they may aim at bridging potential gaps or taking part in the actual knowledge creation process (Ward et al. 2009). This can also be achieved by individuals who do not necessarily have to be a part of the project core-team (e.g. by outside specialists or consultants). Another form of transfer is the execution of knowledge brokering between organisational entities as joint cooperation, cooperation with consultants or research-driven organisations, which remains beyond the scope of this study.

In specific industries, different forms of brokering are found, like the Regional Engineering Manager (REM) who is also assigned to facilitate the transfer of project-based knowledge and learning across the company and accordingly the generic demand for the same KM support mechanism remains (Bresnen et al. 2003). In general, a knowledge broker should use the argument that every project can gain from synergy benefits resulting from facilitated communication and information-sharing across individual project scopes (Kasvi et al. 2003). This is also depicted in the definition of Wenger (2000) who describes the function as roamers or boundary spanners. By moving itself between different areas transversal aspects to cross social, organisational, and cognitive borders or topics around interstitially and invisibility arise and require more scientific review (Shinn 2002).

Brokering also links with communication science that reviews communication of groups and individuals and seeks improvements by analysing related contents, participants, transfer-process and channels (Burkhard 2005). The niche of knowledge-communication science is even more linked as it aims at successfully transferring knowledge by looking at the communication-process via both face-to-face and electronic interaction by an "activity of interactively conveying and co-constructing insights, assessments, experiences or skills through verbal and non-verbal means" (Eppler 2004, p. 291).

Brokering should be seen as a necessity to support the knowledge transfer and solve related challenges in the same way as knowledge visualisation strives (Meyer 2009). This means permitting access to the accomplished knowledge from one individual to another one and works as a conceptual bridge to enhance both quality and speed of the transfer. Challenges, thus, arise for example from information overload and the identification of relevant information from stakeholders or consideration of heterogeneous cognitive

backgrounds.

Currently, most research that is available for brokering focuses on developing IT tools (Pemsel and Wiewiora 2013), gaining an understanding of special characteristics of transfer in global projects as well as accompanying social issues that are related with this. This is also fostered by the approach of this PhD study that is aligned with the seminal paper of Holzmann (2013) that identifies three major themes of research:

- Support tools for knowledge brokering
- Brokering knowledge in global projects
- The social aspects of brokering knowledge

Holzmann (2013) found that only a few studies have focused on the matter of virtual global projects, despite the substantial influence of knowledge-transfer under the resulting conditions. Therefore, further research within theme number two (Brokering knowledge in global projects) is conducted in this thesis by also considering social and IS tools (one and three) in link with the explained focus. Consequently, the related best practice research comprehensively focuses on underlying IS principles and theories as well as tools including different channels and media for transferring knowledge that are mainly dominated by software-tools and automated transfer mechanisms (Loew et al. 2007). Again, management and social aspects are also considered. Beyond that but in link to brokering existing improvement tools like the dynamic knowledge map (Woo et al. 2004) or knowledge evaluation maps (Skok and Kaltmanovitch 2005) could not be taken fully into account, as the scope of this thesis does not allow outlining these precisely.

Just as the organisational memory approach that is also only considered but not fully reviewed: this approach is applied for defining existing knowledge and its management processes and has been a trigger for the development of the important project memory concept. This concept describes knowledge from past projects that can be transferred to future projects via the means of project memory systems, to cater comprehensively also for meta-knowledge to explain what happened and why (Kasvi et al. 2003). It is established that brokering is also used in project-contexts, for intervention for troubled projects or ensuring governance. But it is found to be extremely useful for the facilitation of lessons learnt, improvement of common processes across various projects and coordination of knowledge sharing forums and standards or best practices transfer to other teams (Julian 2008), which supports the objective of this thesis. Knowledge brokering is increasingly

required and applied, also in virtual business environments, in order to facilitate developing, transferring and applying practical knowledge on how to accomplish something with whom and why across boundaries and combined with enabling and sustaining linkages (Meyer 2010). It is also important to highlight that not all project outputs are intentional. All this potentially valuable technical, procedural and organisational project-knowledge has to be managed and brokered in light of the organisationally and geographically dispersed background of virtual teams (Kasvi et al. 2003). In summary, knowledge brokers play a crucial part in project knowledge transfer by coordinating and connecting tangible and potential knowledge sources with other demanding parts of the organisation by cooperating with individuals, communities and organisational set-ups (Gasik 2011). As emphasised in theory, knowledge and learning are interweaved, and as learning is creating new knowledge, knowledge influences future learning (Scarbrough et al. 2004). In this context, prospective learning targets knowledge-transfer from past to future projects and retrospective learning aims at identification, review and generation of past projects' knowledge via processes and methods. Accordingly, prospective and retrospective collective brokering processes will support companies to learn from projects and integrate new process knowledge into the routines of the permanent organisation that will also improve future projects (Julian 2008). This link confirms again the validity of the intended best practices application from e-learning for (P)KM.

2.5.1 Brokerage-Structural Holes

In relation to the discussed knowledge brokering process, especially in the focused virtual project environments, it is important to also analyse and integrate studies of core managerial brokerage-structural holes. In general these are related to the connections of organisations and social networks and consequentially social network research in which there are many methods, theoretical debates and suggestions for future research (Kilduff and Tsai 2003). Providing a comprehensive poststructuralist overview of this area, Kilduff and Tsai (2003) offer a critical review of the status quo and future potentials of this relatively new field, highlighting the importance of the often neglected interpersonal aspects of informal company networks and suggesting a greater focus on the individual (broker) in order to link agency and structure.

With an emergent acceptance of the social network perspective, the organisational network research also discusses the increased focus on (social) relations of individuals and the

embeddedness of exchange in those relations of results that are relevant for individuals, teams and companies (Kilduff and Brass 2010). In addition to these core terms and issues, progressive debates circulate around boundaries, cooperation, competition, cognition, individual and agency characteristics, and the dyadic relationships that are found in complex connections (Kilduff and Brass 2010).

In general, this evolving discipline necessitates new research with a special focus on individual development and learning (Kilduff and Tsai 2003), thus supporting the approach of this PhD.

The precise review of the literature on brokerage-structural holes shows opposing opinions on how networks actually create social capital, with structural hole theorists, who depict solid connections as rigid sources hindering corporate task execution and argue against network closure theorists who highlight the importance of these connections for enhancing cooperation (Gargiulo and Benassi 2000). This leads to different recommendations on the richness of structural holes and network structure. This relates especially to required agility which necessitates a trade-off evaluation between flexibility and safety of the cooperation network (Gargiulo and Benassi 2000).

Current work on the social capital of structural holes discusses the social capital metaphor and associated network mechanisms (besides contagion, closure and prominence) as well as evidence of returns of the brokerage across structural holes (Burt 2001). This generally supports the value-add idea of (knowledge) brokering as in this thesis. Reviewing various sources of empirical evidence, the individual and group benefit is consistently described as resulting from increased learning, creativity and (project) team effectiveness thereby delivering more innovative results where brokering supports strong ties that bridge structural holes (Burt 2001).

Psychological dimensions of this area cannot be discussed extensively within the scope of this thesis and also remain underexplored in related studies, although general interest in (social) network brokering is increasing (Oh and Kilduff 2008). Studies promote the benefits of orienting towards (highly) self-monitoring individuals who enable ties between unconnected social communities and work as direct and indirect brokers who adapt to the groups' needs (Oh and Kilduff 2008). The general focus on individuals and their actions supports the approach of this thesis. This is also supported in most studies of brokerage-structural holes and related network research that strives to enhance knowledge and

learning processes in (virtual) organisational set-ups and understanding of their cognitive groundings (Ibarra et al. 2005). Outstanding studies position this for example with identity emergence or dilemmas and trade-offs connected with decisions of individuals and their implications for the network connections and processes (Ibarra et al. 2005). The relevance of this attention is furthermore sustained by the proven connections of structural hole mechanisms on managerial performance (Rodan 2010). Recent publications are also studying the exact reasoning and mechanisms that enhance performance, by highlighting especially the importance of innovativeness besides the focused knowledge brokering, competition, autonomy and recognition of opportunities (Rodan 2010). The last of these, recognition-based performance, is investigated accordingly with focus on the dynamics that influence individuals and their motivation to contribute with knowledge in increasingly open content communities (Okoli and Oh 2007), similar to those of the reviewed virtual project teams, where also recognition is defined as a best practice potential to enhance the current issues. Here Okoli and Oh (2007) identify structural holes as a social capital source and the mentioned network closure that is signposted by indirect and direct connections shows positive effects. In relation to these incentives, the literature highlights the potential for exchange between groups of, for example, good existing ideas for alternative thinking and ways of working (Burt 2004). This matches with the research objectives of this thesis. In this connection the social network approach can be considered as a competing leadership explanation, having to consider both human and social capital, for which the management has to be active in establishing connections and generating return from them (Brass and Krackhardt 1999).

In modern network organisations that are forced to effectively identify and yield knowledge, a skilful mix of IS and social capital is increasingly important, especially in uncertain and rapidly changing environments that demand agility in terms of managing jointly strong and weak network ties (Brass and Krackhardt 1999). In positioning the discussed networks with mobility in companies, Podolny and Baron (1997) confirm that the employee's mobility and knowledge processing performance is improved via informally tied networks, where the management should observe the interaction of content and structure, while following typology recommendations of content of the network connections in their companies. By highlighting also precise constraints, this important piece of research explains how informal ties influence enhancements and that the structure of social set-ups in companies also determines overall performance (Podolny and Baron

1997).

Advanced modern theoretical research from the field evaluates the origins of network structures and structural holes and develops a framework explaining that the networked structures actually develop from a productive interaction of network opportunities and structural constraints (Zaheer and Soda 2009). Depicting how to overcome the often historic reasons for issues with structural holes, Zaheer and Soda (2009) show how a proactive and homogenous management enhances team performance.

The literature on brokerage-structural holes stands in close relation to this PhD in general and the e-learning best practice sources precisely like governance, marketing, brokerage or cultural dimensions. A relevant example is "Gatekeeper search and selection strategies; Relational and network governance in a cultural market", that systematically studies the role of gatekeepers and how they broker creative knowledge within (social) networks, based on network governance theory (Foster et al. 2011).

2.6 Virtual Project Team-Work

Normally dispersed knowledge should enable teams to work systematically, when it is optimally integrated via routines, directions or even self-contained task-teams, which is preferred to transfer-driven set-ups that are more ineffective (Alavi and Tiwana 2002). However, this ideal approach is challenged by the increasing occurrence of specially characterised virtual project-teams that are required due to globalisation. More specifically, various constraints such as travel-cost reductions, preferences of employees or the request to combine dispersed experts have resulted in the formation of virtual teams (Boutellier et al. 1998). Virtual team environments are set-up of individual members that work together across time, space and organisational barriers to accomplish projects with communication via IS (Maznevski and Chudoba 2000). Scarbrough et al. (2004) correctly outline that KM and learning are impacted by organisational nuances such as autonomies of project teams and ties between them and business units, socialisation, specialisation, as well as batching of projects and co-location, which are getting further complicated in virtual environments. The literature review of KM and PKM has constituted that there is not sufficient research in regards to these complex virtual project set-ups that often impede trusting teamwork and easy context-enriched interpersonal exchanges. This again supports the rationale of this new research. Research on virtual teams in the context of KM outlines four precise challenges arising for integrating knowledge in virtual environments (Alavi and Tiwana 2002):

- Restraining trans-active memory that normally allows individuals to group tacit knowledge to solve common project-tasks due to physical distance and required IS-mediated collaboration and absence of antecedent history paired with the usual diversity of project-members.
- Insufficiencies of mutual understanding due to difficulty to interrelate knowledge of individuals with the absence of non- or para-verbal hints.
- Failure to transfer and retain contextual-knowledge that is in non-dispersed teams done via joint experiences or direct observations. But its issues including misunderstandings arise in virtual contexts from aspects along culture, climate, access to IS or physical set-ups and competition of work requirements.
- Inflexible and weak organisational links due to infrequent and distant collaborations are not conducive to sharing of knowledge. An improvement of this primarily relies on ICT that has to cater for trust and informal, regular and rich exchange including reciprocity.

This approach views companies as distributed knowledge systems, with KM being at the core of this system; a system which facilitates a context for the tacit know-how of individual members to be combined to provide knowledge on the group level. This should improve sense-making, interpretation and responsiveness but is complicated in virtual set-ups (De Boer et al. 1999). Overall, temporary and small-scale virtual teams set-up across organisational structures and combined with its discontinuity-aspect have to be rightly taken into the development of PKM solutions. This is due to its increasing prevalence, as well as to maintain reciprocity, trust and other social aspects that support co-located teamwork and knowledge exchange within virtual environments (Alavi and Tiwana 2002). Overall, it becomes increasingly important to support PKM and brokering around the value creation in virtual environments, which is changing KM realities in line with the teased paradigm-shift within traditional PM. In global multi-national enterprises with an incline of virtual team-environments the physical face-to-face meetings are not possible due to resource, cost or time constraints. As such, e-learning is brought into the scope as it succeeds mostly without physical meetings and supports technical and social features as described in the following chapters.

2.7 Potential Best Practice from Modern E-Learning Management

After having reviewed the persisting challenges and gaps between reality and desired

status of knowledge brokering as well as the wider scope of PM and KM, the following section identifies potential e-learning practices that could become priority elements of the final recommendation based on the later identified best practices. This considers hard, technical and soft human or management factors in order to improve the situation from a generic point of view. Although modern research of PKM distilled the pre-discussed key factors and proposals such as allocations into absorptive capacities, social networks and management of relationships, evaluation of usefulness knowledge governance, customised skill training, motivation and evaluation, there is still a huge demand for improvements within the field (Zhao et al. 2015). Therefore, looking outward into another interrelated but more advanced discipline such as e-learning via a best practices application is useful. In general, best practice is defined as professional or commercial procedures that are prescribed and accepted due to their correctness or highest effectiveness (Oxford University Press 2014).

In terms of knowledge bases and management, best practice is normally identified via benchmarking efforts in order to identify the most effective and efficient way of application. The literature identifies mainly consulting companies as well as technological, automotive and aerospace companies as being the leaders (O'leary 1998). Given the general target conflict between insulated short-term projects and long-term learning in the regular organisation, it does not necessarily offer obvious opportunities for best practice transfer. However, in light of the respective argument, which is supported by the Delphi study, this is a highly potential approach, as, for example, with the "push" principle for dissemination of information in e-learning (Williams 2008). Likewise, Williams (2008) also emphasises the importance for successful learning in project environments being the reviewed elements of knowledge management, such as systematic procedures and roles. E-learning carries a lot of potential by its usage of socialisation methods and communities of practice. This could support the least successful aspect of PKM, which is the knowledge transfer from projects into the organisation and into new projects (Williams 2008).

A basic understanding of e-learning and related concepts is provided in the definition chapter. Alongside the best practice review, the following section further evaluates related methods and theories of e-learning, based on which a comprehensive introduction of e-learning is provided, including the predominant technologies. E-learning succeeds in improving complicated social challenges and cultural issues with its varying components outlined in the best practices overview. The literature review argues for the research to be

carried out followed by the explanation and inter-dependencies being justified what is initially covered with the literature review. Due to the gaps and limitations demonstrated by the literature review, each depicted and potential e-learning practice is chosen intentionally to add potential improvements to these discussed issues in PKM and knowledge brokering. This approach is also supported by the literature in question; it is asserted that e-learning deals with comparable issues and solutions. This therefore allows for solutions that emerge from this domain to be transferable to both PKM and KM areas which require attention.

For example, overall conceptual processes of KM and brokering, where a receiving party has to understand information that has been fed to them from another source, should be considered to be a learning process. Thus, it becomes apparent that reviewing and applying findings from learning psychologists and educationalists will help in the development of better understanding and insight into the research domain, as well as possibly improve the issues outlined. As discussed, there is a strong need to improve as the persistent lack of a thorough KMS and supportive culture for KM in transient and virtual project environments inevitably leads to destroying and impairing organisational knowledge and learning (Kotnour 2000).

Remarkably, processes, which directly aim at a knowledge extension via acquisition and creation, are labelled as learning processes. This is brought forward in the simplification of Gasik (2011) that combines under the term knowledge-distribution processes the focused acquisition, identification, documentation, transfer and sharing.

The selected e-learning practices that have thus far been identified have not only been identified through extensive review of the literature and research field, but have also been defined by the author's own personal experience. It is also a result of claims from current related PM and KM literature that supports the consideration of the selected issues such as governance, which is becoming increasingly important in that context (Zhao et al. 2015). There is an improvement from previous quantitative studies that show that only 80% of R&D companies review projects after its completion and the other 20% conduct the review informally. However, even today, major discrepancies continue to exist between PKM demands versus actual deployment. Dissatisfying results remain that illustrate the requirement for new solutions that are anticipated from cross-divisional best practice reviews as conducted in this study (Zedtwitz 2003).

Given the quick development of digital technology and the internet, the World Wide Web

has turned into an economic, democratic, powerful, dynamic, interactive and global medium for distance teaching and learning. This provides an opportunity for promoting learner-centric instructions and training, with learning on demand (Khan 1997). E-learning has created solutions dealing with open, flexible and distributed learning environments and therefore fits itself to the PKM of global virtual teams. Openness in an e-learning context is defined as learning that occurs in the learner's own and actively influenced and defined pace, place and time (Calder and McCollum 1998). Away from traditional closed systems that were limited to the ideas available in one constrained space, e-learning's flexibility extends boundaries by relying on openness of systems and availability of learning resources spread across multiple sites (Khan 2010).

KMS should ideally, for example, facilitate the sharing of lessons learnt and best practice documents. It is outlined within the following discussion of recognised e-learning topics that e-learning IS solutions have, for example, already developed into suitable facilitators for such exchange activities. E-learning's different aspects will, therefore, be examined in the Delphi study as a potential solution for improvement of PKM and brokering in virtual teams. As such, the thesis supports closing the obvious gap in knowledge brokering in virtual teams with the help of best practice from this other area (e-learning) in order to contribute to the improvement of it via the transfer of evaluated best practices. In line with the overall strategy of this thesis and as outlined in the introduction, there will not be a heavy reliance on the technology details of tools. As it is also argued, for example, within the reviewed Web 2.0 literature, the relevance of these context providing and supportive platforms shall not be overrated and the emphasis lies on the knowledgeable individuals and related processes (Palacios-Marques 2013).

An interesting aspect of e-learning is the focus on learning and the learner as the most important entity. This is connected to the fact that resources required for learning are provided effectively via an on-demand designed distributed learning set-up to the learner in order for him to explore and master the tasks (Banathy 1991). Beyond the focus on the learner, e-learning theory also promotes a holistic paradigm shift that focuses on a necessity of the system to become powerful for all involved stakeholders, by being for example; organised, easy accessible, or efficient (Khan 2010). In that sense, the high level of participation, ROI and overall successes of modern e-learning comprises of a systematic process of preparation, design, assessment and execution of e-learning environments (Khan 2010). These factors actively strive towards learning support and fostering, which

again could be highly valuable to PKM and brokering. Another advantage of continued research in the area of IT that is captured by e-learning is the promotion of flexible and open applications that can be used as modular solutions, which is emphasised in line with the claim of Sigala (2007). Increased competition, combined with the described enhancements, has also led to decreased and insignificant costs. This cements the fact that earlier e-learning theories which rate e-learning projects through cost-efficiency ratio as obsolete (Piskurich 2006).

As already discussed, what is learned by projects is mainly context dependent, transient, tacit, and intangible and therefore, difficult to scale, asses, and make explicit and understandable in other contexts. Therefore, this research approaches e-learning as another related discipline for support as these project qualities remain challenging to be integrated into organisational norms and systems (Bresnen et al. 2003). From its characteristics e-learning is similar to the focused and likewise expanding demand for PKM of virtual teams. That is due to the fact that the involved parties also do not meet physically and rely on strong support systems as well as being concerned with the overall management of diversity, complexity and uniqueness of every new initiative and conflict situation (Khan 2010). Thus, of course also e-learning encounters (similar) challenges, for example, an increased openness of a designed system automatically also increases the complexities of planning, management and evaluation (Land & Hannafin 1996). E-learning theory is relatively new and evolving and different terminologies like internet-based training, mobile or off-site learning do exist. Yet the overall solutions available are perceived as being well-advanced and well adapting to environmental changes and are therefore selected for the best practices application. Related literature presents an eight dimensional framework consisting of the key determinants of successful global e-learning that are as in PKM highly interrelated (Khan 2010):

- **Institutional**: Administration and service
- **Management**: Maintenance and distribution
- **Technological**: Infrastructure planning, hardware and software
- **Pedagogical**: Teaching and learning: Review of content, audience, target, design, organisation and strategy
- **Ethical**: Social, legal and political influence, bias, diversity of learners, geographies and cultures

- **Interface-design**: Look and feel, site and content design, navigation, usability and accessibility
- **Resource-support**: Online assistance
- **Evaluation:** Assessment of learners, environments and instructions

Of course, this framework is not able to capture all existing or evolving issues of modern e-learning, but it serves well for identification of potential micro issues if every involved stakeholder is taken into the centre of its examination alongside the eight outlined dimensions (Garrison 2011). It has to be also noted that not all aspects are relevant for every project but on a macro level, it could even support the overall theory development (Khan 2010). Inspired and guided by personal experience, an extensive literature review and the two conceptual frameworks which have been demonstrated, that of e-learning and the theory developed by this thesis, the following 25 distinctive characteristics and areas of modern e-learning have been identified. In terms of feasibility and relevance they will be reviewed for their potential application for an improvement of the issues of PKM in virtual project teams by being reviewed by the experts of the Delphi panel. These aspects are structured under the following four consistent headlines:

1. IS SET-UP
2. IS-RELATED TRENDS AND POTENTIALS
3. IS-RELATED RISKS
4. MANAGEMENT THEORY, MODELS AND MANAGEMENT OF SOCIAL ASPECTS

This is in keeping with Liebowitz and Yan (2004) and their development of a knowledge sharing effectiveness inventory that not only inspired the content but also the structure of this study as it also consisted of 25 proposals divided into four main sections. As outlined before, KM is likewise consisting of four interdependent areas (technology, culture, process and content). These will be covered by the review of recent e-learning practices by considering (e.g. technological) limitations of KM and the fact that KM can only become effective by being connected with corresponding changes of the organisation and culture (Davenport and Prusak 2000). This structure of four parts is considering the elements of the “Leavitt diamond” with its four edges (tasks, structure, people and technology). Although the headings are named and accordingly sub-topics are grouped differently; concerned aspects are also covered and most importantly - as in Leavitt’s model - all edges seem to be related (Leavitt 1965).

The complexities of knowledge brokering across virtual project-teams remain a challenge. This is outlined in contemporary research that explicitly requests the path of this PhD study to apply multi-dimensional approaches for improvements, ensuring a holistic complementing and balanced combination of first and second generation KM (Zhao et al. 2015). Although the scope of this thesis did not allow for a thorough literature review of OL, it is emphasised that the 25 potential best practices from e-learning accordingly also cover the generally described four catalysts for OL, these being resources, environment, strategy and the organisational platform (Bapuji and Crossan 2004). As the organisational structure is crucial for knowledge transfer and learning, this factor is also considered across the e-learning practices analysis, along with hierarchical aspects.

The following literature review presents that various models, modern solutions and trends (e.g. Web 2.0 and Virtual Learning Transfer) from e-learning show potential for its re-application in PKM (Garrison 2011). An example is the persisting usage of the sometimes-criticised Technology Acceptance Model and the possibility of predicting adoption of innovative technologies (Liu et al. 2009, Davis 1989). Furthermore, e-learning has a better understanding of success factors regarding its solutions, such as structured data that can be transferred to different software systems (cf. SCORM = Sharable Content Objective Reference Model). Another example is the usage of meta-data and managed content, which includes information, communication, learning and material catering for areas for interaction and exchange (Wiley 2002). This source presents these important theories and models in detail and relates them to learning objects, which will also be reviewed in detail in one of the 25 following sections. According to Palacios-Marques et al. (2013), the right framework assures knowledge transfer. Therefore, for successful transmission of competences and knowledge, the key of modern e-learning concepts are obviously also being self-motivational, allowing participation and feedback from users, and being applicable to real business problems. In line with this, Wiley (2002) has pinpointed minimum requirements for modern e-learning platforms. This three-step path consists of:

1. Formative frame: Design of the used platform
2. Training content: Training-material itself
3. Training agents: Users

These stages show in general, similarities and applicability to knowledge brokering in virtual teams. However, each sub-element of these has to be individually reviewed, prioritised and proven within the course of the aimed study. In this modern context,

information transfer models have to be still distinguished from learning models that often resemble tutorials. Bork (1999) describes the latter form as traditionally having strong interaction between both entities but the expert limits himself to orientation and guidance on how to communicate and access information. The information transfer model, however, aims at knowledge retention by the use of technologies and does not refer to problem solutions or application of knowledge to future problems. Consequently, the resulted portfolio of models and theories proves that there are different understandings of the main imperatives that influence accomplishments within e-learning, including factors such as design, ease of use or usefulness, or knowledge transfer from team cooperation. However, research in this area is still proceeding and continuously reveals new explanations and introduces new initiatives, which will be discussed at various stages in the review of the current e-learning topics (Holsapple and Lee-Post 2006). Furthermore, it is already known for example, that team cooperation also plays an important role in e-learning like in virtual project work, which will be a proving factor of the results of the Delphi study likely, which will likely indicate the same (Arbaugh and Benbunan-Finch 2006). This example links once again with the transfer of best practices from supporting systems and processes via the different actors and their responsibilities, which are also reviewed.

Again, the overall hypothesis is based on the assumption that if the right infrastructure and environment is developed, knowledge brokering can be successful in virtual project teams. In terms of identifying and applying potential best practices from e-learning, this could potentially be the case if similarities occur. The knowledge broker should, for example, copy the skills and behaviours of an e-learning manager. On the other side, users of previous projects' knowledge should behave in the same way as learning individuals. This is at this stage based on the assumptions gathered from the review of the literature, and is subject to the final validation of the expert panel from the Delphi study. It is known to the author of this study that e-learning and KM (to which knowledge brokering belongs) are already closely linked and that capabilities of KM are even a key requirement for success of e-learning concepts (Chen and Hsiang 2007).

There is a belief in PKM literature surrounding limitations of efforts in focusing on capturing and codification of project knowledge and learning via IS. However, there are relevant and potential aspects in the IS element of e-learning that supports the social dynamics and dissemination of knowledge in virtual environments. Therefore, IS features receive a considerable amount of best practices proposals, as they potentially surrogate

social aspects from traditional project teamwork. The literature presents proof for the relevance of the e-learning best practices application for KM in general. Research already exists that supports the argument that e-learning itself could even be a potential valuable tool for general KM. Accordingly, an e-learning process framework is developed that describes aspects to be reviewed in e-learning implementations before an online launch as well as essentials of effective online training (Wild et al. 2002). This fits well with the earlier explained issues that companies have internalised that training is a necessity and that knowledge is an asset creating value when it is shared. For that, e-learning, as a knowledge exchange via online means, can provide access to knowledge and accordingly presents similarities to basic KM processes (Wild et al. 2002). If Wild et al.'s (2002) thought process is followed further, in essence, KM and e-learning are both concerned with the four essential steps of generating, storing, distributing and applying knowledge. Arguably, e-learning can be seen even as just-in-time learning that is allowing knowledge to be acquired, passed on and applied to issues as well as stored for future usage. This is not the same approach as in this thesis. Nevertheless, it supports the evident potential of ICT to facilitate KM via e-learning, in terms of creating and distributing knowledge via online supply of training, education and related communication and information. In this context the knowledge chain is introduced, that is also facilitated by ICT and consists of the following four process-steps (Wild et al. 2002):

1. Determination of strategic KM requirements
2. Determination of knowledge gap
3. Closing of knowledge gap
4. Dissemination and application of knowledge acquired

In keeping with this, the literature describes an e-learning value chain as a framework for employment of e-learning as a tool for generic KM. This consists of planning process steps that can be connected with the KM value chain as the first step is linked with numbers one and two of the KM value chain and the following three steps are connected with the third and fourth step of the KM value chain (Wild et al. 2002):

1. Assessment and preparation of organisational readiness: Factors to be considered before going online

- Infrastructure: Tools (content) to channel knowledge and accomplish vital KM processes efficiently with knowledge services like best practices databases, skill-maps or analytical tools
- Knowledge editor: Managing the distinction and fusion of knowledge and KM into e-learning and vice versa
- Organisational culture: Procedures to highlight advantages of shift from hoarding to sharing
- Employee attitude: Procedures to form human-networks and eradicate obstacles between individuals that possess knowledge and others who require it
- Knowledge needs: Determination of gaps via mapped requirements
- Computer usage: Literacy of staff
- Technology requirements: Support of multimedia, ISPs and bandwidth

2. Determination and design of appropriate content: Ties with strategic KM target-requirements and is guided by explicit and tacit knowledge requirements to ensure capturing and disseminating of crucial knowledge via multimedia

3. Determination and design of appropriate presentation modes: Characteristics of traditional learning that should be integrated with factors for effective e-learning

- Engagement of learners + interactivity to build on information
- Development of cognitive skills + repetition and practice for engaging and challenging via case-studies and simulations etc.
- Usage of learners' previous experience + selection of alternative presentation styles
- Usage of actual problems + relevant and practical content aimed at objectives and integration
- Encouragement of cooperation + accuracy and timeliness of information that is measured

4. Implementation of e-learning: Technology, infrastructure and content considerations

- Proper planning, provision and maintenance for a ready network: Response-time, live video-multicasts, local caching and security
- Content application software and tools: Designing, developing and managing interactive and integrated online courses and other components

- Learning map: Link of KM targets with knowledge acquisition requirements to measure success of e-learning via identification of targets, creation of structure, adaptation of information into publishable notations, digitalisation of information material, analysis of content and structure and development of feedback and assessment tools

This illustrates what is essential for e-learning to grow into an effective general KM tool, including aspects from content and social structures. Although the authors highlight that challenges faced by KM are similar to those of e-learning around investments, infrastructure, paradigm shifts and strategic concerns, actually the advantages of e-learning can potentially strengthen and complement KM initiatives. This is reflected in the statement that e-learning's importance resides in the incorporation of traditional education pedagogy combined with benefits of ICT for capturing, transferring and sharing knowledge (Wild et al. 2002). In that sense, the publication highlights the necessity of suitable solutions for KM and also potentially PKM. This stands in light of increasing urgencies for companies to manage their knowledge. By linking this with the potential of e-learning it is a promising tool that does, however, still require careful consideration for planning and implementation.

Several trends are captured and developed in e-learning and reviewed below. Yet the state-of-the art situation of e-learning is most visible as it is even more advanced than what is required for targeted PKM for virtual teams like training and sharing of knowledge with external stakeholders. One additional factor that supports the relevance of e-learning working in tandem with KM or PKM is that e-learning's feasibility and importance for KM is not only reviewed in theory but also in practice, as proven by the company Cisco that has integrated e-learning as a vital part of its KM strategy (Cisco 2014). To ensure the continuation of coverage of both angles, this combination will also be followed in the Delphi study that will consist of experts coming from both academic and practitioner backgrounds.

Overall, the potential of e-learning is numerous and deriving for example, from high flexibility, faster learning curves, easy access and less costs that fit well with modern company requirements. Therefore, the author trusts in the potential of also supporting the even more complex and previously described challenges of global PKM in virtual team environments (Hicks 2000). All 25 aspects are reviewed in the following chapters, by initially providing understanding of the particular area via selected background literature

whenever required, followed by the explanation of each state-of-the art e-learning aspect. This, in turn, develops individual summarising proposals for the Delphi study participants to assess if and how the related aspect could support PKM and brokering of virtual teams. Again, the existing focus and limitations in related management practices have led to the proposed solution, which bases itself on substantial literature review of e-learning and personal experience of the author. This resulted in the 25 identified potential best practices, which are analysed by the Delphi panel to identify most important and feasible elements to be transferred and applied for PKM and brokering in virtual project teams. This is considered a pragmatic application of theory for which P(K)M theory still has a gap, by, for example, not focusing on the development of practitioner capabilities in regards to reflection and the focus that people are delivering the results rather than the tools or concepts (Winter et al. 2006c). The available literature presents multiple models that describe how successful e-learning can be achieved or measured. In the following paragraph, core-models and principles, as well as recent trends and risks will be summarised by splitting it into IS and management related sections. Again, these cover holistically all six crucial dimensions of (e-)learning concepts that are in existence according to Khan (2001):

1. Pedagogic (Basics: Learner and Teacher)
2. Technology
3. Interaction and Interface
4. Assessment
5. Assistance
6. Ethics

In terms of the way the literature is covered, some of the following introduction sections rely heavily on one or two major publications, which is not ideal for a comprehensive literature review. However, in this case for the solitary purpose of introducing the underlying concepts to the reader and gaining sufficient background understanding it is deemed adequate as to also limit the quantity. It could be argued that in some of the following sections of e-learning practices review chapters, either PM or KM is already advanced or starting to progress, like with Knowledge Visualisation, which focuses on supporting the cognitive process for creating and transferring knowledge with the power of visual formats (Meyer 2009). Still, these advancements fail to adapt to or reach PKM and brokering practice, especially in virtual global teams. Therefore all these e-learning aspects

are selected with careful consideration. This is done in order to present the Delphi expert(s) with a comprehensive list of potential improvements for these persisting gaps in the field of global team project environments and the management of knowledge. Ultimately, companies have to understand that tacit knowledge is the access to what customers pay for and accordingly what KM and e-learning solutions should aim at supplying (Frey 2001). Despite being grouped into the four described linked categories, the following literature sections are intentionally displayed as distinctively stand-alone, that will allow an individual and unbiased analysis of the experts for each item.

2.8 25 Potential Best Practices of Modern E-Learning Management

2.8.1 IS Set-up

2.8.1.1 State-Of-The-Art Information Systems

In their article, "Impact of Information-Systems on Organizations and Markets", Gurbaxani and Whang (1991) develop an economic understanding of how IS affects key measures of organisational structures. The two major attributes are company size and allocation of decision-making authority among the various actors in an organisation (Gurbaxani and Whang 1991). The authors base their studies on the following two relevant theories:

- **Agency theory:** this suggests agency relationship models for companies, based on various contracts between the employees, who become so-called self-interest agents. This is in contrast to traditional approaches that consider a company as a united identity, which targets the maximisation of profits.
- **Transaction cost economics:** opposing traditional theory, this acknowledges that the markets and their operations are not free of costs. As an alternative direction - for this theory and the investigation of economic transactions - it is necessary to evaluate these costs.

The article rightly emphasises that these two theories ease the progress of the associations between the attributes of a company and the related information costs that are composed of acquisition, storage, processing, and the dissemination of information. The authors interestingly describe the general downward trend of rights of decision-making within the hierarchical pyramids of organisations. This consequently triggers that the cost of transferring information upwards declines whereas agency cost rises as a result of target

discrepancies. Current IT can achieve a more centralised managing, which results in the reduction of the cost of sharing information by optimising the speed and quality of the processing of information, thus relating to organisational decision-making (Gurbaxani and Whang 1991). Furthermore, the article states that by improving supervision functions and performance appraisal systems, modern IT also prompts a decentralisation of decision-making, which enables senior management to actually diminish agency costs. Finally, by shifting the company's underlying cost organisation, IT may also have a direct effect on the optimal size of the company. As the size of a company is normally derived from a balance between operational, internal and external coordination-costs, efficient and cost-optimised IT may reduce the latter, as IT:

- Automatically reduces external coordination costs which results in an increased usage of markets
- Reduces internal coordination costs as it endows top-management with the capability of managing large-scale companies very effectively (Gurbaxani and Whang 1991).

This is in reference to the image of companies consisting of nodes of contracts between self-concerned employees, agency costs and the monitoring, bonding and residual costs that result in disagreements between the goals of the employer and those of the employed agents (Gurbaxani and Whang 1991). According to the presented theory, companies survive this state only through direct observation, (semi) efficient contracts that include compensation, and also because external labour markets, substitution contests, and buyout activities discipline executives (Gurbaxani and Whang 1991). Furthermore, the authors highlight that monitoring functions of institutions support the reduction of agency costs. Corporate cultures and norms that develop within a company further influence the moderation of agency related problems.

Regarding decision rights on companies, it is rightly emphasised by the authors that the workforce has better local access to information. But if decision-making takes place by the senior management, it creates a demand for information processing upwards in the hierarchical pyramid. This leads to costs of communication, miscommunication and opportunity costs. Decision-information costs consist of information-processing costs (communication/documentation) and opportunity costs derived from poor information. It is obvious that these costs increase when a decision-right is shifted upward in this hierarchy. It is frequently recorded that decentralised decision-making results in a decline of

decision-information costs but an increase of agency-costs. Centralised decision-making, however, results in an incline of decision-information costs and a decline of agency-costs (Gurbaxani and Whang 1991). It is also important to highlight that the extent of the described trends - especially referring to the location of decision-making rights - is not definitive and is also influenced by other factors related to the company itself, along with its environment like roles of ISs, specialities of flows, or information as well as corporate culture (Gurbaxani and Whang 1991). Also relevant for the PhD thesis, the authors present interesting classifications for transaction costs: operational search and communication costs can be decreased with the help of IS as it simplifies close intra and inter-company connections with its information sharing and mutual monitoring features. IS can also reduce transaction costs by offering cost-efficient features for reaching relevant information and processing transactions (Gurbaxani and Whang 1991). The authors correctly emphasise that informational economies of scale also exist; as the management is facilitated, more efficient IS systems are applied in the company. In addition to this, it is necessary to understand the roles of IS in a company (Gurbaxani and Whang 1991):

- **Operations:** IT promotes mass-production, resulting economies of scale, flexibility, and decreased costs in manufacturing a multifaceted product or service line (direct impact on productivity).
- **Transaction processing:** IT simplifies the creation of value-added partnerships and the reviews of advantages by a variety of inter-company sharing of information.
- **Monitoring/performance evaluation:** IT is an effective instrument for supervising and recording performance actions of the company's agents.
- **Communication/documentation:** IT enables the maintenance of a company's memory and related communication through the creation of databases, as various business units may synchronise actions.
- **Decision support:** IT systems reduce decision-information costs since management can easily retrieve and analyse information; it is also endowed with powerful simulating or forecasting tools.

In addition to Gurbaxani and Whang's (1991) influential article on ISs, the following article by Petter et al. (2012) is reviewed and reflected upon in this chapter to further underpin the understanding of IS in this thesis. "The Past, Present, and Future of "IS Success", by Petter et al. (2012), presents the overall argument that companies should widen their per-

spective of the usefulness of IS and observe it from the customer and stake-holder's standpoint. Profiting from various research on the evaluation of IS's success, the target of the company should be a successful ROI on IS that can still be measured by basic items such as information/system quality and usage/output (Petter et al. 2012). The major part of the publication deals with the explanation of the changing nature of IS success within distinctive eras since the 1950s, which is not discussed entirely in the scope of this thesis and only some examples are outlined to explain the development of the importance of IS and related information. Therefore the following section shortly summarises only the four most relevant development eras (Petter et al. 2012):

- **Management Reporting and Decision Support Era (1960s – 1980s):** the inability of the management to handle the quantity of information resulted in poor decision-making.
- **Strategic and Personal Computing Era (1980s – 1990s):** questions arose if IS serves to ease employees' needs; the user information satisfaction concept (UIS) was developed.
- **Enterprise System and Networking Era (1990s – 2000s):** it became easier to collaborate and share information between connected employee teams and single applications, which led to network information. New means like ERP or social interactions of employees brought new benefits. These were sometimes difficult to assess and led to the question if systems supported the user or the other way around.
- **Customer Focused Era (2000s and Beyond):** this era continued with a sophistication of IT and customisations, including the emergence of the social impact of IS as information was also used by employees for personal issues. Accordingly, assessment of success of IS solutions became more complex, considering also factors like ease of use, business target support, usefulness and enjoyment. The latter meant a totally new aspect of IS success.

The second part of Petter et al.'s (2012) article is also relevant as it deals with the current situation of IS assessment. This assessment is mostly input and process-orientated and rather project-based. Mainly conducted are cost-benefit reviews (Petter et al. 2012). Surprisingly, the majority of IS assessments described in the article still focus on technical topics instead of social impacts (value delivery). The target of IS success measurement should be to consider strategic company objectives, application of suitable measurement tools, and

the capability of providing feedback and results back to the company, which then connects with the theory of organisational learning (Petter et al. 2012). Furthermore, the authors emphasise that companies still often do not consider adequate user impacts on the roles of employees, or most importantly, its customers - when assessing IS success.

As a final step, the authors conclude that broadening internal-orientated views to fully understand the significance of information in the future is necessary, which supports the research of this thesis. Relevance will become key and systems will be needed to adapt to new circumstances quickly to be able to forecast in real-time (Petter et al. 2012). The authors identify the need for development of research processes and tools that are able to adapt and assess IS success by also considering those advantages that are subjective and not tangible. Moreover, they imply that ISs are endowed with a potential to resolve complicated social challenges and are able to assist with large-scale decision support tools both flexibly and easily, based on real-time and localised mass-data. The authors posit that the success of the output could even be assessed by their social value in an unforeseeable future. Furthermore, a demand for more practical approaches to IS success assessment is emphasised, which should, for example, focus on enabling organisational processes or talent development (Petter et al. 2012). All in all, the authors state that the definition of success is always built on the stakeholders and their environment, varying between accurate, quick, quantitative, objective, strategic, target-oriented or even social evaluations.

Existing Practice from e-Learning

The evolution of network technologies from client server to broadband wireless-solutions with centralised servers has tremendously supported the ability of ubiquitous and personalised learning. This is supported by the emergence of virtual and web-based inter, intra and extranet technology that supports learning and its contents' development from text-based to rich multi-media content (Kahiigi et al 2008). The same source also emphasises that the success of e-learning is not only based on the evolution of its underlying technology but is also due to its consideration of circumstances such as resources, digital divide or environment. In line with above reviewed articles, e-learning's IS solutions support the theory of the influence on reducing costs, achieving business targets, and success that is derived from relevant information and system quality, usage and output as well as customisation and adaptation. E-learning theory has also come to understand that assessments should be input and process-oriented as well as project-based and should consider strategic company objectives and drive feedback and suitable

measurement tools (Holsapple and Lee-Post 2006). Overall, as supported in the two reviewed articles, e-learning has come to understand the necessity of successful state-of-the-art IS with regards to managing knowledge and information and consequently, resources and costs.

2.8.1.2 Distinction of IT: Leading to Sustainability / Competitive Advantage

Another influential publication that adds to the importance of IS is "Types of Information Technology Capabilities and Their Role in Competitive Advantage", by Bhatt and Grover (2005)**.** Relevant main ideas of this publication are assessing IT's differential advantages for a company itself while challenging Carr's (2003) hypothesis that IT "is ubiquitous, increasingly inexpensive, and accessible to all firms". The authors' study on IT functionalities and its influence on competitive advantage are presented against different perceptions of IT such as *classical*, *economic*, the *complementary resources theory* and the r*esource-based* view. The latter assumes that differential advantage is based on the organisation and its usage of distinctive, precious, and reproducible assets and competences (Bhatt and Grover 2005). Referring to this, the authors especially highlight *resource picking*, which refers to the creation of economic charges whenever companies use superior knowledge to get benefits from resources on the market. Furthermore, *capability building* is emphasised, which is the capability of companies to create exceptional know-how which may enhance its own resources in a heterogeneous way. The focused IT capabilities that are presented in this article are grouped into three distinctions (Bhatt and Grover 2005):

- **Value competences*:*** this group discusses settings for competitive advantage like value, heterogeneity, and sustained advantages i.e. lacking flexibility.
- **Competitive competences*:*** this discusses IT administration and relationships between business and IT-employees, and the overall business knowledge, referring to IT understanding based on learning-by-doing, confidence, alliances of friends and communication between staff that evokes after time.
- **Dynamic capabilities*:*** this describes the modernisation and adaptation competencies of companies to concur with ever changing business realities and the related absorptive capability to gather and use knowledge about opportunities and in addition the intensification of accumulated, shared and applied learning.

There are two interesting related outcomes that Bhatt and Grover (2005) illustrate:

1. A significant relation is proven with regards to the fact that higher intensification of OL improves quality of IT infrastructure, IT business coherence, and relationship set-ups. Accordingly, the described absorptive capability improves knowledge assessment and utilisation, and a good learning intensity enables companies to adapt the IT set-up to changing business demands.

2. It is proven that although an increased intensity of learning does not necessarily improve competitive advantage, the manifestation of learning in the precise sort of IT competencies will improve competitive advantage. In summary, the authors correctly state that learning has to be applied to precise projects as it does not occur in a vacuum, which support the main topic of this PhD thesis that refers to project-based knowledge transfer potential.

Another related article is reviewed to emphasise the importance of the particular thought process referring to IT and competitive advantage. "IT and sustained competitive advantage: A resource-based analysis" by Mata et al. (1995), introduces IT as a source of sustained competitive advantage. It contradicts the traditional value-perception of IT as solely serving cost decrease or revenue inclines. The resource-based analysis of this article builds on the previously introduced perspective, referring to the capability of using IT to deploy the ultimate benefit sources of companies. This empowers IT to be a possible source of sustained competitive advantage. Highly relevant for further PKM research, it is described that immobility of valuable and heterogeneous resources means that companies that lack a particular resource or competence have a cost disadvantage. This arises through the acquisition, development and application of that resource in comparison to another competitor that already holds this resource (Mata et al. 1995). This immobility of resources is mainly caused by:

- Role of history
- **Casual ambiguity:** sources of advantage are often tacit and invisible. However, expensively imitable benefits/attributes are taken for granted like standard operating procedures or culture.
- **Social complexity:** aspects like credibility, repute or culture are difficult to change instantly by management.

The article also defines the application of a resource-based view to various attributes of IT, which are proposed as a source of competitive advantage. For the context of this thesis,

only the two aspects of often-tacit t*echnical (*valuable: *K*nowledge prerequisite for set-up/operations of IT-systems*) and managerial IT-skills (*ability to understand, use and further develop IT systems) are relevant. That is because they are promoted by interpersonal relationships and exchange, making them a definite source of sustained competitive advantage (valuable, heterogeneous plus immobile). However, these competences potentially stop being a source of sustained competitive advantage when they are transcribed, organised and transmitted cheaply and properly (Mata et al. 1995), as intended by the solution of this PhD thesis.

Existing Practice from E-Learning

Leading companies have understood well that the establishment of a profound e-learning set-up is critical for sustainable competitive advantage; it also helps to prevent problems related to staff dismissals, reorganisations and progressively disseminated workforces (Chandnani 2003). To sustain competitive advantage during economic downturns and rapidly changing business demands, it is important that a company employs staff that know how to apply correct information that they received via e-learning (Bhatt and Grover 2005; Chandnani 2003). In connection to what was stated before, higher intensification of organisational learning improves the quality of IT infrastructure, IT business coherence, as well as the relationship set-ups (Bhatt and Grover 2005). This is an effect that e-learning promotes. When e-learning is successfully used to improve knowledge assessment and utilisation, the resulting good learning-intensity enables companies to adapt for example, the IT set-up to changing business demands (Bhatt and Grover 2005). Overall, e-learning also promotes the idea of value competitiveness and dynamic competencies with the described absorptive capability that improves knowledge assessment and utilisation, in connection with a good learning intensity that supports this adaptability (Bhatt and Grover 2005).

Following IS-literature's recommendation to not solely concentrate on IS, but also management and organisation, state-of-the-art e-learning is approached as a holistic project (Mata et al. 1995). Furthermore, companies that train management skills can consequently decrease discrepancies and conflicts between technically oriented IT staff and business-oriented management to achieve a sustained competitive advantage. Here, e-learning sets in as it provides sources for sustained competitive advantage with its solutions for technical as well as management-related training that support the implementation of multifaceted strategies like cost-leadership and differentiation. This is especially relevant with regards to tacit benefits or attributes as well as security aspects. Most importantly, e-learning

adaptors execute the mentioned theory that companies should not concentrate on IT itself but rather on the management and organisation of it and the development of skills (Mata et al. 1995). In addition to this, tools like mobile e-learning, for example, support the establishment of close working connections between IT, business managers and related social complexities (Wagner 2005). As software is nowadays generic and available to all companies via various sources, IT is increasingly diffused and this can be compensated by other sustainable means such as e-learning (Mata et al. 1995).

2.8.1.3 Governance and Learning Objects

After having initially reviewed the business administration and management related aspects of KM, it was also necessary to review the underlying principles of IS (see previous chapters) as well as the corporate and IT governance which influence the core topics of this thesis. Instead of describing general corporate governance, the precise example of IT governance is used, as this is closer to the subject and thus enables the technologies of knowledge brokering. This section, reviews an outstanding publication from the IT-governance area. "Don't just lead, Govern: How Top-Performing Firms govern IT", by Weill (2004) contains relevant explanations, including the ultimate positive influence of suitable governance on financial performance that are prevailing targets also of optimised PKM. The article contains a comprehensive empirical study and starts with a relevant explanation of the importance of IT governance, which is the basis for decision authorisation and responsibilities in order to ensure appropriate behaviour patterns for the usage of IT. The appropriateness refers to the integrity of the overall company-strategy, corporate culture and targets, and consequently, aims to reflect corporate governance principles (Weill 2004). Thus, IT governance should aim to control and empower via the regulation of input rights (who can provide input for a decision), decision rights (who can make which decision) along with responsibilities for everybody (Weill 2004). The author describes six distinctive IT governance archetypes:

- **Business Monarchy:** senior business managers decide IT topics, thus influencing the whole organisation. Input is ideally obtained from different business-units, CIO's direct reports, comprehensive IT budget management process, service level agreements, and systems that track application/activities of IT resources.
- **IT Monarchy:** similar types of decisions made by top IT professionals.

- **Feudal System:** only business unit heads, owners of key processes (including representatives) conduct decisions (refers to traditional feudalism focusing on own demands). Rarely found in modern integrated companies.
- **Federal ideal:** a harmonised approach towards decisions, encompasses both business unit and corporate-level decisions. Applications for provoking different views make it a very difficult model as it mirrors the approach of governments that balance duties of two hierarchies.
- **IT Duopoly:** corporate IT group that considers the company as a whole. Two-way decision processes are ensured by a mandatory inclusion of representatives from IT executives and business teams. For solving non-single business-unit topics, it is relatively inefficient as it is a similar to a hub and spoke-model in which the corporate IT group has a duopoly with every different business-unit.
- **Anarchy:** this produces very quick IT reactions as smaller groups than in the feudal system or even single employees may make own decisions that are caused by own requirements. This archetype is rarely found due to its problematic and expensive security and support set-up.

After having briefly looked at all models, it is easier to understand how companies perform IT governance and which patterns are derived from this. Referring to decision rights, applicable models differ according to each of the five topic-groups (Weill 2004) for:

- **IT principles:** duopoly strategy ensures compliance with business strategy while ensuring support from IT groups. In this domain federal models and both IT and business monarchies are used commonly.
- **IT architecture:** predominantly, the IT monarchy style is applied in this domain, as it is technical rather than a strategic area. But many companies try to influence this by means of duopoly or federal input right, which may ensure a reflection of the business strategy.
- **IT infrastructure:** for this domain again the leading model is the IT monarchy, whereas some organisations include business leader decisions.
- **Business application needs:** in contrast to the previous domain, this domain often results in application of the federal model style which ensures that a company's strategies and targets are reflected in the process of local application arrangements. Howev-

er, this is also the only model where a significant number of companies apply the rarely found feudal system.

- **IT investments and prioritisations:** in this domain the business monarchy, federal and duopoly styles are almost equally applied. Business monarchy enables a top-down decision for strategic changes, whereas the federal and duopoly approach seeks consensus.

Referring to input rights, more than 80 per cent of the interviewed companies apply the federal model for business application needs, principles and investments. Although this proves that more business-related IT decisions are made, it does not indicate top performance. It normally involves a great amount of individuals and therefore, the predominant amount of input rights are broadly based, but they differ more for rather technology-related IT decisions. The second most applied form is the duopoly. The author compares these findings with companies that perform IT governance in the most effective ways. Under review, these organisations usually apply IT duopoly, especially for IT principles and investments, since it allows for common decision-making, including business and IT, while maintaining focus on precise topics from the involved business leaders. On the other end of the performance scale, companies often use the federal model for all decisions other than application needs, which leads to inefficient and time-consuming processes (Weill 2004). Overall, three effective IT governance patterns can be defined, as depicted in the following overview.

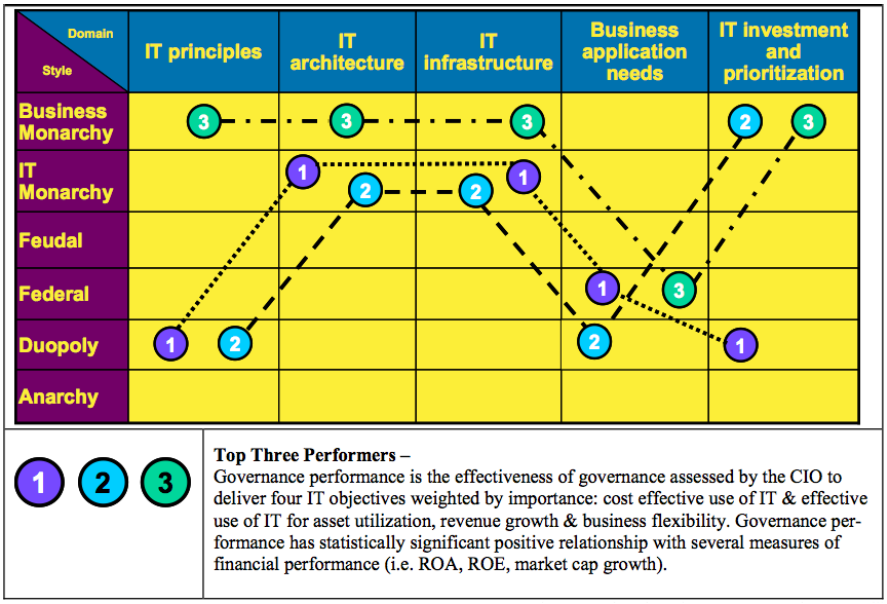

Figure 2.2 Top three governance performers (Weill 2004)

The author correctly summarises that patterns one and two match growth and profitability, whereas the third central pattern is applicable for companies that focus on profitability and cost-control or a single business unit-structure. There is a positive cohesion between IT governance and financial performance, but financially well-performing companies again vary in their patterns from the leading (IT) governance companies (Weill 2004).

As another relevant element for the understanding of this thesis, the author also presents good and applicable suggestions for companies on how to develop and evaluate IT governance. In the beginning, the management should map the IT governance onto a matrix and review it if it could result in behaviours that are in favour of the overall company performance targets. The adaptation of related top performers' governance strategies from other companies may lead to a new and more appropriate (IT) governance model, which has to be implemented and communicated thoroughly and (re-)assessed periodically (Weill 2004). The following eight critical success factors exist for assessment: transparency, active goal-oriented design, infrequent design, education about IT governance, simplicity, an exception-handling process, governance designed at multiple organisational levels and aligned incentives (Weill 2004).

Existing Practice from E-Learning

E-learning has incorporated the importance of governance. Initially, it is important to distinguish between corporate governance that states that knowledge is information and transferable, and knowledge governance that defines knowledge as local, special, dispersed and dynamic (Foss and Michailova 2009). According to Foss and Michailova (2009), knowledge governance means the definition of tools and structures that stimulate the knowledge-sharing and creation processes. As these processes are unlike normal business processes in various ways, knowledge governance has become a renowned topic for organisational and management theory. This links with many disciplines such as human resources, intellectual capital, strategy and innovation as well as international management (Foss and Michailova 2009).

For sustainable success, it is vital that companies develop a strategy that combines both corporate and IT together with knowledge governance on macro and micro levels in order to support employees to share, integrate, create, and finally, use existing knowledge (Foss 2007). Overall, informal governance mechanisms appear to be more useful than formal ones and e-learning has understood the complexities and has developed solutions for connecting islands of knowledge. A related example is the governance of open-source com-

munities like Wikipedia. For this, a study pinpoints only one formal but seven informal mechanisms such as user-collaboration, article talk-pages, collaboration among users, discussions on article talk pages, assistance from expert-users and involvement of reputable users and a high amount of editors (Schroeder and Wagner 2004). That study also proves that in a daily practice of creating content, informal mechanisms are significantly more important than formal ones. In line with governance science, it is concluded that the assurance of transparency as well as participation is vital for sustaining stability in a self-governing community (Schroeder and Wagner 2004).

In connection with governance, a centric term and deliverable of e-learning are *Learning Objects*. These are non or digital resources or entities for contents (e.g. electronic images or papers) that are offered, (re)used, referenced, but also adapted or scaled during various e-learning disciplines and contexts (Wiley 2000). The term originates from computer-based delivery (CBT), where pieces of content can be assembled like LEGOs of atoms. Standard bodies have evolved this term into standardised formats and specifications on how to organise these pieces into learning material (Downes 2005). This provides another very interesting aspect to the best practice analysis for virtual project teams, as the interoperation, reusing as well as access of these objects provide a comprehensive offering and improves necessary productivity and quality while reducing needed resources (Koohang 2004). The overall usage of so-called ELOs (E-Learning Objects) has significantly increased in practice and has proven benefits (Muzio et al. 2002). In general, e-learning technology provides five different standards (Velicanu 2013):

- **Metadata*:*** cataloguing of learning content and requiring a consistent label to store, index and retrieve learning objects by multiple utilities.
- **Package Content:** setting standards and specifications allowing the exchange of courses between platforms.
- **Profiles of learners:** with personal data like learning plans, history, requirements or certificates.
- **Student registration information*:*** delivered to enable receiving of required learning.
- **Communication content:** from individual data and previous activities.

Once again, it needs to be highlighted that IT duopoly sets ideal environments for e-learning principles and investments, since it allows for common decision making, including business and IT while maintaining focus on precise issues. Effective governance en-

sures performance with regards to (cost) effective e-learning and asset utilisation, revenue growth, and business flexibility. The presented eight critical success factors also translate accordingly to e-learning: transparency, active goal-orientated design, infrequent design, education about IT governance, simplicity, an exception-handling process, governance designed at multiple organizational levels and aligned incentives (Weill 2004).

2.8.1.4 Information and Data Management Tools (ERP and Data Warehousing)

For a better understanding of the complex content of this PhD, selected parts of the extensive ERP and Data Warehousing theory were included in the literature review as these give fundamental input for parts of the conceptual framework.

Enterprise Resource Planning

"Putting the Enterprise into the Enterprise System", by Davenport (1998) provides a good summary for bridging this topic with the overall company strategy; relevant arguments are reviewed in the section below. ERPs ensure a seamless integration of information from Finance and Accounting, Logistics and Supply Chain, HR, as well as Customers and Sales (Davenport 1998). These systems are available off-the-shelf and result in the most significant development of the usage of companies regarding IT in the 1990s (Davenport 1998). Today, these complex systems involve challenges due to the huge investment resources and know-how needed. Also, firms still lack reconciliation between ERP-requirements and the actual overall company demands that often follow different structures or cultures (Davenport 1998). Often, the systems do not match existing corporate structures or cultures and this brings up further challenges due to ERP's own logic. The creation of customised solutions may even become a source of competitive advantage if executed properly (Davenport 1998).

The author highlights that it is important that companies remain realistic despite the great prospects and analyse the risks and compatibility of the new system with their own company. The luring prospect is the fact that ERPs provide a solution for the problematic fragmentation of information even in huge and complex companies across various legacy systems (Davenport 1998). The author explains rightly, that various systems result in direct and indirect costs and if the systems are fragmented, the business will be the same unless the ERP supports and builds one comprehensive database. This gathers and provides automatic, real-time information between modular applications that support all business functions and management worldwide. Again, the potentially resulting increase in

productivity and timeliness comes with some risks (Davenport 1998). Previously, companies would first decide how they run their business before seeking a matching software solution for support (Davenport 1998). However, according to the article, today's off-the-shelf systems are universally applicable and generic, forcing firms to adapt business in order to match with the system. A customised solution is only probable to a certain extent via modularisation.

Major adjustments are simply unfeasible due to the complexity of ERPs (Davenport 1998). As companies shift from flexibility to rationality, this leads to the fact that central sources of competitive advantage are endangered. An example is the fact that SAP R/3 is used by the majority and the resulting great convergence of procedures carries a risk for loosing competitive edge. In total, the concerns around costs and implementation are outbalanced by benefits like provision of operating standards that almost force a company to increase productivity (Davenport 1998). The connected streamlining of organisational set-ups creates flat, flexible, and democratic organisations that encourage staff to get more information and produce more innovations. Furthermore, processes standardisation and central hierarchical control increases discipline and uniformity (Davenport 1998). Here, the question arises for global companies until which degree that is productive, since the centralised set-up could harm local market-approaches.

An interesting solution presented by the author is the federalist operating model, which does not necessarily foresee a global standard ERP, but a diverse regional version and units based on one system that caters to tailor-made local conducts. To this extent, companies give up some of ERP's transparency and ease for increasing local market-responsiveness as only some core-data is shared by everyone, whereas others are gathered and managed on a local level (Davenport 1998). The distinction between local and global information-types is another challenge and requires individual analysis and decisions. Central to the success of ERP systems is the company's management that has to review the mentioned challenges and implications carefully and maintain long-term targets (Davenport 1998). This involves dealing with many questions around competitive advantage, influence on company and cultures, scope, and alternative solutions. The article rightly emphasises that top-management has to actively support preparations, planning and implementation to understand that the creation of interrelated processes and of one version of data around one centralised database is not simply a technological challenge.

Another relevant publication from the ERP literature is: "A Framework for Evaluation

ERP Implementation Choices", by Luo and Strong (2004). The authors emphasise that, in order to integrate ERP-systems successfully with company-processes, managers have to customise both the system and the company processes (Luo and Strong 2004). In general, implementing off-the-shelf ERP-systems is very difficult. However, the reviewed research reveals that it is less complex and also less expensive to shape operational processes into the ERP software than reprogramming or entirely developing an ERP-system around the existing processes in a company. The customisations within the actual employment-phase should aim to harmonise both the ERP-system and business processes that relate to it (Luo and Strong 2004). Luo and Strong (2004) further highlight a very significant aspect, one that is also referred to during the discussion around e-learning or knowledge brokering IS solutions. For the customisation of the system, the company requires technical change-skills that include being able to understand standard ERP system-set-up, principles, and to change extensive software and tools in an environment of connected databases (Luo and Strong 2004). In addition to this, it includes the managerial and project-related capability with regards to setting and matching realistic objectives by ensuring optimal resources, communication and (corrective) actions (Luo and Strong 2004). Also, process-change skills are needed in case operational processes should be effectively adapted. This includes being able to understand current organisation-wide processes and their surroundings as well as develop and implement new processes creatively (Luo and Strong 2004).

Again, finally, it requires the capability for coordination and management of extensive process-modifications. This includes change and PM again by considering or even integrating related projects and using the chance for learning from the different projects and their teams. The article states that skill-levels may change after a while and companies should support the skill-development and adapt approaches accordingly. In-line with the above two publications, a good adoption of an ERP-system will have an impact on the overall company-results. This was also proven by other publications, as Hunton et al (2003) found that adoption of ERP-systems supports companies to get a competitive advantage as adopting companies performed better over a timeline of three years in comparison with non-adopting firms (Hunton et al. 2003). As the initial sections of the e-learning practices review only aims to provide a common understanding of the underlying aspects, in this limited scope, not all relevant literature can be discussed.

Data Warehousing

A basic understanding of data-warehousing theory is necessary for a discussion on e-learning systems. Therefore, the following section presents findings from "Recent Developments in Data Warehousing" by Watson (2002). A data warehouse, in general, is defined as a data-collection that is established for decision-making support (Watson 2002). This warehouse is characterised by subject, organisation, integration, archiving of historic data and non-volatility. This means that everybody accesses the same data and cannot change or update it. The process for this starts with extracting and transforming data and ends with loading and making it accessible for employees or other tools (Watson 2002). The article presents two distinctive development approaches:

1. Data-mart strategy: Starts with specific data requirement from the staff (bottom-up) and includes storage of a selected number of subject-areas. Results in smaller data size as it also pulls data from a small amount of system-sources. It is suggested for companies to expand data-marts in a way that guarantees integration of data-marts from different company units, as multiple unintegrated data-marts risk potential. Benefits: Easy and fast development combined with low costs and financial risk.

2. Enterprise Data Warehouse Approach: Arrangement of a data-warehouse from the management (top-down) with central formation of dependent data-marts that pull data from the warehouse instead of source systems. This ensures that users access data-marts instead of warehouse which leads to shortened response-times and easier and more adaptable data presentation. Risks: End-results may not meet entirely companies' or users' demands.

The related Extraction, Transformation, and Loading (ETL) Processes take data from source systems, convert it for decision-making support and store it in a data-base (Watson 2002). As sources for data and input, mostly ERP-systems are used as well as external data. Data-Transformation means cleaning the data by filtering out useless data, analysing, correcting or standardising and finally integrating the data around a common identifier (e.g. ID) (Watson 2002). Another process is Data-Staging, in which data is administered before being loaded into the warehouse, which is also referred to as "work-in-process" area. Metadata is data about the data in the warehouse (Watson 2002). Data is loaded into different data stores like data-marts, data-warehouse and operational data-stores. The loading of new data can be executed in three ways: "bulk" (uploading of both old and new data each time), "change data capture" (only new data is uploaded) and "trickle" loading

(continuous updates and uploads) (Watson 2002). Watson also presents different technologies, which is noteworthy for later elaborations of learning and knowledge tools. Relational technology stocks data in tables including attributes and rows, whereas multidimensional database-technology stores data in a manner that supports a dimensional assessment of data. The benefit is that this enables tailor-made visualisations of the data with quick response times. However, costs increase as well as learning needs and it can store less than relational technology (Watson 2002). Companies use various data access tools and applications for their employees to provide flexibility. Hereby, it is observed that a trade-off exists. More flexibility results in more complexity and difficulty in usage. A common tool is, for example, data mining for revealing unknown relationships. An interesting form that relates to e-learning and knowledge brokering are Enterprise Intelligence Portals that deal with unstructured data like documents, emails or even photos that are not included in the actual data warehouse (Watson 2002).

User characteristics are another relevant aspect from the article, as it provides hints to later discussed people-related aspects of knowledge brokering. In the context of data warehousing information is produced mainly by professional analysts and accessed by end-consumers (Watson 2002). These can be grouped into Tourists, Explorers and Farmers. A tourist may not be aware of data he requires, but reviews a lot of data with high interest on metadata, not deep data analysis. The explorer has a rough hint of what data is relevant and where it can be found. However, he often struggles with the large quantity of data and refers to metadata. The farmer recognises what data he needs, where to find it and does not depend on metadata (Watson 2002).

Existing practice from E-Learning

Due to the benefits of adopting the most effective ERP systems, e-learning has enhanced their solutions to utilise benefits of this area. For synergies from ERP potentials like the standardisation processes and central hierarchical controlling that increases discipline and uniformity as stated above. E-learning solutions are usually directly integrated in ERP systems (Thinq 2014). Interestingly, the discussed federalist ERP operating-model is an approach also found in e-learning. This model foresees not a global standard uniform, but diverse regional versions and units based on one system that caters to tailor-made local conducts. As in ERP best practice, e-learning practice also mirrors the ERP understanding that top management has to actively support the preparation and implementation by understanding that the creation of interrelated processes and that one centralised database

is not simply a technological challenge (Hunton et al. 2003). Accordingly, also in e-learning applications, both the system and the company processes are customised and harmonised. This, of course, requires technical and process change skills, as well as understanding of the environment and managerial and project-related capability. This is in regard to setting and matching realistic objectives by ensuring optimal resources, communication and (corrective) actions (Luo and Strong 2004).

As e-learning platforms are getting more and more relevant for global organisations, it is often found that with these systems, trainers are not able to conduct thorough supervision and assessment of their learners' performance to ensure successful outcomes. Accordingly, researchers promote the linkage of data warehouse and OLAP technologies with e-learning activities as these are most suitable to build tools for tracking learning successes (Zorilla 2009). The overall integration of data mining with e-learning reveals high potentials that are only starting to be discussed and analysed in science (Hanna 2004). At this immature stage, it is already understood that data mining software can support identification of valuable pieces amongst huge amounts of information but only identification of these will not present value (Hanna 2004). Here, data mining results have to be taken further and integrated - for example, in properly managed content-management-systems. Besides the mentioned important Enterprise Intelligence Portals, e-learning theory is promoting a new form based on Data Warehousing called E-learning Data Warehouses (EDW) that consist of gathered information from various dispersed and unrelated E-learning Information Sources (EIS) (Akaichi 2007). This supports consultation and analysis for e-learning. It is obvious that basic characteristics from data-warehousing and e-learning practice resemble each other, as both feature subject organisation, integration, archiving of historic data and data transformation.

As previously explained, both areas deal with cleaning the data by filtering out useless data, analysing, correcting or standardising and finally integrating the data around a common identifier (Watson 2002). Practices like data staging, metadata, loading, storing and assessment in multidimensional databases, which enables tailor-made visualisation of content is also successfully applied in both areas. Also the trade-off of more flexibility resulting in more complexity and difficulty in usage is obvious (Watson 2002). In line with this are the reviewed Enterprise Intelligence Portals that deal with unstructured data like documents, emails or even photos (Watson 2002). Finally, also the end-user types of data warehouses relate to e-learning users, like "tourist", "explorers" or "farmers" who have

different preferences that applications, policies and processes need to respond to in order to be used effectively (Watson 2002).

2.8.1.5 Procurement of IT Tools

With regards to the procurement of IT Tools, e-learning is appearing more advanced than knowledge brokering for virtual projects. This is explained at the end of this chapter, whereas the first part presents and reviews the main findings from the highly relevant article "The unified Procurement Strategy for Enterprise Software: A Test of the "Move to the Middle" Hypothesis," by Kauffman and Tsai (2009). A unified procurement strategy means that a company procures all services and products from one supplier (Kauffman and Tsai 2009). The article rightly presents the following advantages and disadvantages of a unified procurement strategy of IT tools. The company will have a stronger bargaining power, diminish transactions, and external coordination costs - the pre-integration will reduce problems of compatibility. Furthermore, the chosen provider will be encouraged to develop the products' quality (Kauffman and Tsai 2009).

Overall, the authors also describe so-called "non-contractible benefits" in the relationship, which are visible in information-exchange, collaboration and innovation as well as a high degree of attention. The downsides are mostly high dependency on the competitiveness of supplier-products and the often resulting reduced motivation of the supplier that then results in decreased supplier-performance (Kauffman and Tsai 2009). The opposing strategy to this is the multivendor procurement strategy which deals with purchasing from various different suppliers (Kauffman and Tsai 2009). The "move to the middle" hypothesis deals with a shift towards more outsourcing but with fewer suppliers, including a creation of tight, long-standing relationships. It results in closer coordination; bargaining power changes positively when a company invests more into single-supplier software (Kauffman and Tsai 2009). Accordingly, the authors rightly mention that increased dependency from each other in a long-standing partnership decreases risks like hiding of information.

Also relevant to the context of this research is the Industry-Clockspeed-Theory presented by Kauffman and Tsai (2009). This relates to the overall consolidation of providers in the business software industry and the fact that new technological innovations like open source software oblige suppliers to create custom-specific software stacks. This is done in order to remain competitive and create differentiation by providing pre-integrated

software-stacks. The change to a Unified Procurement Strategy is presented with different characteristics of traditional and modern IT design (Kauffman and Tsai 2009). For traditional IT design, the authors mention that proprietary standards apply, whereas modern IT design standards are open. This lessens, for example, the costs of switching supplier and products. These modern standard-based solutions reduce risks of being locked into one area and provide flexibility to bring in new or change existing software (Kauffman and Tsai 2009).

Traditional IT design integration was mostly buyer-supported, whereas modern solutions feature supplier-supported integration, which makes companies available for pre-integrated solutions (Kauffman and Tsai 2009). The article rightly emphasises the importance of the in modern IT-design emerging creation of software-stacks, defined as different sets of applications, which provide a cohesive and entire solution-program. Now, companies can benefit from bundled pricing and frame-contracts since the entire stack eases individual negotiations for single products (Kauffman and Tsai 2009). However, the authors warn that companies may reduce their growth potential and competitiveness to the solutions from the stack-supplier. As a conclusion it is highlighted, that modern IT-design supports a unified procurement strategy.

Existing practice from E-Learning

Again, in this area, e-learning also presents very advanced concepts and realisations of the potentials of the presented **"**move to the middle" hypothesis. The increasingly important outsourcing aspect will be discussed in greater detail within the next chapter. One relevant aspect that e-learning theory recognised is the potential from usage of the discussed open base standards to enhance, for example, Web Based Training (WBT) (Lobin et al. 2003). There are, for instance, developments around the benefits of XML-based mark-up language usage for forming the already discussed learning objects within an open source WBT-system (Lobin et al. 2003). In line with the above mentioned benefits, in e-learning practice, it is often observed that companies tend to source comprehensive 'one-stop-shop' solutions that are supported also from single suppliers with long-term relationships. This is proven by the increased offer for this demand (See Spirit21 2014). This seems to be especially true for companies with modern and agile IT and organisational set-ups which adapt early e-learning and the unified procurement strategy (Kauffman and Tsai 2009). Overall, e-learning realised to establish highly potential procurement-solutions that overcome previously impeding factors such as time, cost and distance.

2.8.1.6 Outsourcing

Another advanced aspect of e-learning is outsourcing. In their publication, "Just Right Outsourcing: Understanding and Managing Risk", Aron et al. (2005) state the risks associated with outsourcing continue to impede the uptake and growth of outsourcing. Therefore, their article sets out to describe these risks and how companies can avoid them. They refer to strategic chunkification, which bears fewer risks, as it deals with outsourcing only components of processes instead of whole processes. It is stated that the risk-reduction is the major driver for growth of offshore business outsourcing (BPO). This is due to the fact that IT supports distance supervision of outsourced undertakings through enhanced telecommunication technology (Aron et al. 2005). There are different types of risks presented in the article:

- **Strategic risk:** derived from opportunistic actions of the company itself or the outsourcing provider.
- **Principle-agent problem (shirking):** suppliers may employ unqualified employees, save on IT resources or training, but still request 100% payment for low-performance.
- **Poaching:** abuse of transferred data (illegitimately copied or resold) to gain turnover. Certain endangered activities should be re-internalised in order to prevent poaching.
- **Risk of unintended operations-performance:** due to complexities, restrictions of exchange between systems or simply, the distance between the company and its supplier.
- **Risk of opportunistic renegotiation*:*** the supplier capitalises on the situation that the company may have no possibility to debate or change to another supplier. The supplier may even cause intentionally a disruption of operations via his systems and enforces higher pricing in that way. Contrary to poaching and shirking, this risk is easily detectible and obvious.
- **Atrophy risk:** this risk is intrinsic and occurs if companies outsource certain areas and lose the internal skill-set.
- Risk from re-location of outsourced services to remote places: risks from exchange rates, sovereignty, or geopolitics.

To prevent or reduce the above risks, the article advices to focus on chunkification of the outsourcing process in two ways:

- **Vertical chunkification:** this specifies activities from overall processes that will be outsourced to the supplier and those that will remain in-house. If processes are clearly separated into activities that are individually assessed according to their risks and connected to a risk-mitigation-concept for every activity, the overall risk of poaching can be reduced.
- **Horizontal chunkification*:*** this defines which part of an individual activity will be transferred to the provider and which, again, will remain in-house. If activities are divided in this structure and only the activity parts are outsourced - maybe even split among various suppliers - it decreases the risks of opportunistic renegotiation and shirking.

In keeping with this, literature is emerging with claims for using the advantages mentioned, combined with the untapped potentials of strategic-outsourcing of intellectual services, such as KM. The aim of which is to increase cross-divisional, integrated, updated, innovative and value-added features (Quinn 1999). This also supports the argument for this aspect being part of the reviewed potentials from e-learning. In link with this, Quinn (1999) also highlights the precise potentials for enhancing quality, flexibility, reliability, focus, and global spread by strategic and information or knowledge-based outsourcing in virtual set-ups by also highlighting new challenges around the control of nodes or precise assessments of cost or effects that have to be mitigated.

Existing Practice from E-Learning

In line with the discussed move to the middle strategy, it is observed that the theory of e-learning shifts towards more outsourcing but with fewer suppliers, including a creation of tight as well as long-standing relationships with these suppliers. Here, it is proven that e-learning has internalised that in the new economy, outsourcing entails more than simply buying a service from an external provider (Parkin 2001). It means a partnership that links impeccably with the company's business by contributing to the strategic evolution. Besides streamlining internal processes and compressing deployment-time, an e-learning outsource-partner acts as a change-agent. Thereby, progress accelerates and outcome-quality improves in a more economical way, together with less operational risks in comparison to in-house solutions developed by training departments (Parkin 2001).

E-learning theory and its industry are convincing more and more companies to overcome invalid reasons for not using outsourced e-learning. This refers to perceptions that in-house

e-learning development expertise is strategically vital and outsourcing is expensive, complicated, risky, and lets the company lose control (Parkin 2001). In this context, e-learning manages to constantly embrace best practices from other areas, as in this case e-business. In the manner that e-learning is promoting, e-business has already outsourced most of the so-called mission-critical processes like instant customisation, management of dynamic content or database-integration due to the fact that these fall outside core competencies of a company (Parkin 2001). E-business has also taught e-learning that an online course in order to become managed successfully has to be integrated into a learning-environment that is again integrated into a service-environment that all operate in real-time on-line (Parkin 2001). In this respect, e-learning practices present that there is more to contemplate during e-learning outsourcing besides development and integration of courses into the LMS. The company, for example, also has to consider web-enabling, deployment, hosting, support, upgrading and marketing (Parkin 2001).

Modern practices from e-learning also present useful considerations and a proven process for successful outsourcing and avoiding typical mistakes. Initially, a company should reflect on time-criticality and availability of internal resources and skills as well as sensitivity of outsourced information (Stayton 2011). Following this, the companies should define the ownership and leadership, mission, targets, risk-tolerance and conduct a reality check. Thereafter, a company should identify suitable, healthy long-term providers that ideally have experience and a learning background and that can support a required big-bang switch (Stayton 2011). In terms of software, companies should avoid advertised solutions whose launch has not happened yet and may not ever happen (vapourware). Also, newly developed products that are compelling but often impractical should be avoided (Parkin 2001). In this situation more simple but proven software provide a better start for achieving the goals. Overall, the focus of the outsourcing should be on service instead of technology, as well as outcome and strategy, instead of activity and tactics (Parkin 2001). Experience from e-learning portrayed in literature suggests that the ideal way to quickly and successfully implement global corporate e-learning is indeed strategic outsourcing. This is because it provides focus, simplicity, limited overhead, innovation, flexibility and quality for PM, technology, design, infrastructure, administration, as well as learning and business models (Stayton 2011).

2.8.2 IS-Related Trends and Potentials

2.8.2.1 EP and Web 2.0

Enterprise 2.0 and Web 2.0, based on their general principles and characteristics, appear to be very close to those of KM. Some Web 2.0 tools even evolved from KM-attributes and therefore, become one of the important and reviewed trends for potential improvement of PKM that e-learning already captures well (Levy 2009). Other scientists even argue that Web 2.0 goes beyond the distressed and poorly rated (P)KM by being even more complex and multi-layered. Accordingly, more potential for improving challenges of knowledge-transfer and learning in organisations evolves (Snowden 2007). Again, after explaining the underlying theory, reference is made to the particular state-of-the-art e-learning practice. The article "Enterprise 2.0: The Dawn of Emergent Collaboration", by McAfee (2006) is discussed as it describes the trend very well, including related risks and potentials. In this context, it is important to understand that Enterprise 2.0 stands for the implementation of Web 2.0 tools and set-ups by companies (Levy 2009). IT is used for communication via various channels, like email or instant messaging that do not allow access or research to the exchanged information by anyone else apart from the senders and receivers (McAfee 2006).

On the other side, various platforms like the intranet or webpages offer broadly available information that is produced centrally. Here, the difficulty lies in the fact that only a few percentages' output is presented and that no traces are available (McAfee 2006). This leads to the demand of platforms that do not solely capture information, but also concentrate on output as well as practices from knowledgeable employees (McAfee 2006). Here, McAfee (2006) rightly presents the crucial problem that common platforms are used less frequently than channels. In addition to this, users are not satisfied with existing applications and their way of knowledge-capturing. The enterprise 2.0 technologies provide a solution via digital platforms for interacting along with generating, distributing and filtering of information as well as recording of user-identities (McAfee 2006). This is achieved by providing the information to employees in a persistent and visible way. Enterprise 2.0 Technologies refer to SLATES, which stand for the six components (McAfee 2006):

- **Search:** navigation help or keyword-searches that aim to increase the platforms' value.
- **Links:** the ability to establish webpage interlinks by highlighting "better" ones that are repeatedly linked.

- **Authoring:** everybody in the company should have valuable knowledge to contribute and this needs to be facilitated and promoted by cumulative blogs or iterative wikis for groups. These seek high-qualitative and up-to-date information that is linked**.**
- **Tags:** allow for improved and user-friendly classification of content and to trace employees' actions.
- **Extensions:** recommendations that are produced by matches of preferences based on described likes or tags.
- **Signals:** technologies that highlight and alert, for example, via email or RSS whenever new and relevant content is published.

The publisher of the article also highlights significant ground-rules:

- Offerings should aim at ease-of-use without requiring additional software or being more complicated than authoring an email.
- Companies should not enforce predetermined notions on employees regarding how to publish or structure output. Rather, they should start with empty spaces in their tools.

EP 2.0 network effects through authoring, tagging, and linking, promote a structure that becomes gradually fine-tuned. EP 2.0 should endow huge companies with easier searching, analysis and navigation processes than those of SMEs (McAfee 2006). The author also rightly emphasises, as discussed before, that the successful usage of EP 2.0 highly relies on the senior management – they have to promote a receptive culture in which trust exists and new cooperation practices are refined. Furthermore, companies should target one common platform instead of multiple unlinked platforms (McAfee 2006). An initial information-rollout-phase should inspire certain employees to commence the creation of relevant knowledge for co-workers that will let those join the initial employees in usage and production of knowledge. The management could further support the rollout, for example, by emails to all employees or with a wiki start-page with mission statements or initial articles from the management itself (McAfee 2006). A certain preliminary hierarchy and structure will further ease the start. Another relevant section from the article is the critical summary of challenges, which also have to be taken into consideration in the application of established e-learning practices:

- Busy but knowledgeable employees may not use innovative technologies or only extract instead of share information.

- Employees as well as managers normally follow established procedures already in use and may be hesitant towards newly promoted technologies. This makes the described initial phase very important in order to stimulate the usage of new technology.

Besides this, Web 2.0 can, for example, also enable selected groups like younger employees to become catalysts for information-exchange or become enhanced with adding files, linkages to ERP, CRM, security mechanisms, by following the eight core principles of Web 2.0 (Levy 2009):

- Web as platform
- Development of services
- Active participation of decentralised and voluntarily contributing users
- Improvement of services when usage increases
- Collective intelligence
- Content management as core
- Perpetual beta and potential is learned by usage
- Development of rich user-experiences by small elements

Reference is also made to another important publication by Snowden (2007); this article describes that organisation focused KM has been a theory maintained by dysfunctional IS. However, social multi-channel sharing via people-focused web 2.0 with relatively small, low-cost and easy to implement tools is a highly potential advanced technological shift. This trend currently produces further developments including jointly evolving tools. However it still lacks a clear underlying theory as of yet.

Existing Practice from e-Learning

There are many opportunities already described for the use of EP 2.0. The following section connects an outline of current Web 2.0 practices from e-learning to highlight some of the precise potentials for application on knowledge brokering in virtual project-teams. As another area where e-learning has better overcome challenges than (P)KM 2.0, this is proven by the existence of knowledge-gaps due to passive employees that may share elsewhere in private social media but refrain from doing so within the company (Levy 2009). Despite the relative maturity within e-learning 2.0, there is still a remarkable progress and emergence of new trends within related sciences that can be observed. This might be due

to the fact that no model has been found to be universally appropriate and many of the models lack empiric significance or testing (Palacois-Marques et al. 2013).

According to O'Reilly (2007), the original idea of Web 2.0 was based on applications that advance user-performances by providing collective intelligence through active participation from the user. The four key pillars are: Sharing, Participating, Cooperating and Communicating. This revolutionary invention does not only have a significant influence on the overall organisation, but more precisely but also on its e-learnings, as the concept aims at users who produce bulk content. Similar trends are already observed in virtual projects – however, these projects are yet to reach maturity. Current known forms of the Web 2.0 include blogs, social networks, podcasts, wikis, RSS feeds and most recently so-called data mash-ups, which deal with a mixture of combining, aggregating and visualising from various sources. These facilitate increased sharing, cooperating, participating and communicating. The obvious potentials (for e-learning and consequently PKM) are described by related publications and cannot be individually explained in the scope of this thesis.

Aristotle's observation of emergent properties whereby – the whole is greater than the sum of its parts - applies again (Palacois-Marques et al. 2013). The new online network results in increased aptitudes for knowledge that establishes interconnections, capable of solving difficulties that individual experts would not be able to resolve on their own (Schultze and Stabell 2004). Weinberger (2007) states that knowledge results from social thinking processes during interaction with others - an inexhaustible source. Web 2.0 therefore offers an innovative channel that newly connects individuals around e-learning endeavours. Despite the huge promises, this also presents certain dangers, as Keen (2007) emphasises. According to the author, the huge amount of data encounters restrictions from human intelligence, which is incapable of progressing it effectively and can lead to counter-effects such as confusion instead of the intended guidance. Also, there is no empirical proof that higher amounts of content result in higher levels of quality.

In keeping with the overall strategy of this thesis - not to focus too deeply on the software and technology details - Web 2.0 literature argues that the relevance of these platforms that provide context and support shall not be overrated and that the emphasis lies on the knowledgeable individuals (Palacios-Marques 2013). One advantage of continued IT research is the promotion of flexible and open e-learning-applications that can be used as modular solutions (Sigala 2007).

Increased competition, combined with the depicted enhancements, has also led to

decreased and insignificant costs. As discussed, it makes previous theories that refer to rating of e-learning projects by the cost-efficiency ratio, obsolete (Piskurich 2006). Overall, the web 2.0 can be summarised as a social rather than a technological revolution. It shifts the internet as an information transmitting and delivering medium (e.g. for reading articles) to an open social network platform that encourages to create, share, reproduce and carry on content with vocabularies consisting not only of words but also multimedia (Downes 2005). In terms of e-learning, the closest answer to this is the previously discussed community of practice. This is described as a shared interest-domain that enables members to learn together by interacting and developing a shared resource repertoire (Wenger 2000).

The modern e-learning 2.0 describes a learning community that uses active ICT-based collaboration and communication as main base of the learning process (Regueras et al. 2008). This form has evolved over years, starting with *e-learning 1.0*, which is a motionless bundle of material provided via course-ware or CDs provided by content-developers with limited or no true interaction or contact with a teacher or input from the learner (Regueras et al. 2008). Ad-interim, *e-learning 1.5*, which mainly based on LMS (Learner Management Systems) provoked more interactivity with both the tutor as well as other students via chats or forums (Regueras et al. 2008). As an enhancement to this, *e-learning 2.0* is based on a student-centric model that focuses on a personal learning environment. It uses social software to encourage students to create and share content and interact not only with their tutors and other students but with worldwide contacts from whom knowledge can be retrieved (Regueras et al. 2008). As the importance of e-learning 2.0 is growing quickly, more research is necessary to fully grasp all potentials (Ebner 2007). However, it is ironic that e-learning 2.0 brings society back to the state of learning, prior to modern schools. At the time, learning was still supported by the community, instead of removing students from it into artificial classroom environments where content is supposed to be learned without connection to the related context (Blamire 2006).

E-learning 2.0 that is based on the web 2.0 technologies and theories is supported by educational institutions that promote, for example, informal podcasting or blogging about personal interests that create networks of interaction like the described communities of practice (Downes 2005). Adding onto the discussed developments, e-learning has successfully internalised the web 2.0 shift from delivering pre-defined learning-material via online software towards connected tools for creating usable learning-nodes with

content-authoring activities from users (Downes 2005). The single corporate application system becomes a personal learning centre. This includes re-used and re-mixed content collections of interoperating application-environments with syndicated contents where users have personal spaces to create and showcase own e-portfolios of potential learning-inputs for others (IMS Global 2014).

As discussed in the procurement chapter, successful e-learning 2.0 requires open-source and collaborative applications as well as creativity enabling and gaming simulations that are discussed in detail in the chapter of virtual worlds and edutainment. Reference is also made to ubiquitous computing and learning that is best described by the concept of workflow learning. This integrates deeply corporate web-based applications into combined process solutions for real-time task support by contextual collaboration with people and systems catered for design and modification achieved by modelling and simulation (Cross 2004).

2.8.2.2 Cloud

Another potentially relevant area of advanced e-learning is found in cloud computing. This section initially reviews significant literature from this trend in order to provide the reader with a background understanding of current cloud theory. The final section deals with the precise enhancements of e-learning theory around cloud-solutions. This section reviews the article "Cloud Computing and Electricity: Beyond the Utility Model", by Brynjolfsson et al. (2010) which evaluates the overall advantages, disadvantages, and applicability of the so-called computing-as-utility business model. Brynjolfsson et al.'s (2010) definition for cloud computing is separated into two sections:

- From an academic standpoint, cloud computing includes both IS hardware and software of "cloud" centres applications supplied via internet in form of services.
- From a more practical perspective, cloud-computing encompasses virtualised IS resources on-demand via the internet, easy to use, funded via subscriptions, shared by other entities and based out of a company's own data centre.

The highlighted advantage of a general-purpose technology utility is compared by the authors to the economies of scales producing a cost advantage that arises with increased output or consumption of a product as known from electricity utility. Here, centralised set-ups and supply lead to better utilization than multiple small and decentralised locations (Brynjolfsson et al. 2010). This is because it is challenging to operate wide-ranging sys-

tems via external clouds. Therefore, larger enterprises often set-up their own private cloud solutions for increased cost transparency, consistency, and strategic advantages. Another interesting aspect discussed in the article is that high distances decrease costs, but latency-costs may out-balance this. Therefore, cloud-centres should be close to the company for safety, convenience, and performance reasons. The presented disadvantages of this business model itself include (Brynjolfsson et al. 2010):

- Services usually not interoperable or switchable between cloud suppliers, resulting in high dependency.
- Security being a main concern, as dynamically shared objects such as customer details or internal secrets in cloud networks are beyond a company's control.
- Due to co-inventive and innovative industry stage, companies using cloud services, have to adapt their set-ups and processes drastically to remain functional.

However, the authors rightly emphasis that the most significant advantage of cloud computing is the facilitation of even more innovations as reliable universal solutions increase and costs decreases. Another article on cloud computing will be discussed in the following section, as it brings up additional aspects of the technology. The article entitled "What every CEO needs to know about the cloud", by McAfee (2012) starts with a categorisation of the current cloud services:

- **Infrastructure As A Service (IAAS):** simplest offer in the form of storage computing capability via a cloud-server.
- **Platform As A Service (PAAS):** software-ready set-ups, on which companies can write and develop tailor-made applications.
- **Software As A Service (SAAS):** a main category and supplies applications (often in a set) that are cloud-based and not stored on the customer-hard-drives.

The categorisation is reviewed highlighting the similarities among all three groups (McAfee 2012):

- Switching from capital expenses to operating expenses as companies rent the services instead of purchasing them.
- Suppliers have responsibility for administrative or service-related problems and additional capacity can easily be rented immediately.

- As in the previous article, private clouds are discussed, as they potentially ease regulative and safety matters. Yet costs may not be reduced as with external public clouds. The latter now also increase regulative and safety feature, wherefore the advantages of private clouds are diminishing.

In terms of the platform's strengths the article mentions increased productivity of individual employees, as documents are instantly accessible from anywhere using different devices. Additionally, collaboration is simplified as employees can contribute to forum-discussions, ask questions to the entire company, or quickly install different interest groups for exchange with experts concerned with similar topics (McAfee 2012). With regards to the later discussed "big data" topic, the authors correctly state that cloud-services support companies by analysing their gigantic data stores. Overall, cloud computing reduces administration concerns, facilitates, and integrates work through different devices, places and company limits.

This article also describes potential disadvantages of cloud computing around costs, security, and reliability but adds the aspect of regulation and presents counter arguments for all concerns:

- **Costs:** uncertainty abounds though cloud-computing supports economies of scale resulting in future cost decreases arising usually from the increase in size of an operating unit. These are supported from the purchasing side using Moore's Law, as service-costs also decrease over time.
- **Reliability:** it is arguable that if companies control their own set-ups stability should increase. Nevertheless, service providers also permanently improve their cloud services with regards to reliability.
- **Security:** although concerns around virus or hacking attacks persist, it is assessed that these security topics also relate to a company's own computer set-ups. Additionally, cloud suppliers have improved capabilities for network-protection and risk-prevention as they employ reliable experts and technologies.
- **Regulation:** there will be oversight concerning multi-faceted legal and controlling obstacles for cloud computing, that cloud-suppliers try to consider in their products. Interested companies are given a practical approach for it, including the identification of potential restrictions or unclear areas, followed by experimenting with SAAS.

With relevance to PKM, a new development project may be appropriate for a trial-run and a review with a company's major IT supplier may be valuable to understanding the supplier's approach concerning clouds (McAfee 2012). As highlighted in the article, cloud computing strengthens collaboration, productivity, analytics, as well as application improvement. The related value and impact is difficult to pinpoint at this stage, but companies can only experience it with cloud computing.

Existing Practice from E-Learning

E-learning has managed to integrate different categories of cloud services. It grasps the advantages of simplified collaboration and group creation, increased productivity of individual employees, analytics, as well as application improvement (Velicanu et al. 2013). This is achieved through virtualised on-demand IS resources and data funded via subscriptions, and shared by other entities and based out of the companies' own data-centre. E-learning further links these advantages and integrates them with other aspects such as outsourcing (set-up of e-learning systems is entrusted to external cloud-providers) or mobile learning (browser-based applications that are also accessible via mobile platforms) (Laisheng et Zhengxia 2011).

Cloud e-learning is a relatively new term, which describes the integration of cloud computing into e-learning, which vastly improves efficiencies and management of e-learning (Laisheng et Zhengxia 2011). E-learning articles discuss the positive impacts in terms of affordability as a result of applying cloud-computing architectures for the development of e-learning solutions (Pocatilu et al. 2009). Velicanu et al. (2013) emphasise that e-learning systems have all the benefits of cloud computing architecture referring in terms of services, platform, and as well as infrastructure. For e-learning systems mostly cloud computing, distributed computing as well as service-oriented and event-driven architectures are applied set-ups. However an optimal architecture should consolidate benefits from all areas into an integrated cloud environment (Velicanu et al. 2013). Besides the high ability of companies to proactively determine with cloud solutions which data can be shared with third parties, an additional advantage of these solutions is their high level of overall data-security. This is ensured through protocols, encrypted passwords, data being stored on separate servers, and the overall supported back-ups and ISO-certifications (Velicanu et al. 2013). On top of this, (mobile) data-availability is promoted through easy worldwide accessibility with or without limited requirements for client-side software which reduces costs and resource-requirements (Masud et al. 2011).

Furthermore, current e-learning issues such as computer or hard-disk loss, crash recovery, or database down-times are decreased (Ouf and Nasr 2011). Another advantage of a cloud platform is the cost saving scalability of capacities as well as availability of e-learning functionalities like e-mail accounts, forums, individual web pages, chats, or class books (Velicanu et al. 2013). Interesting developments related to this are interactive cloud computing based solutions for building virtual and personalised learning environments. These support content-creation and management, idea-exploration, as well as integrate different pedagogical approaches to learning and teaching (Al-Zoube 2009). These provide an enhanced experience when compared with traditional LMS. This is because e-learning cloud-solutions provide well known environments where goals are more easily achieved using flexible architecture and mash-ups of heterogeneous services that support different activities such as production, distribution, reflection, and discussion.

2.8.2.3 Consumerisation

Another advanced area of e-learning, is so-called consumerisation. This describes the reality of employees bringing their own IT solutions into their work processes. The following section initially discusses an article explaining this phenomenon. **"**IT Consumerisation: When Gadgets turn into Enterprise IT Tools" by Harris et al. (2012), looks at how companies deal with consumerisation and the resulting complexity of their IT, by providing guidance on how to capture and utilize benefits while avoiding risks and redundancy in their IT environment. The authors describe how the once dominant corporate IT is being replaced by personal consumer electronics and technologies. In 2011, almost every fourth employee was already using these routinely. The stated reasons given by employees for this perception are that their personal solutions have higher ease-of-use and effectiveness, are easier to comprehend and also more enjoyable to use than those provided by the company. These consumer-applications are less expensive and complex in terms of implementation as they embrace current technologies that support innovations that reduce costs. In addition to this, the authors emphasise the rising concerns around reliability, precision and interconnectivity; besides innovation potential, productivity and customer service may increase. This is because employees use private smartphones for example for checking emails or for accessing company databases or applications even after business hours (Harris et al. 2012). Also, staff satisfaction may increase due to the freedom of using self-selected technologies. This may even impact the overall attractiveness of companies as a place to work. The

article describes the following three distinctive strategies for coping with IT consumerisation:

- **Laissez-faire strategy:** does not impose restrictions on usage of private devices etc. This may not be a real strategy and more of a fail to cope with consumerisation. Even if it may comfort employees and reduce IT-expenses, the initially stated concerns of inter-compatibility, security, and standardisation are not addressed.
- **Authoritarian strategy:** extreme control on the usage of private applications and devices within the company. Mainly driven by the objective of reducing costs and maintenance as well as security-problems.
- **Middle ground strategy:** solution with four distinctive specifications:
    - *Widen range of allowed private solutions:* by specifying technical minimum requirements or providing consumer solutions from the corporate IT-side. Conflict situations in which private-solution may not meet security-standards have to be observed. Also, it is necessary to establish processes that enable companies to delete company data on devices, in case they get lost or a staff member resigns. A continuous update of authorised solutions has to be conducted, requiring a high amount of approval-efforts for applications and devices with partially short life cycles.
    - *Provision of a fixed allowance to purchasing:* IT applications, devices, and required software. This may be restricted by an up-to-date list of permitted or prohibited products.
    - *Segmentation of related IT policies:* according to work roles and descriptions may be beneficial as staff have heterogeneous demands or interests in using consumer solutions. This demands extensive planning and development.
    - *Proactively promote use of state-of-the-art consumer solutions:* to show how new technologies can be used in innovative ways to improve or even convert business processes.

In order to successfully promote this middle-strategy, the authors emphasise embracing the following five directions, which are also relevant to PKM:

- Understand that IT consumerisation is evolving and has varied appearances beyond Facebook or iPads. It is necessary to recognise that the company's network frontiers are not clearly defined anymore.

- Comprehend that security is achievable via consumer solutions, while focus must rely more on policies and applications, rather than device- and network security. The adherence to policies is of the utmost importance and training as well as security has to be adapted accordingly to mitigate risk levels. As risks associated with IT consumerisation decrease, its appeal increases for businesses that prioritise risks.
- Incorporate cultural, economic, and national differences by developing appropriate measures.
- Understand changing motivations amongst user bases are another important aspect. Younger generations show high levels of comfort with regards to selection and usage of solutions. They even may consider their choice of IT as a form of empowerment.
- Seek to include consumerisation into strategy and processes, as this is a potentially unique infrastructure with long-term benefits that would be difficult to establish without IT consumerisation.

The authors, therefore, conclude that devices will become less visible with smaller dimensions and become less costly by gaining capabilities and speed. As a result, companies have to acknowledge that consumerisation is unavoidable and therefore, has to be approached proactively.

Existing Practice from e-Learning

"From connecting to collaboration, the professional communications environment is becoming increasingly complex: Enterprises need to deliver an enriched customer and employee communications experience" (Dubois 2007, p.4). Here e-learning has found an application beyond Facebook or iPads. This comprises the above-mentioned risks and innovation opportunities with easy, effective, and satisfactory state-of-the-art solutions. A term related to e-learning is social learning. This is an essential trend that requires companies to re-work learning and development strategies and embrace them as the *consumerisation of (e-)learning*. This is defined by the fact that an estimated two third of employees are bypassing learning and development solutions for instant access to information (Hart 2011). Current practices of e-learning promote to allow the staff to improve their work and life-styles. This is done by welcoming various learning-approaches or interests that allow staff to develop into "smart workers" by improving productivity, by finding and applying content and creating and sharing on Social Media as well as building communities (Hart 2011). As mentioned above, business processes have to be adapted to

social learning which enables learning within the work flow through sources like YouTube, Wikipedia, SlideShare, Facebook or LinkedIn (Taschner 2012).

Dealing with the topic of big data, learners seek simple answers in any format that is linked to the content in terms of job or performance support rather than just courses (Hart 2011). Instead of traditionally approaching physically surrounding colleagues, smart workers now access a huge amount of sources improving productivity by finding and applying new tools (Hart 2011). This trend is highly cross-linked. It has for example similar motivations underlying the increasing usage of mobile learning. These motivations include that if the context in which learning occurs was unimportant, it would not be required to make learning mobile and ubiquitously available in any context, which is promoting new opportunities for learning creation, relationships and behaviours (Downes 2005).

2.8.2.4 Custom Software Development and Customisation

For discussing the theory of custom software development and customisation the publication "Managing Information Technology: Methodologies for Custom Software Development" by Brown et al. (2012) is taken as a basis. It states that it is initially required that one develops a proposal for an IT investment, which justifies the systems development and accurately defines what the system has to perform in order for IS experts to build solutions. This consists mainly of a feasibility analysis and a system requirement definition (Brown et al. 2012). Besides documenting costs, benefits, and risks, the analysis contains the development-plan and defines what the system does and how it would work. According to the authors this should cover all economic, operational, technical, and also political questions. The related definition may be an expensive step, but it pays off by avoiding costly changes at later stages in the process (Brown et al. 2012). This initial definition part documents system in and outputs and conversion processes as well as a cost/benefit analysis and compiles reviews from IS and business.

The following construction part consists of system design (structure and content), building (program, databases and files) and testing (user-acceptance) (Brown et al. 2012). Afterwards the implementation starts with the actual installation, including the training and conversion of existing data into the new system. The following operations step is achieved when the new system operates in production mode and the staff and support personnel are granted the necessary documentation. The following maintenance deals with correcting errors, adapting the system to external changes, and enhancing it (Brown et al. 2012). The

authors rightly state, that despite this part being precarious to the business and requiring a detailed understanding of the system and the influences of changes (ripple effect), it is considered a low-status job and increases over the time as the system is deployed.

This paper highlights that this development can only be successful if the project team consists of skilled IT, business, and project managers plus a system analyst, each reflecting different perspectives. Success is defined by budget, schedule, and quality. The paper presents the three success criteria: manageable project size, accurate requirements definition, and executive sponsorship (Brown et al. 2012). The authors also present development alternatives:

- **Prototyping methodology:** foresees building a system and then revising it based on initial experiences and new understanding.
- **Rapid Application Development (RAD):** hybrid of both models.
- **Agile System Development Process:** based on the assumption that business conditions change continuously and it becomes increasingly difficult to bridge the gap between business problems and software potentials. In contrast to RAD and prototyping it concentrates on simplicity, communication, feedback, courage, and a whole team approach, which results in shortened delivery cycles and close collaboration.

Besides these processes, the authors also present other relevant aspects, such as SCRUM, which emphasises independent project teams and coordination and communication between and within these teams. This is done by continuously and iteratively monitoring work and applying highly effective work methodologies including quality assurance. A major vehicle for success is meetings such as the daily SCRUM-meeting (short stand-up session that highlights daily accomplishments), SCRUM of SCRUM-meeting (Scrum Masters coordinating inter-/intra-team issues), sprint planning meeting (monthly work-unit allocation), and sprint review meeting (review of monthly high-/lowlights) (Brown et al. 2012). One last relevant aspect from the paper is guidance on dealing with outsourced staff, to lower the costs of software development and for being able to bridge internal gaps in technical expertise. In this case, companies should manage expectations. This is to be done by focusing on outcomes, taking actions to integrate off-site staff, ensure regular and secure communication-links, create a centralised PM office, and begin pilot projects for building trust and experience.

Existing Practice from E-Learning

As mentioned already in the e-learning 2.0 chapter, a major advantage of e-learning is using is the promotion of flexible and open applications that can be used as modular solutions (Sigala 2007). Customisation is one of the primary advantages, endowed within state-of-the-art e-learning, as simple solutions like Blackboard offer customisations that are incomparable to standard learning forms like common textbooks. To facilitate best practices, innovation, effective teaching and learning most e-learning solutions are conceptualised with an internal structure that serves as a customisable shell, for example as programs like Microsoft PowerPoint do (Laurillard 2002). Another interesting comparison used in e-learning theory, is comparing the requirements for customisation with best-in-class customer relationship management (CRM) solutions (Neville et al. 2005).

Custom software development and customisation is widespread as far as e-learning is concerned. To accommodate this, governance proposals are developed to better manage the extensive forms of learning, which exceed conventional means of learning (Laurillard and McAndrew 2002). A library of generic frameworks, could store bottom-up solutions that have a proven track record for effective re-use, customisation, support needs, and objectives of the learner in order to be pedagogically sound (Neville et al. 2005). The strong customer demand for flexibility of learning as well as the strong competition of service, content, and technology providers in the e-learning market, has further pushed the developments of customizable solutions (Clarke and Hermens 2001).

2.8.2.5 Virtual Worlds and Edutainment

For understanding the phenomena of virtual worlds and edutainment a summary of the evolution of e-learning IS solutions is provided. In the beginning, e-learning started with the *CD-ROM* which was pre-dominantly used in the 1990s. The major advantage of this medium is the conduction of special training sessions can take place without internet access (Gooley et al. 1994). This technology may still be found today for software or language tutorials.

Content-management-systems (CMS) host a central platform that supports the common development of content as well as the management of it for the purpose of publishing documents. A famous example is Moodle (2013).

Learning management systems (LMS) comprise of set-ups that support either direct or indirect learning especially via the management of leaning-content (Mayes and De Freitas

2004). A prime example is the Blackboard-solution that is used by the Salford University.

In addition to this, the *Learning Content Management System* (LCMS), is a hybrid that is mainly used in academic-learning (Kahigii et al. 2008) and provides a multi-user environment where providers create, store, re-use, and coordinate digital learning-content (Velicanu 2013). The application of standardised metadata for structures and transfer allow the exchange of the previously discussed learning-objects (LO) as well as interoperability (Velicanu 2013).

An enhancement to these computer-based trainings, are so-called *Multimedia Communities* which move the functionalities of previous e-learning technologies away from pure text oriented content to multimedia offerings to which learners can actively contribute and add references (Omwenga and Rodrigues 2006). A relatively new type of e-learnings is *Virtual Worlds*, which are being used more and more. In these imitations of the real world, the process is socially enhanced and the set-up is very informative, captivating, and also funny (Graven and MacKinnon 2005). *Game Authoring Technologies* are another emerging form of technology that targets the learning improvement via further interactions and simulations. These range from text-oriented gaming to extremer forms featuring graphic set-ups and the synchronous participation of multiple players (Graven and MacKinnon 2005).

Existing Practice from E-Learning

Both Virtual Worlds and Multimedia Communities specifically support an individual's learning, development, and thinking by creating social communities as also outlined in the e-learning 2.0 chapter (Kahiigi et al. 2008). This may be another entry-point for duplication of up-to-date e-learning practices into virtual project teams. From initial multi-user online computer gaming environments to the most mature Second Life (SL) unstructured 3-D spaces, it provides attractive platforms for e-learning with an eye on the immersive and technical as well as social potential (Warburton 2009). A classic example from e-learning is Collaborative Learning Environment with Virtual Reality (CLEV-R), which is a web-based solution that applies Virtual Reality (VR) with multimedia in concert with communication-tools to enhance collaboration among learners (Monahan 2008). The potential for group e-learning is emphasized as virtual worlds provide shared quasi-realistic visual spaces for individuals to meet and interact by hearing and seeing another via avatars (Frances chi et al. 2009). This creates a sound environment for group presence and learning interactions. Related aspects of this potential e-learning best practice like avatars also

relate to general issues like trust. However, this cannot be further evaluated in the scope of this thesis.

In connection with Virtual Worlds is "edutainment", further pushing learning exchange and build-up via social groups (JISC 2007). This form of learning is emerging from game authoring technologies and is based on Virtual Worlds' assumptions. This successful development in e-learning is based on the understanding that children learn from gaming skills strengthening their understanding to take charge of their learning and to apply meaning to words by relating them to experience which is different from common teaching (Downes 2005). Edutainment, the blend of education and entertainment, is embraced already with interactive e-learning solutions (Williamson and Smoak 2005).

2.8.3 IS-Related Risks

The following section includes important IS related dangers and areas of concerns, which e-learning is facing successfully already. The related e-learning responses may be again promising for PKM and knowledge brokering for virtual project teams.

2.8.3.1 Big Data

As mentioned in the review of cloud computing, big data is a relatively new term concerning many different companies. The initial part of this section reviews a relevant article for the background description of the phenomenon. "Making Advanced Analytics Work for You", by Barton and Court (2012) observes how big data could fundamentally change the way a company operates. The article presents three interconnected and supportive competences that companies need in order to take full advantage of big data and related analytics:

- **Ensure identification of correct data in combination with the management of various data-sources:** when big data becomes optimized data it endows a company with a more granular and panoramic assessment of the environment. Identification starts with tracking usable existing data sources and exploring new sources. Problems or opportunities are specified and then data is sought comprehensively. The questions that the management has to ask for this new approach to work are which courses they could take if all required information would be available. Besides needed management support it also needs appropriate IT support, as current IT set-ups may deter creative data-collection and analysis. As a comprehensive rework of existing IT set-ups may take a long time, companies should prioritise selected quick-actions for recognition and connection of most relevant data.

- **Be able to construct advanced analytical models to forecast and optimise results:** this should be initiated by a question of identification of an opportunity and an assessment of how a model may enhance performance, rather than building a model based on data. Two recommended approaches are:
    - **Data mining**: statistical assessments on big data in order to classify patterns which may not be beneficial for management.
    - **Hypothesis-led modelling:** simulates processes and reflects on decision-making support as it reflects on which data and model are most suitable. Often the complexities of models are too high for application in business and therefore companies should seek for the model with the minimal complexities that still supports performance-improvement.
- **Promote a transformation of the organisational-capabilities***:* aim at data and models to produce improved decisions. An existing problem often results from an incompatibility between present company culture and skills and the new strategies of productively applying analytics. This is often aggravated by the fact that management-members sometimes do not have confidence in models or do not have experience with them. As a response to this, development of success-relevant and usable analytics is important. Also, embedded analytics inside easy-to-use applications for regular employees should be a priority. The cultivation of big data exploitation-skills is also extremely essential as the management has to understand the central relevance of analytics for trouble-shooting and opportunity management. Here, it is required for employees to learn through application in real-life scenarios.

Overall, the senior management has to steer efforts on data sourcing, model set-ups, and culture transformation (Barton and Court 2012). It has to be emphasised, in line with the article, which features a clear competitive strategy on data-usage and analytics, as well as a set-up of appropriate technologies, has to support all three presented sectors. Accordingly, companies have to look towards an integrated methodology for data sourcing and the senior management has to invest substantial efforts on the internal alignment of all business-units in order to support the strategy (Barton and Court 2012).

Another relevant article, that will enhance the reader's understanding in addition to the above section is the article "Big Data: The Management Revolution", by McAfee and Brynjolfsson (2012). This article describes how by making use of big data even traditional companies can gain better and more precise assessments and knowledge of their business,

insight which can later be used to optimise decision-making and forecasts, ultimately reaping competitive advantages. The authors highlight three major dissimilarities of big data and traditional analytics:

- Velocity of creating data in real-time endows adapting companies with agility for improving competitiveness.
- Volume factor lets companies' process huge amounts of data in single attempts.
- Variety of formats of big data such as images or GPS signals that exists in high quantities for almost every relevant topic starts a new epoch. This is supported by the fact that related technologies such as bandwidth or storage cost less so that new methods become more reasonable.

The article also confirms that big data-driven companies show enhanced overall business performance in terms of operational and financial results. Also, with the usage of big data, a new decision-making culture emerges. Before these decisions were often triggered by experience but big data now brings additional challenges or as the authors describe them, "muting the hippos", meaning the best-paid managers' opinions. Still, employees depend too much on perceptions and experiences and not sufficiently on data itself (McAfee and Brynjolfsson 2012). Therefore, habits need to be transformed, and managers need to let themselves be overruled by data after they have thoroughly reviewed the data-analysis.
The article presents five challenges for managers of big data:

- Leadership teams that present precise objectives, direct success factors and ask appropriate questions need to be established.
- Proper talent management has to ensure that the company has experts trained to work with extensive data and understand business requirements in a way that connects it with the potential of big data.
- Technology has to incorporate every relevant external and internal data-source by providing appropriate tools to cope with the speed, amount, and diversity of big data.
- Management has to ensure that information and related decision making rights are placed together.
- Company culture has to promote asking questions and avoiding pure experience-based decisions, as data-driven decisions have a tendency to result in better decisions.

Existing Practice from E-Learning

Given modern demands and digital infrastructure, combined with increasing mobile and tablet usage, as well as state-of-the art software platforms, innovation within education is becoming an integral part of teaching and corporate training (Pietrosanti 2013). As mentioned in the web 2.0 chapter, the potential of big data has to be related to its dangers as it encounters restrictions by human intelligence, which struggles to progress potentially leading to confusion (Keen 2007). In this area once more e-learning presents advanced solutions that may be applicable to knowledge brokering in virtual project-teams. Initially it is noteworthy that big data is another highly inter-connected discipline of e-learning, which for example links with the previously reviewed cloud solutions that support companies in analysing their gigantic data volumes.

E-learning presents various approaches and solutions thanks to the demand derived from the buzz-word big data, which is anchored in the science of data mining and data analytics technologies. It means that on-hand database tools and old-fashioned data processing solutions do not provide sufficient solutions for the challenges of capturing, correlating, searching, sharing, and transferring, to name but a few. (Pietrosanti 2013). One key advantage is that the leverage of big data analytics provides interactive and tailor-made learning-information that is the result of better tracking and monitoring user-experience according to individual skills and progress (Kumar 2013). A core challenge that is addressed by new fast and scalable integrated e-learning solutions is that users are generating big data via various channels and that a lot of unstructured data emerges efficiently (Pietrosanti 2013). This is data very complex to manage, store, and process. To understand the overall potential, various kinds of research are conducted within e-learning science to get an understanding of the potential heralded by big data. Some examples identify more accurately real behavioural patterns, learning styles, and preferences or areas that seem difficult are revisited and recommended frequently (Pietrosanti 2013).

Consequently, understanding what and how information is learned from data will be extremely valuable for better-informed decisions, identification of mistakes, as well as forecasting and taking preventive action. This is because potentially an individual's performances and failures as well as strengths in future courses can be predicted and accordingly trends and improvements of upfront programs can be tracked (Pietrosanti 2013). Overall, the big data innovation is currently game-changing, revolutionising and optimising e-learning and its results. That is because it supports the development and the

execution of personalised and adaptive learning programs and accordingly questions past learning design-principles and beliefs for the processes, the systems, and the design of e-learning and learning itself that are derived from former tracking options (Pietrosanti 2013). One example of big data in education that challenges past assumptions is the finding that new students are more likely to drop out of online colleges if they take full course loads than if they enrol part-time (Kelly 2012). In today's technology-driven world, we are usually forced spending most of our time with different digital devices. Here lies a huge potential area when our digital footprints can be tracked and explained in a learning-context which provides immense opportunities for improving effectiveness, adaptability, and extending possibilities of present tracking standards (Kumar 2013).

These advancements support the ROI and competitive advantage considerations and e-learning is considered as a low risk area to start with big data management (Pietrosanti 2013). Therefore various related software solutions arise on the market within e-learning. Two seemingly good examples are Knewton Technology (2013) and Civitas (2013) which aim to improve learner success. Due to big data enhancements, new types of data can be collected and analysed that were previously not available. Additionally, performance support is nowadays immediately provided for current problems without interrupting work or learning. E-learning science envisions a future of this with work-based support scenarios where every action of each learner is analysed and assessed in real-time and a support tool is provided whenever an individual requires assistance. (Kelly 2012). Although the roles of the e-learning trainer are examined in a following chapter, it has been emphasised already that this role has changed as the trainer supports individuals in coping with the information overload or better known as filter failure (Hart 2011).

2.8.3.2 Escalations of Implementations

Literature presented at the end of this section will provide evidence that e-learning is very well advanced in implementing related projects. To understand the difficulties of this process, the following section will summarise the main arguments from the article "Why Software Projects Escalate: An Empirical Analysis and Test of Four Theoretical Models", by Keil et al. (2000). The research assesses frequencies and durations of escalating IS-projects as well as their difference when compared to non-escalating projects, aiming at developing models to distinguish between both. The authors describe that more than 25% of IS projects fail. This phenomenon is referred to as "runaway systems" in which IS-projects go far beyond agreed budgets and deadlines by often resembling to an "escalation

of commitment to a failing course of action" (Keil et al. 2000). The authors describe how runaways actually seldom occur but that any occurrence will become extremely obvious. In contrast to this, escalations in fact take place much more regularly. When employees in a company conceal negative information from their management, science refers to this as the "mum effect". If managers are aware of negative information but deliberately decide to disregard it because of certain cognitive preconceptions, it is called the "deaf effect". Both of these effects, may cause escalations that take place due to occurrence of negative project status information that is not properly processed, and causing a continuance of what seems to be an inadequate course of action (Keil et al. 2000).

Software projects are frequently confronted with underestimated timelines and budgets and are more likely to encounter performance-complication and escalations (Keil et al. 2000). The implications that the article asserts are:

- **For practice:** results underline the relevance of highly qualitative communication and the monitoring of projects in order to prevent information asymmetry. Management should install alert systems that spot escalations at the earliest possible stage and agree at beginning of a project under which conditions it should be terminated.
- **For research:** escalations occur frequently and cause projects to produce inferior results when compared to projects that do not escalate. It is relevant that variables that are derived from multiple escalation theories be applied to distinguish between escalating and non-escalating projects. Escalation recognition is likely achieved by investigating the existence of specific behavioural factors instead of structural variables like size of projects.

Existing Practice from E-Learning

Again, e-learning presents very advanced practices in terms of project implementations and avoidance of escalations due to underestimated time-lines and budgets. Despite that some publications (Khan 2010) still argue around failures and their causes such as diffusion of innovation, most literature nowadays presents positive guidelines that are knowledgably based on lessons learnt from early e-learning projects and its failures (Romiszowski 2004). Key success factors highlighted from the literature include the development of a clear strategy, structured approach, and cultivating a greater understanding of the environment and related stakeholders.

Factors that define success in the context of e-learning initiatives are long-term cost-

reductions, improvement of individual, along with company performance, maintenance of core competences, and adaptability to markets and competitors (McGraw 2001). Consequently, the underlying learning strategy should consider benefits as well as limitations of the implemented e-learning technology and aim beyond content and delivery and towards a comprehensive approach, covering wide-range topics such as motivation, culture, productivity-enhancements, and skill development (McGraw 2001). Here it should be mentioned that successful e-learning implementations have based their strategy on a previously developed comprehensive learning strategy. This should be the result of identification and the cataloguing of existing learning content, gap-analysis, assessment of sizes, resources, and costs, determination of existing learning levels and suitability of current methods (McGraw 2001).

To ensure ROI, accomplishments and avoidance of the described information asymmetry, the already introduced importance on communication is evident, as ideal e-learning implementations clearly define communication plans, deliverables and principles (Cross at al. 2002). Overall, one of the most vital preconditions for achieving the aims of an e-learning implementation is the consideration of essential pedagogic aspects, which are still sometimes ignored (Govindasamy 2001). During effective launches, established e-learning practices present more avoidance of obstacles for learners as well as constantly monitoring of successes and deviations in order to continuously improve and sustain long-term successes and avoid negative project status (Cross at al. 2002). The stated structured approach should ideally consist of a systematic end-to-end process that covers planning, design, development, evaluation, and implementation (Khan 2005). Khan (2005) derived in the introduction referenced eight-dimensional framework that supports holistic implementations for e-learning projects. Eight dimensions (Selected sub-dimensions):

1. **Institutional** (Administration)
2. **Management** (Maintenance of environment and distribution of information)
3. **Technological** (Infrastructure planning and hard/software)
4. **Pedagogical** (Teaching/learning including content, audience, target, media analysis and design approach, organisation and learning strategies)
5. **Ethical** (Influence, cultural, geographical, learner-diversity, legal issues, digital divide)
6. **Interface design** (Look and feel: Page, content-design, navigation, accessibility, usability testing)
7. **Resource support** (Online support, resources)

8. **Evaluation** (Assessment of learner, instructor and environment)

Further lessons that can be learnt from successful e-learning project implementations is to have a thorough upfront analysis that targets a clear understanding of actual problems and causes by asking precise questions and developing the solution and implementation plan based on the findings (McGraw 2001). Example questions are (McGraw 2001):

- Are learners geographically dispersed?
- How will the organisation integrate and manage e-learning across the company?
- Which learning approaches and technologies will the organisation embrace?
- Do learners have consistent, reliable access to learning and information?
- What's the connection-speed for remote-users and is network bandwidth an issue?
- Are solutions standards-compliant, what are the security requirements and so on?

2.8.4 Management Theory, Models and Management of Social Aspects

As described, PKM relies on social and interpersonal interactions rather than only technological and process oriented tools. Persisting limitations of traditional IS and the procedures for PKM persist. Therefore the potential best practices application reviews not only new and innovative IS as in the above three sections, but also considers related developments of social and management aspects in the following fourth section. The codification relies on the easy and cost-effective accessibility of knowledge via technology, without the necessity of contacting the knowledge source. Therefore, it limits also the communication mediums' constrained richness in regards to bandwidth, customisation, and interactivity in contrast with the rich personalisation communication mediums that cater to the social aspects around context, discussions, and interpretations (Chai et al. 2003). The successful implementation of e-learning technologies to enhance the learning is already challenging. Besides the technological aspects it requires a blended approach of pedagogical and organisational components, which will be reviewed in the following sections (McPherson and Nunes 2008). This section accordingly also reviews summarising literature that emphasises the demand for holistic approaches including both technological, social processes, solutions, and summarises selected key findings from the previous sections by bringing them into the context of this section. This section provides a review of the most important topics from the area of management and social aspects, which highly relates also to the reviewed aspects from the three previous IS sections (Set-ups, trends, and risks).

Although some of the described aspects in the following section have already been reviewed partially in the initial review of KM literature, it is deemed necessary to further discuss the following aspects in detail in order to provide guidance in the context of the following management and social-related e-learning practices. This initial introduction-section also summarizes the key findings from the article "The Knowledge-Creating Company", written by Nonaka (2007), as it is highly important for the understanding of the following practices. According to the author, a knowledge creating company, continuously creates new knowledge, disseminates it widely, and quickly incorporates it into new technologies or products. As many managers fail to understand knowledge and its proper management, very few succeed in understanding the real nature of such a knowledge creating company. Therefore, they do not know how to manage it. Nonaka (2007) produces respectable and relevant arguments by distinguishing between:

- **Western management:** portrays knowledge as systematic or formally quantifiable and organisations as machines for information-processing
- **Japanese approach:** states that new knowledge creation is not only processing of information but strongly depends and is made available by rather subjective tacit insights and intuitions or presumptions of individuals.

Accordingly, tacit knowledge is defined as extremely valuable, but also consists of subjective observations, which are placed within the brains of the employees and therefore challenging to capture. Underlying this fact is that an organisation is not a machine but a living organism with a degree of collectivism related to identity and purpose. Here personal commitment becomes key for exchange between tacit and explicit knowledge in both directions and enables constant re-creation. Therefore knowledge creation should be put into the focus of the overall KM, and HR-objectives (Nonaka 2007). The author rightly emphasizes the four standard patterns for knowledge creation, cited also from Snider and Nissen (2003):

- **Socialization (tacit to tacit):** very seldom-used form, which cannot really be leveraged.
- **Combination (explicit to explicit):** does not help to extend overall knowledge load.
- **Internalisation (explicit to tacit):** explicit knowledge is internalized by staff.
- **Articulation (tacit to explicit):** described in the following model.

The necessary transformation of tacit into explicit knowledge, as well as the dynamic interaction of the four patterns, is described with the relevant "spiral of knowledge" model. In this section, the starting point consists of tacit knowledge that is personal and difficult to communicate or formulate such as cognitive or technical skills or "know-how" and the ending point is formed by explicit knowledge that can easily be shared (Nonaka 2007). It widely regarded that that the Japanese succeed very well in exchanges between tacit and explicit knowledge and as Internalisation initiates Socialisation, the knowledge base increases (cf. also Goffin et al. 2011). Nonaka (2007) furthermore explains this by three means, which are hard to differentiate, because of the fact that figurative languages as well as symbols are the strongest tools for conversion of tacit into explicit knowledge:

- **Metaphor:** depicted as an enabling technique allowing employees with different backgrounds to intuitively understand a topic by means of symbols or their imagination. Very useful in the beginning stages of knowledge-creation as it allows direct commitment for the creative development and can be used by merging two distinct thoughts as a special trigger.
- **Analogy:** more precise process for evoking contradictions or similarities.
- **Creation of a model:** by applying systematic logic that resolves contradictions it makes concepts transferable.

Another relevant, key message is Nonaka's (2007) description of management of a "knowledge creating" company as a process from "chaos to concept". It starts with redundancy, which means the conscious intersecting of information, activities, and responsibilities within a company. This seems as being fundamental as it is encouraging a "common cognitive ground" that initiates communication and dialogue. Nonaka (2007) assigns three different groups, whose dynamic interaction cause new knowledge:

- **Front-line employees**: become caught up in own narrow responsibility, lose understanding of broader context and have to be managed necessarily by reflection.
- **Managers:** have to navigate chaos into purposeful creation of knowledge and endow "front-liners" with guiding conceptual-framework.
- **Senior managers:** have to articulate described symbols, metaphors and concepts, which provide orientation for knowledge-creating process of subordinates, expressed in the "conceptual umbrella".

Also, in relation to this PhD thesis, Nonaka (2007) states that teams play an essential role in a "knowledge creating" company in which team-leaders or the so called "knowledge engineers" become the intersection of information, both horizontally as well as vertically. Also, the author highlights that explicit knowledge is rather leaky, whereas tacit knowledge is embedded.

As a follow-up to the actions described in the previous article, it becomes vital for a company to manage the created knowledge. For this, Hansen et al. (1999), provide relevant guidance in their collection of the still mostly valid argumentation "What's your Strategy for Managing Knowledge?". Relevant arguments of this paper are reviewed in the following section. Despite the fact that, the research of this PhD thesis observed that companies, and especially virtual project-teams, still struggle to properly manage knowledge, this topic has already been discussed in management theory since the 1990s. Since then the developing IT has arguably started to enable organisations to capture, exchange, and store knowledge in a more economical way (Hansen et al. 1999). Accordingly, the authors also claim that the theory of KM is too new to science and that no proper guides or models yet exist as outlined before. This has been fully validated, but at the time the authors published this article end of the 1990s and it has only partially changed until today. Nevertheless, the article provides a relevant explanation of the two underlying technology strategies and contains many thoughts that still influence KM today, wherefore this article is a centric part of this literature review:

- **Codification strategy:** knowledge is meticulously collected, stored and accessible for every user. Enables a huge amount of employees to use knowledge without getting in contact with original producer and accordingly allows economies of scale by saving re-sources.
- **Personalisation strategy:** knowledge is narrowly anchored within the developer itself and mostly exchanged through human interaction. Instead of knowledge databases, this strategy emphasizes the building of people networks and dialogues, which appear mainly in the form of brainstorming and conversations. This can be supported by elec-tronic means such as email or video-conferencing services. The on-going exchange will obviously create deeper understanding and the adoption of either strategy highly depends on the company's needs and business model.

Remarkably, the authors observed that the most productive organisations were

concentrating on one strategy, while using the other one only as a supportive side-tool (80:20). It is accurately stated in the article, that KM-strategy of an organisation has to mirror the overall competitive strategy. Again reference is made to the ultimate value proposition, since the end customers will profit more from a proven qualitative knowledge-system instead of solutions that have yet to be perfected. Accordingly, the codification strategy enables an organisation to capture "economics of reuse". This means that existing knowledge is effectively available in terms of time and costs and does not have to be modified or reproduced again (Hansen et al. 1999). Consequently, this will free more resources for additional projects as it reduces, for example, communication-costs or workload. In contrast to this, the authors mention critically that the personalisation strategy builds on "expert economics", which means production derived from tacit knowledge, which consumes more time as well as costs. The article provides an important general suggestion for dealings with KM theories: managers should not inherently pursue conversion of tacit knowledge into explicit knowledge, as this could lead to problematic situations.

The following e-learning practices review presents issues that are already addressed by e-learning and accordingly explained relating to the necessity for up to date information, processes for conversion of chaos into concepts with consideration of a conceptual umbrella and lifecycle stages. Good examples are evidenced in the e-learning practices applied by Japanese firms for solving the issue of subjective observations. These are placed within the brains of the employees and thus challenging to capture. The usage of figurative language and symbols are the strongest tools for conversion of tacit into explicit knowledge (Articulation) (Nonaka 2007). The distinct aspect around models, analogies, and metaphors will be accordingly reviewed in a separate part. Likewise the personal component is a re-occurring and mentioned key as a influencer of knowledge and e-learning success and accordingly the remaining practices sections focus on these issues around personal commitment and the team-cooperation. Management buy-in and top down drive paired with discussed integration, standardisation, incentivising, and performance measurement topics are other distinct topics that are discussed in separate e-learning-practice review-sections as well. These present advanced solutions for the addressed issues like lack of incentivising or mechanisms for codifications, confusing databases or lack of awareness, consistency, transparency, and appreciation of existing knowledge.

2.8.4.1 Knowledge Marketing

After having reviewed the literature that summarised the knowledge creation and management strategies most effectively as an introduction to the fourth practice-category around management, the following section is dedicated to an article chosen to support the understanding of the management related current e-learning practice of knowledge marketing. This is done by explaining how to potentially optimise the knowledge brokering process by referring to an internal knowledge market. This exists between experts and knowledge seekers, and is observed to be often inefficiently managed. "Strengthening Your Organization's Internal Knowledge Market" by Matson et al. (2003) introduces the topic with a reference to the 1990s in which a literal KM "boom" with a lot of ineffective investments by organisations into the topic happened everywhere. However, it is also stated that a halt of investments would likely worsen situations. Therefore, a company would have to focus on optimisation of their investments into KM in two areas. Top-down, the management has to have a clear understanding of the business' problem and has to be precise about the facts that are blocking the knowledge flow in order to fix problem. What is relevant are the typical stated failures and reasons for it as well as remedy (Matson et al. 2003):

- **Non-existence of mechanisms for codification**: knowledgeable staff do not recognise how and when they shall codify gained knowledge. Creation of standard formats along with the provision of support for development, in case of the need for extra content or support.
- **Lack of incentivising to stimulate codification:** creating recognition for knowledge shared and highlighting the importance of sharing knowledge through all internal communication channels and the company's promotion and performance review processes can help.
- **Unproductive and overlapping databases and systems**: confusion of employees searching for knowledge due to high quantities of even wrong or obsolete knowledge. Application of various search metrics, usage of a proactive push principle for chosen knowledge and synthesizing knowledge for certain groups to facilitate. Coordination can be achieved by the set-up with a single source that is able to store all documents and profiles of the mentioned subject matter experts.
- **Stored knowledge not seen as a value or asset:** causes employees not to search in systems at all. Quality control measures and reviews are important.

- **Lack of transparency and consistency within knowledge architecture**: leads to heterogeneous interpretation of locations and inclusions of certain documents. Can be countered by setting-up and controlling definitions of metadata, maps of categories, as well as conducting audits that review outdated, redundant, and unused content.
- **Informal networks:** will never reproduce entire company knowledge and consequently knowledge guides or brokers have to be established, which provides assistance to employees.
- **Delegation of KM to the management of individual business units:** leads to redundant responsibilities and processes that can be prevented by overall corporate standards that are supported by knowledge sharing incentivising and measurements.
- **Problem of intellectual property:** unprotected knowledge may leave the organisation and lose its value. This could be overcome by comprehending the lifecycle stages of the knowledge and its properties and then push potential concepts rapidly across the organisation to ensure highest utilisation of this advantage in a stage where it is still unknown to the external market. On top of this, a company also has to improve and renew knowledge that has become irrelevant or revealed to external markets.

In relevance to the thesis, the authors pinpoint that the management has to review the knowledge marketing processes and identify stagnation and their causes as soon as possible, before solving it with effective measures. Ensuring a market-view in this situation ensures avoidance of redundancies, emerging business-related problems that waste resources as well as poor decision-making. It is important to firstly understand how internal knowledge markets can be impacted, as these have to be steadily regulated and failures may occur frequently. The metaphor of a market is wisely chosen as transparency and a high amount of liquidity is also needed as prerequisites for a working knowledge markets (Matson et al. 2003). However, knowledge markets may differ in terms of expansion drive, since only selected employees provide or search for knowledge. The authors rightly highlight that the management can substantially increase this perception of value and reduce the transaction costs for searching.

Only after gaining this comprehension will the management be able to overcome the real problem that lies in the understanding of how manipulating the frame conditions in different market situations can favour the KM (Matson et al. 2003). A reference is made again to a market-oriented point of view that only works if the corporate targets are well defined helping companies to understand and overcome obstacles of sharing the right

knowledge. It is relevant that this point of view also helps to reduce redundancies and avoid ineffective decision-making, by taking into consideration available knowledge (Matson et al. 2003). We have to understand that after a thorough analysis of knowledge demands and most critical market mistakes, a company has to strive to provide the appropriate knowledge to the appropriate people in the appropriate time (Matson et al. 2003). In order to achieve this, obstacles can only be overcome by measures that are built on objective market diagnosis. The ultimate goals of effective knowledge markets require appropriate processes, measurements, and underlying infrastructure that continuously improve (Matson et al. 2003).

Existing Practice from E-Learning

The special analogy of knowledge markets and marketing is used successfully in e-learning theory and exists beside the various other terminologies such as knowledge communities, chains, or supplies (Mentzas et al. 2009). As defined in the reviewed article, knowledge markets are transparent with a high amount of liquidity. Knowledge marketing processes and identifies stagnation and their causes as soon as possible, solving them with effective measures. Establishing a market view in e-learning ensures avoidance of redundancies, emerging business-related problems that waste resource, along with poor decision making due to uncoordinated approaches. In line with the presented article, here the market is portrayed within e-learning as a planning centre that aims towards standardisation as well as coordination. Accordingly, companies have to understand how internal knowledge markets can be impacted and that management can substantially increase this value perception and reduce the transaction costs for searching (Matson et al. 2003). After a thorough analysis of knowledge demands and most critical market mistakes, a company must strive to provide the appropriate knowledge to the appropriate people at the appropriate time. In order to achieve this, obstacles can only be defeated by measures that are built on objective market diagnosis. The ultimate goals of effective knowledge markets require appropriate processes, measurements, and underlying infrastructure that is continuously improve. Here, e-learning has various solutions to support companies with the required marketing set-ups on both corporate as well as a personal level (Li and Liu 2008).

2.8.4.2 Ownership of Learner

The following section starts directly with the review of e-learning practice in order to

identify a potential solution of constraints around limited time and so on from global PKM. It will be the same in most of the following chapters. As for the following concepts only limited technical or complex background literature review is required for comprehension, the following chapter commences with the practices from e-learning. It will only partially be referring to important background literature to emphasise significance and relevance where necessary.

This is valid for a sense of ownership among learners, as one of the exceptional characteristics of e-learning is that it enables the leaners to take ownership and control over the learning output via the adoption of multidimensional means of multiplicative communication (Garrison and Anderson 2005). This correlates with the overall trend of evolving augmented internet-users that approach not only gaming but also working and learning in new ways: being called “digital natives or “n-gens” these individuals are absorbing and authoring information rapidly via various sources and media types simultaneously by having preferences for input on demand, widely accessible, and inconstant communication with peers, expecting immediate responses (Downes 2005). In the same way markets are also getting more intelligent, organised and up to date. Scientists describe new related phenomena like augmented learners as similar to open-book exams, being allowed to use smart-phones, and augmented workers learning informally in hyper-organisations (Cross 2014). This is also in line with the progress of abolishing structures from prior internet eras that deal with intermediaries that are being disregarded, while consumers are getting increasingly active and engaged, even directly with producers successfully requiring new standards for accountabilities and transparencies (Downes 2005).

In order to allow the learner to effectively take ownership and control of the learning, e-learning solutions have been adjusted. Accordingly, the trend of becoming "learner-centred" in terms of design has developed beyond customising options for different learning styles or preferences and on to endowing the individual learner with direct control of learning itself (Downes 2005). Our increasingly consumer/client-centred culture is nurturing this shift. Student-centred learning is nowadays defined by high autonomy, a focus on active learning, creation, communication, participation, as well as changing roles for the teacher and student, which will be further reviewed in a later chapter (O’Neil and McMahon 2005). Accordingly, e-learning practice now promote the empowerment of control for learning individuals when using e-learning tools and working through content at their own pace. This is proven by practical examples like e-portfolios where learners are

provided with responsibility of achieving assigned learning targets and documenting their progress (Ipurangi 2014).

2.8.4.3 Interactivity and Integration

As described in previous chapters, e-learning is naturally a multi-device blended learning process and inclusion of cloud and web 2.0 prove the integration aspect already, as claimed by Pietrosanti (2013). This only provides the framework for the actual requirement of integration. Successful e-learning also promotes interactivity between individuals by producing the introduced theories of self-motivational tools and communities. All demonstrated technologies and practices support interactivity and communication not only between instructors and learning individuals but also between those learners themselves (Kahiigi et al. 2008). This is another very interesting aspect to potentially become a relevant best practice application in virtual project teams. The interactive aspect of e-learning is best illustrated with the following models. The conversational framework from Laurillard (1993) describes an iterative exchange within the teacher-student relationship and argues that this supports high-level cognitive skills.

Salmon's Five Step Model (2000) indicates a positive progression in the teacher-student model but also student-student relationships with regards to intensity of interaction as well as quality. The suggestion lies on an environment that focuses, as previously argued, on the learner and in which the teacher assumes an instructing character that adapts according to the learner's requirements and context (Salmon 200). Another relevant model is the Content Communication Collaboration Model that facilitates mapping of the various learning activities like presenting, interacting or practising (Dempster 2004). This last model deals with multiple methodologies as well as technologies for facilitation of higher integration between the described activities (Dempster 2004).

The integrated idea is also developed by Omwenga and Rodrigues (2006), who established a framework that enables validation and evaluation of e-learning processes in the integrated e-learning environments. By considering both pedagogy as well as contexts, they promote e-learning in flexible and integrated approaches. Overall, the models arguably explain the necessity and importance of interactivity and again the described build-up of (social) communities and supporting culture for successful and integrated e-learning via a blend of the various explained e-learning themes. Even beyond the ownership topic of the previous chapter, Siemen's Connectivism emphasises that

competences are derived from building connections and that away from meaning-making tasks in former constructivism, chaos is a new reality for knowledge workers that dictates that meaning exists and challenges the learning-individual to identify hidden patterns in it (Siemens 2004). Besides collecting facts and developing meaning, building interactive integrations of knowledgeable communities is key to success. This is internalised in the previously reviewed e-learning technology advancements, especially within e-learning 2.0 and social community reproductions (Chatti et al. 2008).

2.8.4.4 Ease of Use and Usefulness

One central point that is often discussed within the context of e-learning is the prediction of adoption of innovative technologies. In this regard, the previously referenced Technology Acceptance Model (TAM) is most commonly used and also forms the basis for new concepts that evolve. The TAM itself was invented by Davis (1989) using general user satisfaction as a benchmark-index (more precisely: perception of ease of use and usefulness, relating also to user interfaces) for the assessment of the quality of ISs and related sufficiency for the tasks that were aimed to be performed. In this sense, the TAM links the confidence in usefulness with the intent of the actual usage. This contrasts with other theories, such as the Theory of Reasoned Action (Azjen and Fisbhein 1980). The authors of this theory argue that there is only an indirect link between the trust in usefulness and the usage-intent via the user's attitude that is impacted by the confidence and in return, influences the intentions. The scope of this study does not allow further discussion on these models and theories like the theory of reasoned action, which is a part of trust of knowledge. One respectable example in which the TAM was used as a basis, is depicted in the enhancement from Yuen and May (2008). In addition to the two mentioned variables, subjective norms, self-confidence and intention to use the system are included in Yuen and May's (2008) revised model.

Overall, and also based on the findings from Bandura (1982) around self-efficacy that will be discussed at a later stage, it is deduced that these models help to understand how (e-learning) systems support individuals in increasing productivity, effectiveness and performance. However, it has to be emphasised that all of the models still face certain difficulties and limitations. With reference to previously reviewed practices from e-learning, Wiley (2002) has pinpointed the previously reviewed minimum requirements for easy to use and useful e-learning platforms. These ideally consist of structured data that can be transferred to different software systems (SCORM = Sharable Content Objective

Reference Model), metadata and managed content (information, communication and learning material including areas for interaction and exchange). Furthermore and in line with present e-learning practices, Wiley (2002) pinpoints the necessary basis for a successful design by mentioning the following three elements:

- **Formative frame**: Design of the used platform
- **Training content**: Training material itself
- **Training agents**: Users (further analysed in a following section of this thesis)

2.8.4.5 Team Cooperation

A further issue that is related to the management and social part of current e-learning practices is brought up by Arbaugh and Benbunan-Finch (2006). These scientists argue that if the transfer of knowledge is connected with the advantage of team cooperation, it ultimately leads to a better opinion and promotion of learning. Consequently, the previously reviewed portfolio of models and theories proves the fact that there are different understandings of the main imperatives that influence accomplishments of e-learning solutions. This includes for example not only factors such as design, ease of use or usefulness but also knowledge transfer from team-cooperation. However, research in this area is still proceeding and continuously reveals new explanations and introduces new initiatives, partially also reviewed in other areas (Holsapple and Lee-Post 2006).

Overall, modern e-learning solutions are widely recognised as support tools for cooperation within organisations and teams (Smejkala et al. 2013). As discussed previously, social state-of-the-art e-learning solutions like e-learning 2.0 or virtual-worlds with human avatars can support team-cooperation, especially in instances like dispersed work environments where learners cannot (regularly) meet personally with other team-members (Hansen 2008). As aforementioned, in this context of cooperation the team-leaders ideally become brokers or so called “knowledge engineers” working as the intersection of information both horizontally and vertically to foster cooperation (Nonaka 2007).

2.8.4.6 Entities and Roles within the Execution: E-Learning Manager = Knowledge Broker?

In conventional training environments teachers are specialists within the area of what they demonstrate. In modern e-learning environments it is observed that teachers become more of something akin to managers or guides. Their new responsibilities comprise of helping to ease the learning-process by actively providing guidance and mediating the entire learning-

project (Resta 2002). In addition to this, it has become increasingly the case that new e-learning managers endow their audiences with sustainable value through teaching them to "learn how to learn" (Garrison and Anderson 2005). Also promoted is "one's belief in one's ability to organise and execute the actions required to produce the expected outcomes" (Bandura 1997). This is called self-efficacy. In various sources from the area of traditional teaching and related performance, this term is discussed and thus, a self-efficacy theory has evolved. Within this principle, Bandura (1997) mentions four main causes for self-confidence. Consequently, the teaching manager has to have experience, ability to observe, persuade verbally and an appropriate affective and physical status. Hodges (2008) rightly observes that this concept is developing in modern e-learning.

There are various reference models that summarise these new skills and competences that are needed by successful learning managers. Three of these theories are discussed. Firstly, the International Project Management Association created a standard called the IPMS Competence Baseline (ICB) (Project Management Institute 2008). This definition comes interestingly from the PM field but is also applied within learning management and constitutes three elements:

- Behavioural
- Technical
- Contextual

Secondly, Marsh and Hattie (2002):

- Relevant knowledge
- Training
- Innovations
- Successful integration of systems/software as well as communication

Finally, Berge (1995) adapted from Ryan (2000):

- **Pedagogical**: Discussions, Questions/Answers
- **Social**: Establishment of suitable environment
- **Management**: Guidance
- **Technical**: Transparency of Software/System

Increased capabilities in a particular area lead to increases in the overall success rate of the

projects. One example is the technical aspect. It is proven, that higher IT expertise of the learning manager leads to more interactive projects that consequently lead to increased facilitation of learning for the individual (Lonn and Teasley 2009). The abovementioned skills should also be considered by companies which are trying to hire adequate candidates as well as develop internal trainings. Again, in these modern contexts, information transfer models have to be normally distinguished from learning models that resemble tutorials. As explained before, Bork (1999) describes the latter form as having strong interaction between both entities but the expert limits himself to orientation and guidance on how to communicate and access information. The information transfer model, however, aims at knowledge retention by the use of technologies and does not refer to problem solutions or application of knowledge to future problems.

As previously defined, knowledge brokering is understood as the transfer of knowledge through individuals of projects (Ajmal and Koskinen 2008), as in the portrayed case of the PhD thesis. Again, this can also be achieved by individuals who do not necessarily have to be a part of the project core team (e.g. by outside specialists or consultants). As discussed, knowledge brokering is interpreted in different ways depending on the context and the theories are not yet clearly developed with regards to functions of knowledge brokers, as well as the participants in the actual transmission of gained knowledge in virtual teams. Besides contributing to the overall research, this also connects to the best practices potential of e-learning managers, as the primary target of knowledge brokers is the facilitation of knowledge sharing and exchanging. And in this regards again, e-learning provides potential best practices, as e-learning managers facilitate knowledge transfer by easing learning processes with guidance, mediating and teaching how to learn as explained previously. Both the e-learning manager and consequently also the knowledge broker, ideally become a guide or catalyst, not necessarily an expert. It is emphasised again that these functions heavily rely also on an informal network (Matson et al. 2003). Also skills such as training experience, ability to observe and persuade, and technical skills including as contextual knowledge are obviously important success factors, in line with the three portrayed models.

2.8.4.7 Entities and Roles within the Execution: Learning Individual = User Of Previous Projects' Knowledge?

In conventional contexts, the learner mostly plays a passive role. Under the application of innovative and more open simulations within e-learning which were described above, the

part of the user shifts to become more influential and significant. Besides the previously highlighted necessity for ownership of the learner including student-centricity and high levels of active choice and control (O'Neil and McMahon 2005), according to Horton (2000) these individuals are characterised by:

- **Privation of resources:** space or time to attend conventional face-to-face sessions.
- **High motivation and self-discipline:** clear targets, time management and self-expression.
- **Perceived demand for training and particular knowledge:** although a certain amount of prior knowledge within the field to be trained normally exists.
- **Open-mindedness:** towards innovations and technologies.

Referring to the analysed TAM and self-efficacy theory, two indicators are key to the successful use of systems by the learning individuals. On the one hand, science presents perceived usefulness derived from research on motivation and expectations (Bandura 1982). On the other hand, perceived ease of use and related flexibility, simplicity and control of the system is presented (Davis 1989). Consequently, the role of the learning individual has high relevance for success of e-learning (Van Raaij and Schepers 2008). The overall quality of e-learning projects is often positively connected with the above-described abilities of the users as well as their overall acceptability (Ho et al. 2010). The latter reference to acceptability is especially referring to awareness levels, motivation and resistance to change (Folorunso et al. 2006). This potentially imposes a significant prospective for improving knowledge brokering in virtual project environments and related change management. The relevance of this is again proven, as two of the most mentioned factors within the rating of existing models are the perception of value adding and existence of previous IT training. The second factor also applies to the learning-manager and is added by the necessity of being able to create and deliver a knowledge basis that can be trained (Mahdizadeh et al. 2008). Therefore, it is demonstrated that overall sustainable success can only be achieved by integrations of both entities with appropriate environments. This has to include proper PM, which should be transferred into knowledge brokering initiatives.

2.8.4.8 Reflection and Progression

Just as important as in research fields, reflection and progression is also a major part of established e-learning practices. It has been discussed in many ways, that e-learning has enhanced the learning process with improved accessibility of knowledge as well as

techniques that base on interactivity. In the same way, this may achieve an improvement of knowledge brokering in virtual project teams by applying similar processes. The following section will provide again an insight into an established e-learning practice with particular focus in this case on higher education and the originating underlying drivers, as well as the evolution process which e-learning has adapted. This is done with focus on reflection and progression. Looking into the higher education organisations and analysing where the major changes of their structures over the past decades came from, Sing et al. (2005) argue that this was mainly coming from introducing new technology-driven concepts such as e-learning. The flexibility of e-learning has successfully improved the learning process by overcoming and finding solutions for impeding factors such as time, distance, costs or other personal situations like work or family care (Sing et al. 2005). Higher education organisations have adapted e-learning technologies also, because of this catalysing effect on solving inflexibilities and problematic structures (Shabha 2000).

As aforementioned and in keeping with the knowledge brokering problem, e-learning has converted traditional learning and its related models, strategies and processes and therefore made adapting organisations more competitive (Graven and MacKannon 2005). Referring to the mentioned competitive pressure in current international markets, especially related to the projects' knowledge brokering, non-adopters or weak performing organisations may face severe risks in a similar way. With regards to the higher education world, the mentioned conversion is especially due to the following reflections and process-progressions and factors that are enabled by e-learning are (Kahiigi et al. 2008):

- Increased demand for alternatives of traditional learning offerings and availability or learning resources
- Collaboration that provides new research potentials
- Increased amount and mix of on- and off-campus students in addition to so-called life-long learners and individuals that demand education in the workplace
- Increased demand for skills and knowledge from employers
- Meeting increased learning demands while reducing required costs
- Initiative to become part of the knowledge society and its knowledge based economy

In this context, the literature repeatedly provides two further highly important factors that have been mentioned also in this PhD thesis before but which are highlighted at this stage again: Firstly, the shift of the focus from the teaching to the learning individual is highly

supported by adoption of a facilitating role by the teacher. That supports that learning individuals in return take possession of their personal and learning development (Sherry and Wilson 1997). Secondly, effective e-learning highly relies on a consideration of the integration of both pedagogic and technology. This is because a simple conversion of conventional learning content into flexible new electronic forums will not succeed properly (Govindassamy 2002).

2.8.4.9 New Trainings: Integration of Pedagogy and Technology

Conventional teaching practices have to be adapted and redesigned. Teachers have to be trained in order to be able to assume their new facilitating role in e-learning effectively as they also face new educational concerns, differing or more intense work patterns and need to acquire the skill-sets to manage the online learning platform itself properly (Kahiigi et al 2008). The same publication rightly presents three main issues:

- **Improvement of ICT skills:** the usage of e-learning improves in terms of administrating, (social) interacting, motivating and time needed, the higher the skills of ICT for both the learning as well as the teaching individual get for gaining comfort and confidence around ICTs
- **Technology use:** this argument tightly relates to general concerns about the transmission of more and more data over technology as well as certain personals concerns especially by the instructors around changing or increasing work patterns, loss of personal face-to-face relationships or simply conservatism and the previously described opposing against change
- **Identification of underlying pedagogy:** e-learning trainings are ideally two-folded and linked as neither pure technology nor new pedagogic approaches in itself will not succeed

As mentioned, effective e-learning highly relies on a consideration of the integration of both pedagogy and technology, since a simple conversion of conventional learning content into flexible new electronic forums will not succeed properly. The same may be valid for knowledge brokering in project teams and the virtual aspect.

2.8.4.10 Required Management Buy-In and Incentives

As McAfee (2006) and other related literature has stated, top management commitment is in general required in order to let a KM initiative become successful. This is emphasised

by Hansen et al. (1999) that are right in emphasising that proper KM has to be actively driven by the CEO and a dedicated top manager instead of being treated as an isolated activity, which can endanger losing overall competitive advantage. This is not only valid for the overall approach but also to parts of the described e-learning and PKM areas, like for example outsourcing (Quinn 1999). However, it has to be noted that this leadership role is a delicate one, as it has to adapt continuously especially from an initial active stimulus strategy to a passive one without too much intervention once the initiative is ramped up (McAfee 2006). Besides the implementation of professional set-ups, processes and trainings a top-down management support is required for effective e-learning (Kahiigi et al 2008).

In order to succeed with both the initial change and operational implementation, and also ensure the long-term sustainability of the new approach, e-learning necessitates comprehensive commitment from the senior management to push for the change but also adapt related other processes in the organisation and review results. This is a difficult task as many organisations may still be historically built too rigid and not geared towards new technological integrations. To prevent limited uptake of technology and ineffective use of technology to support learning, Schönwald (2003) also highlights that e-learning employments are serious endeavours which involve important aspects such as the necessary change from top-management of processes from the areas of strategy, organisation, economy, culture and didactics that consider all effected stakeholders. This holistic angle is another success factor that will also need consideration for virtual project teams and their knowledge brokering. Overall, the utilisation of knowledge has to be intensively encouraged by the senior management and a related corporate culture and the utilisation needs thorough evaluation through project evaluations or audits (Beijerse 2000).

Besides extrinsic and intrinsic motivation, and in conjunction with the central leadership buy-in, appropriate incentive measures contribute to forming a supportive behaviour and culture and ultimately contribute to the success of e-learning as mentioned also in previous chapters like the ones related to governance or outsourcing (Ajmal et al. 2010). Accordingly, as outlined before, other than technology, a multi-faceted approach of KMS should include important organisational and cultural aspects, such as the shift from traditional award of staff for individual performance and know-how towards an incentivising for sharing and contributing (Alavi and Leidner 1999b).

2.8.4.11 Visualisation and Imagination

As outlined in the literature review and the knowledge marketing practice section, visualisation and imagination have a key role. With regards to these two aspects, e-learning applied modern practices by solving the issue of subjective observations, which are placed within the brains of the employees and therefore challenging to capture. This is achieved as outlined by the usage of figurative language as well as symbols as strongest tools for conversion of tacit into explicit knowledge (Articulation) (Nonaka 2007). This aspect deals with models, analogies, and metaphors that increase the effectiveness of e-learnings. In this context Japanese theories have been incorporated into e-learning as described (Nonaka 2007). The increased usage of visualisation as well as creativity and imagination is also obvious in various previously described practices, such as edutainment. As discussed before, visualisation permits access to the accomplished knowledge from one individual to another one and works as a conceptual bridge to enhance both quality and speed of the transfer (Meyer 2009). E-learning focuses on supporting the cognitive process for creating and transferring knowledge with the power of visual formats to overcome challenges that arise for example from information overload and the identification of relevant information from stakeholders or consideration of heterogeneous cognitive backgrounds (Meyer 2009).

2.8.4.12 Incorporation of Society's Paradigm Shift: Knowledge Society

Aside from the discussed micro-economic management considerations like top management commitments, role models or reviews and support for shortcomings, e-learning theory and practice has sought to effectively incorporate the macro-economic paradigm shift towards the information and knowledge society. As highlighted in previous chapters, e-learning succeeded not only with adaption of society's paradigm shift away from traditional more into electronic and personalised training needs. Rather, more recently, e-learning also supports companies to remain part of the competitive knowledge society and its knowledge-based economy. E-learning science even goes already beyond this. It states that not only working and learning but living and learning will eventually merge and the challenge will not reside in the problem of how to learn, but in how to use learning to create something new, in reference also to communication (Downes 2005).

2.9 Summary of Literature Review and Potential Best Practices

The following chapter summarises the literature findings by referencing it to the conceptual framework in relation to the following research-conceptualisation. Also it

authoritatively refers to the main relationship and research questions to be empirically studied. Amongst others, Williams (2008) shows that the important knowledge transfer between virtual projects is inadequate, notably the example of sharing best practice through project-reviews. The field of e-learning shows potential best practices that benefit virtual learning and knowledge exchange, so the potentials of merging features of e-learning with features of KM and PM has been chosen as the area to pursue in this thesis. Knowledge is accepted as a key asset for competitiveness, interest in KM is increasing in most organisations, and organisations are developing more project-oriented business models without the expertise to manage related project knowledge, so a joint approach in terms of PKM is beneficial (Ajmal et al. 2010).

E-learning is creatively managing challenges similar to those of KM, like the necessity of partnership, interest and a trust-base. Support (altruism) with e-learning solutions that are more oriented with human-needs and match their expectations in terms of control etc. have been established (Levy 2009). Basic PM tasks have to be enriched by key KM-solutions in order to ensure continuous learning and resulting competiveness (Ayas 1996). According to Palacios-Marques et al. (2013), true value can only be created when the entire approach and set-up are aimed towards innovativeness, complementarity, loyalty and efficiency.

A review of features of the fields of KM, PM, knowledge brokering and e-learning, defined the 25 described practices that have been selected to be reviewed further, as they form a link between PM, KM and virtual project teams and may potentially improve these. As claimed within the research, there is no single deliverable that enhances lessons learnt and knowledge-exchange in virtual project set-ups, so these 25 different but inter-linked aspects from e-learning cover a wide scope, enabling current practices for potentially overcoming PKM limitations, including management support, routines, culture and incentives, to be evaluated. In order to allow the reader a better overview and understanding of each of the 25 items, a summary table with the key findings from each aspect is included in Appendix II. This explanatory glossary also served the experts during the Delphi study that is described later.

At this stage, after the thorough literature discussion, it is important to position the conceptual framework of this study. Generally, conceptual frameworks outline potential courses of action and present the approach used to address the central premise of the research (Botha 1989). In the case of this thesis, it acts as a map to ensure close coherence to the empirical study. In the form of a transitional theory model, the conceptual

framework aims to connect all the relevant aspects of the study (Botha 1989).

Figure 2.3 presents the conceptual framework of the thesis and focuses exclusively on concepts that are directly related to e-learning, PKM, and brokering for virtual project work. Accordingly, these components of the conceptual framework were chosen based on academic and business relevance to the field of study, availability of reliable sources, along with the personal interest and knowledge of the author. In addition to the said components, further related topics have been reviewed solely to provide the author with a deeper understanding of the wider fields. These issues are, thus, not depicted in the framework as they are not explicitly integrated in this study.

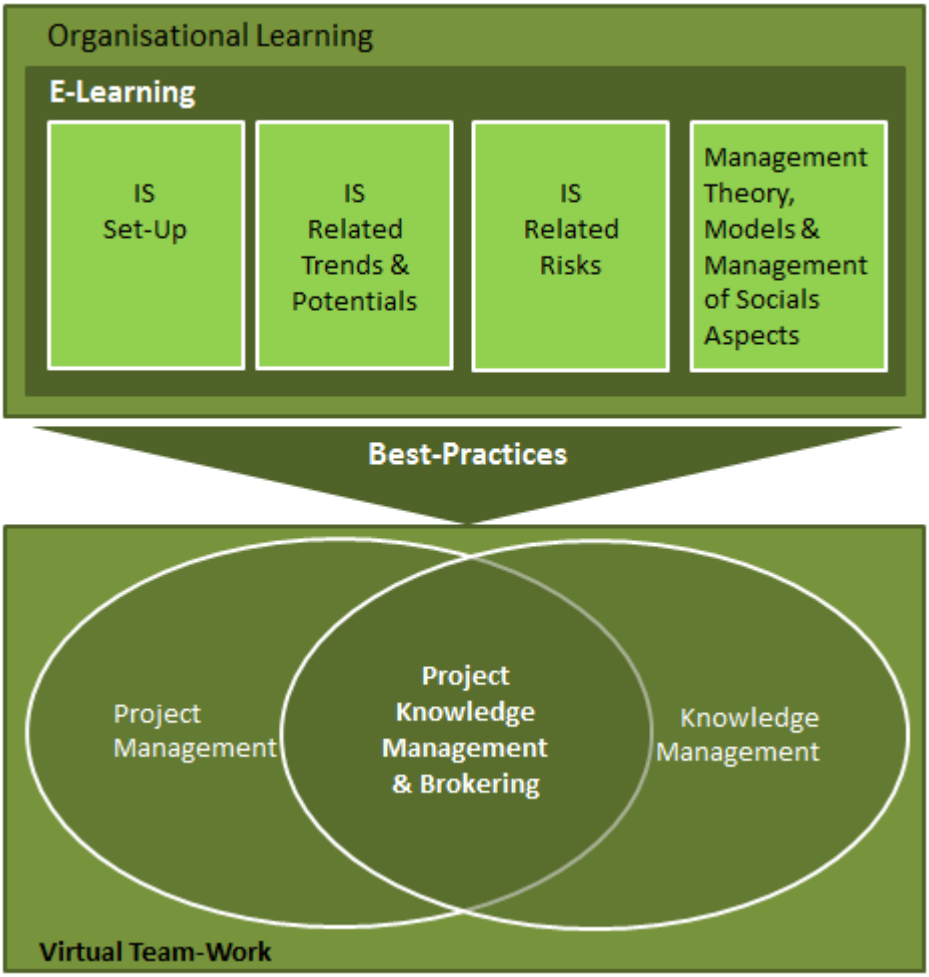

Figure 2.3 Conceptual framework for this PhD study

As outlined, the conceptual framework indicates the convergence of key areas of literature and provides an overview of the highly complex and interrelated research fields. Accordingly, the research was built upon further sub-topics like governance, consumerisation or outsourcing risk that are structured underneath the depicted main topics. At this stage, the identification of tensions between the related KM and

organisational learning fields are outlined, although an increasing convergence between both disciplines has been observed over the last years, due to the fact that both review similar issues despite their application of heterogeneous terminologies (Easterby-Smith et al. 2000). This undoubtedly has an impact on the approach of this research.

The conceptual framework continually evolved as the author progressed through the literature, with different versions emerging to reflect the development of the author's thinking and reading. This repeatedly revised conceptual framework is used as a synthesising vehicle of the main analysis and conclusions of this research.

In terms of the overall research conceptualisation and actual design of the research method, the literature review structure has already pre-defined the overall heading and chapters that contain summaries of the separate e-learning practices that are used as a basis of the questionnaire. The research questions are clearly defined:

- What are the key issues and status quo in PM, KM, PKM / brokering and virtual project teams?
- Which characteristics make e-learning state of the art and successful?
- Which areas (from e-learning) can potentially be applied (feasibility) to improve knowledge brokering in virtual teams (structures, processes, systems, strategies, enablers)?
- Which areas will have the strongest impact (importance)?

These serve as guidance, as research instrument objectives operationalise the initial questions and objectives defined at the onset of the thesis (Berg 2012). Therefore, the explained identification of categories, adding of data and the subsequent emergence of the structure grounded in the literature and the depicted conceptual framework sought to pave the way for the overall structure of the survey.

Four categories that are in line with the structure of the literature review help to provide organisation as well as consolidation and classification of the ranked factors. The grouping is done for purposes of presentation and not for the ultimate analysis. The statements of the 25 discovered e-learning topics potentially considers whether the particular e-learning state of the art aspect is an important and easily usable best practice for improving PKM and knowledge brokering of global project-teams. Accordingly, every statement starts with the question: "In order to become successful by fully grasping potentials from e-learning best

practices, effective PKM and knowledge brokering for global virtual project-teams has to - in the way of e-learning -...", as depicted in the following figure 2.4 This is supported by the summarised description per topic, contained in the referenced explanatory glossary, based on which the experts are asked to provide their feedback in the online-questionnaire.

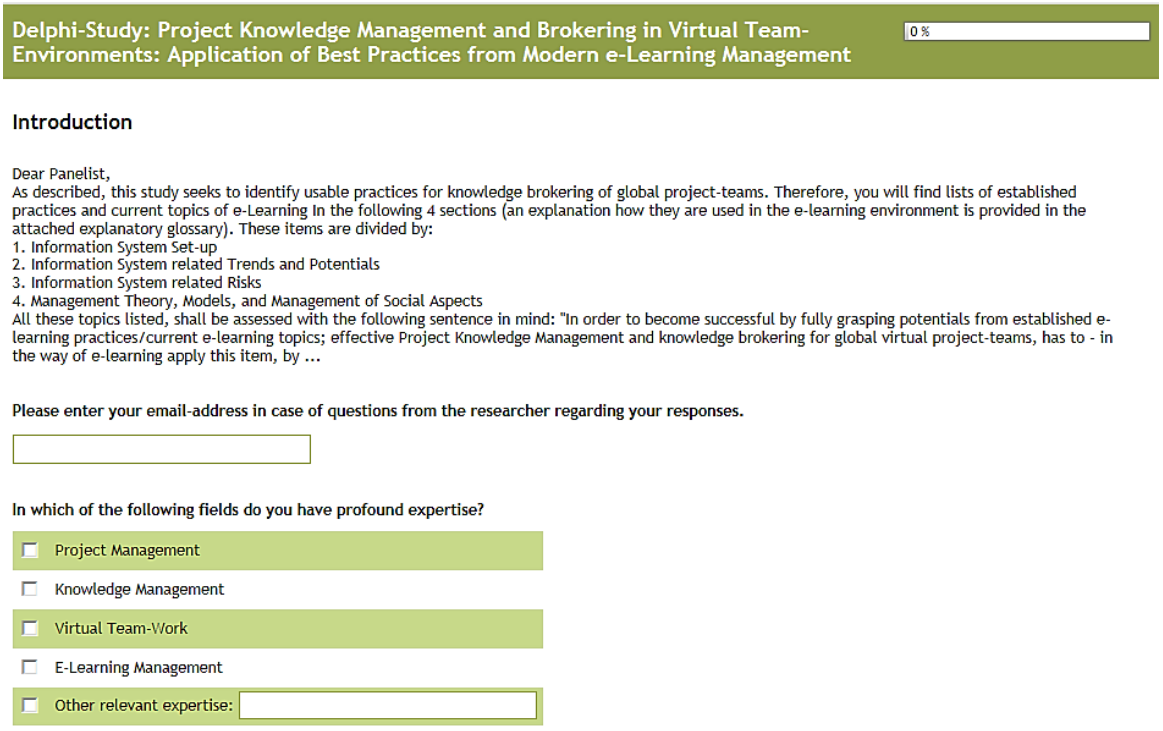

Figure 2.4 Screenshot of first page of first round online-questionnaire

3 Chapter Three: Research Methodology

3.0 Chapter Overview

As Babbie (2010) asserts, the selection of the appropriate research method for studies is an essential factor that provides for rigorous methods so that results will be credible. Research is generally defined as a diligent and systematic inquiry or investigation into a subject in order to discover or revise facts, theories, applications and so on. (Oxford University Press 2014). Accordingly, different types of research exist. In contrast to theoretical *pure research*, *instrumental research* is motivated by contributions to understanding. Such research aims to perform more effective interventions to observe the effects and increase knowledge and understanding of the environment (Clarke 2000). Instrumental research can be further delineated into two categories, applied research and problem-oriented research, in which the latter is concerned with the experimentation of new topics and technologies in order to address a problem (Clarke 2000). The focus area of this study was mirrored against available research strategies, instruments and methods in order to find the most appropriate one.

Before that, a philosophical review had been conducted, which considers higher aspects such as positivist and interpretative approaches and their respective underlying philosophical assumptions. In the following research methodology chapter, considerable focus is put on applied research based on observations and facts as well as choices that support the overall exploratory and explanatory manner of this study. All this fits into the overall context of the study of social science and sociology, defined as the "science of institutions, their genesis and their functioning" (Durkheim 1982). This research methods chapter sets the environment and describes the rationale for the choice of a Delphi study approach with its methodological techniques. This section also provides a critical appraisal and justification why this particular research method was adopted and in doing so relates the method to the research questions. Also it emphasises that the increasing popularity of the Delphi study in IS-research requires, especially when used in the ranking-type format, an often neglected rigorous method coined by consistency for data-collection, analysis and illustration of results (Schmidt 1997, Hsu and Sandford 2007).

3.1 Philosophy: Identification of the Appropriate Stance

For the identification of the right philosophical stance, it is necessary to understand the extreme paradigms in the research methodology. In this context, a paradigm is defined as a framework of concepts, actions and values, which form a way of viewing reality for the discipline that shares them (Miles and Huberman 1994).

3.1.1 Positivism

The positivist approach promotes a researcher's view of the nature of reality (Ontology) as being external and objective as well as independent from social activities (Clarke 2000). Positivism holds that the creation of knowledge (Epistemology) occurs through the controlled observation of a phenomenon from which credible facts and data emerges and form the basis of law-like generalisations. Similarly, observation allows for the identification of causality, which, in turn, supports the reduction of a phenomenon to its simplest elements (Clarke 2000). The positivist research is 'value free' (Axiology); free from the possible bias or assumptions of the researcher and is thus conducted in a value-neutral way by an objective researcher that is independent from the data (Clarke 2000). As a result, the positivist researcher applies highly structured and measurable quantitative data collection techniques with large sample sizes (Berg 2012), although Willis (2007) and Myers (2008) point out that positivist researchers may also employ qualitative approaches if structured appropriately. In this context, post-positivism (or post-empiricism) is a summary term for critiques and derivations of positivism such as criticalism, realism or the discussed pragmatism (Kuhn 1962).

3.1.2 Interpretivism

The main alternative to the positivist approach within IS research is interpretivism. Interpretivism defines the researcher's view of the nature of reality (Ontology) as socially constructed, subjective and under constant change (Clarke 2000). The related view of knowledge (Epistemology) consists of subjective meanings and social phenomena with a focus on details of a situation and the reality behind the observed details to understand what motivates particular actions. As previously discussed, epistemological debates have been conducted for a long time and with a wide range of perspectives, such as rationalism (Descartes), empirics (Locke) and interactionism (Kant) (Alavi and Leidner 1999a). The discussion of the historic perspectives of epistemology and knowledge is not in the scope of this thesis. Therefore reference is made to Polanyi (1969) and those philosophers

mentioned in case the reader wants to gain further insights. The interpretivist's view of values (Axiology) is almost completely dichotomous to that of the positivist, as s/he does not believe it is possible for the researcher to remove him or herself from the research context. It is understood that research is bound and laden with value, with the researcher taking part of what is studied and giving up any claim to objectivity (Clarke 2000). Here, it is supportive to consider Popper's philosophic view on falsification that states that in real world scenarios, laws cannot explain human interactions as with physical sciences (Popper 1959). He states that many versions of reality exist and that these are not carved in stone but a creation of the researcher and related to the actual context. These versions are influenced by gender, culture as well as beliefs and their intricate relationships instead of the determinism of outcomes (Popper 1959).

3.1.3 Pragmatism

After having positioned positivism and interpretivism, certain pragmatism excerpts will be discussed. Although being historically an ambiguous and vague term, pragmatism imposes "various holistic corrections of the atomistic doctrines of the early logical empiricists" (Rorty 1980). "Breaking with the Kantian epistemological tradition altogether" Rorty (1980) rightly defines Pragmatism as "simply anti-essentialism applied to notions like truth, knowledge, language, morality and similar objects of philosophical theorising".

Contrasting with scientific realism, pragmatism is motivated by expected consequences, assumes an external realm independent of our observances and opposes telling a narrative (Creswell 2013). With the pragmatic basic set of beliefs that guides action, truth is what is workable during the time of research and it explores the how and what in terms of targeted consequences defining the motivation for mixing usually qualitative and quantitative elements (Creswell 2013). Pragmatic paradigms do not consider the world as absolutely united and are pluralistic and not restricted to a single reality or philosophy. This links pragmatism to mixed methods, which freely choose qualitative as well as quantitative assumptions for the research in order to best support the actual research purpose (Creswell 2013).

Resulting from the publications of James, Mead, Dewey, Peirce or Rorty, the pragmatic worldview develops from situations, activities and consequences, which is in contrast with post-positivism deriving from precursor circumstances (Creswell 2013). Being concerned with problem-solutions and applications, the pragmatic researcher highlights the actual

research problem over the research approaches, while leveraging all relevant methods that improve the understanding of the issue (Creswell 2013).

While usually considering the research contexts (political, social, historical etc.), pragmatism enables multiple methodologies and assumptions, while "simply want[ing] to change the subject" (Rorty 1980). As the philosophical partner for mixed method-research, pragmatism will and should not end the philosophical debates but this is a very productive middle solution, both methodologically and philosophically, by bridging between conflicting assumptions and by for example providing agreement of importance of certain values (Johnson and Onwuegbuzie 2004). In general, there are several different types of mixed methods research that include overlapping research groups and definitions and related literature debates current issues around equal mixes, staging, integrations and the epistemological justification for the connection with pragmatism and its wide range of theorists (Johnson et al. 2007).

A more thorough discussion of the underlying philosophic considerations as well as precise weaknesses and strengths of the mixed method or related frameworks is not feasible in the scope of this thesis and therefore the reader is referred to the cited publications for further explanations (e.g. Johnson et al. 2007). Generally speaking, pragmatism is useful in IS and knowledge as well as education research, in order to overcome persistent issues with singular methods. This is supported by the increasing multitude of related publications that successfully derived from the pragmatic paradigm and use the strengths of both qualitative and quantitative elements connected in mixed research methods (Johnson and Onwuegbuzie 2004).

3.1.4 Deduction, Induction and Abduction

The discussed main research stances differ distinctively in terms of characteristics as well as their connected mainly quantitative and qualitative methods and the mixed methods. Accordingly, it is also distinguished between deductive and inductive approaches, although a combination of both (abduction) also exists (Peirce 1896). Deductive approaches involve theory testing through the search for causal relationships and facts that have to be measurable (Lapan et al. 2012). This approach has a strong tendency to apply quantitative methods and thoroughly collects samples from which to generalise results. Contrary to this is the inductive approach, which is more inclined towards qualitative and mixed methods and seeks at formulating a theory (often also in link with a conceptual

framework as in this PhD study) and developing understandings of cause-effect relationships (Lapan et al. 2012).

3.1.5 Methods or Methodology

Prior to reviewing the major relevant strategies and methods for data collection, it is important to define the difference between the often synonymously applied terms method and methodology. The research method is a strategy of investigation that goes from the underlying philosophical assumptions to the actual research design and data collection (Lapan et al. 2012). More precisely, the research method is defined as the inquiry strategy that leads to the selection of the research design and data collection (Lapan et al. 2012). In general, the term method refers to an orderly, logical, or systematic way or procedure to conduct investigations in accordance with a definite plan (Oxford University Press 2014).

In contrast to this, the science methodology is a framework of methods as well as directions and principles aiming at the regulation of a particular discipline (Oxford University Press 2014). In the philosophical context, it is further defined as the underlying rules and principles of the organisation of a system or review procedure (Lapan et al. 2012).

3.2 Research Strategies

3.2.1 Quantitative versus Qualitative Dualism and Approaches-Strategies

In contrast to the third wave (mixed methods), quantitative and qualitative strategies are well distinguished in the literature and various publications argue for the application of one or even both strategies (Creswell 2013). The following tables summarise the distinct strengths and weakness of qualitative and quantitative research.

Figure 3.1 Strengths and Weaknesses of Quantitative Research (Johnson and Onwuegbuzie 2004).

Strengths:
- Testing/validating already constructed theories about how phenomena occur - Testing hypotheses that are constructed before data are collected. Can generalize research findings when data based on random samples of sufficient size - Can generalize research finding when replicated on many different populations and subpopulations - Useful for obtaining data allow quantitative predictions to be made

- Researcher may construct situation that eliminates confounding influence of many variables, allowing one to more credibly assess cause-and-effect relationships - Data collection using some quantitative methods relatively quick - Provides precise, quantitative, numerical data - Data analysis relatively less time consuming - Results are relatively independent of researcher - May have higher credibility with many people in power - Useful for studying large numbers of people
Weaknesses:
- Researcher's categories/theories used may not reflect local constituencies' under-standings - Researcher may miss out on phenomena occurring because of focus on theo-ry/hypothesis testing rather than on theory/hypothesis generation - Knowledge produced may be too abstract/general for direct application to specific local situations/contexts/individuals

Figure 3.2 Strengths and Weaknesses of Qualitative Research (Johnson and Onwuegbuzie 2004).

Strengths:
- Data based on the participants' own categories of meaning - Useful for studying limited number of cases in depth - Useful for describing complex phenomena - Provides individual case information - Can conduct cross-case comparisons/analysis - Provides understanding/description of people's personal experiences of phenomena - Can describe, in detail, phenomena situated/embedded in local contexts - Researcher identifies contextual/setting factors related to phenomenon of interest - Researcher can study dynamic processes - Researcher can use primarily qualitative method of "grounded theory" to generate inductively a tentative but explanatory theory about phenomenon

- Can determine how participants interpret "constructs" - Data usually collected in naturalistic settings - Responsive to local situations/conditions/stakeholders' needs - Responsive to changes that occur during conduct of study, may shift focus of studies as a result - Data in words/categories of participants lend to exploring how/why phenomena occur - Can use important case to demonstrate vividly phenomenon to readers of report - Determine idiographic causation
Weaknesses:
- Knowledge produced may not generalize to other people/settings - Difficult to make quantitative predictions - More difficult to test hypotheses/theories - Lower credibility with some administrators/commissioners of programs - Generally takes more time to collect data compared to quantitative research - Data analysis often time consuming - Results more easily influenced by researcher's personal biases/idiosyncrasies

The connected debates between qualitative and quantitative paradigms also resulted in purist approaches on both sides. Qualitative purists, usually referred to as interpretivists or constructivists, shed positivism by promoting the assumption that multiple realities co-exist and that context- or time-free truths do not exist, as cause and effect is difficult to clearly define (Johnson and Onwuegbuzie 2004). Research for them is value-bound and concerned publications are usually detailed and somehow informal (Johnson and Onwuegbuzie 2004).

Quantitative purists contrarily believe that social enquiries are objective and observations should be regarded as entities, while the observer is isolated from those, which results ideally in formally time- and context-free reliable generalisations and social laws (Johnson and Onwuegbuzie 2004). Despite the depicted differences, also some similarities between qualitative and quantitative approaches exist, such as the common application of empirical observations, inclusion of safeguards to manage bias and validity issues as well as the attempt to analyse and develop assertions about environments and individuals in social

sciences (Bryman and Bell 2015).

Literature examining the different types of research-methods, describes the qualitative-quantitative continuum, with mixed methods in the centre and moving outward in both directions (Johnson et al. 2007). Connected with this is the often discussed qualitative/quantitative dualism (QQD), which is a remnant of Kantian reflection that is criticised by recent philosophic publications (Tellez 2001).

3.2.2 Mixed Method Approaches-Strategies

After having reviewed the linked and attractive pragmatism, mixed approaches-strategies are now discussed, as they are a natural complement to traditional quantitative and qualitative methods (Johnson and Onwuegbuzie 2004).

Pragmatism, evolving from the debate between either interpretivist or positivist and when either position is practically unrealistic, has been discussed previously. In relation to this research philosophy, mixed methods, consisting of qualitative and quantitative elements, are highly appropriate when the research questions determine working with variations in a study's axiology, ontology and epistemology (Saunders et al. 2009).

Considering the applied philosophy rather as a continuum instead of opposites, the application of mixed methods, derived from a pragmatic stance seems appealing and value-adding in this case, when the data collection and analysis has both quantitative and qualitative elements (Saunders et al. 2009).

In general there are two variants of mixed methods. Firstly, mixed-method research is defined as using both qualitative and quantitative procedures either sequentially or in parallel (Saunders et al. 2009). Although usually one technique is prevailing, the result is a clear separation of qualitative data being reviewed with qualitative methods and quantitative data with quantitative methods, despite the fact that philosophically qualitative and quantitative research strategies are combined (Saunders et al. 2009). Secondly, mixed-model research links qualitative and quantitative data collection and review processes together (Saunders et al. 2009), so that the researcher quantises the qualitative data and qualitises the quantitative data (Bryman and Bell 2015). In terms of a secondary analysis a reduced understanding of the social context may create risks for the robustness of the findings (Bryman and Bell 2015).

In essence, the research literature claims that multiple methods are beneficial as they are applicable to various purposes within research, and deliver more robust and interferential

results depending on the research questions (Saunders et al. 2009). The Delphi study is a mixed method that deals also with pluralism and eclecticism (Bryman and Bell 2015). This approach will be reviewed in the following section 3.3.

3.2.3 Case-study research

Case-study research investigates phenomena within their real context by studying entities (e.g. events, persons, decisions, institutions) holistically. The cases studied are then used to: illustrate or explore phenomena; or to attempt a generalisation from the particular (the cases) to a universal assertion (Yin 2013). For a long time, case-study research has not been acknowledged as a formal method, being regarded rather as only an exploratory step within other methods.

Being applicable to pragmatist, relativist, interpretivist and realist orientations, the methodology deals well with distinct circumstances that encompass various evidence-sources, triangulations and more variables than data-points (Yin 2013). It contributes to knowledge in various areas, fits well with IS research and is present in many forms such as theory seeking, testing, and storytelling (Gerring 2007). In the common process that is followed, a case study is conducted after a theory that presents rival explanations and influences is proposed, concluding with a discussion and case-description including causal links (Gerring 2007). The forms of case studies differ. Single case research is applied to one particular relevant circumstance with uniqueness. Multiple cases are executed to verify the relevance of the findings of one case to others (Gerring 2007). Apart from this, embedded case studies deal with sub-segments of an entity which is contrary to holistic studies that focus on the entire entity (Gerring 2007). Overall, case studies may carry a risk of wrong interpretation due to potentially insufficient data and cause and effect explanations (Yin 2013).

Although commonly asked philosophical questions about this type of research remain unanswered, this type of inquiry is now well accepted when the phenomena require this design logic in order to analyse in-depth actual “cases” and the boundaries between them and the relevant real-worlds contexts (Yin 2013). This distinguishes case strategies from other reviewed methods such as surveys, as when the “cases” and their contexts are not clearly distinct. Overall, case study research examines a contemporary phenomenon within a real-life context, in particular in cases where boundaries between phenomenon and context are not fully obvious, for example at early research stages, which require

informative information (Yin 2013).

3.2.4 Strategies for Studies: Choosing a Methodology

To provide a context of the exploratory-explanatory research of this PhD study, the following section introduces also the most essential elements of the main strategies for related studies. The methods applied for these strategies are typically mixed and they are also well established in the literature of management and social science as well as IS research. Social research is concerned with the iterative interaction between ideas and related evidence, through which ideas allow the researcher to make sense of the evidence, and subsequently apply evidence to enhance, review and verify ideas (Ragin 1994). Generally, social research aims to generate or confirm theories via data collection and analysis with the overall objective of exploring, explaining and forecasting (Ragin 1994).

3.2.4.1 Ethnography

Ethnography represents a personal involvement of the researcher in the lives of the studied individuals by pursuing the study's phenomena in their cultural as well as social contexts (Lewis 1985). In this approach multiple perspectives can be integrated into the research design and the retrieved data is normally very rich in relation to the research environment. But thorough analyses can potentially also lead to generalizability of findings (Lewis 1985). Often found in IS research, ethnography is based on anthropological fieldwork in which the researcher gets closely involved over a lengthy time-period with the individuals being studied (Agar 1986).

3.2.4.2 Grounded Theory

Grounded theory strives to develop theory, which is grounded by data that is gathered and analysed in a systematic manner (Reichertz 2010). According to Glaser and Strauss (1967), grounded theory is an inductive theory discovery methodology, which enables the researcher to develop a theoretical account of the general features of a topic while grounding the account at the same time in empirical observations. Accordingly, this theory proposes a constant exchange between data collection and analysis (Martin and Turner 1986). Grounded theory proposes the systematic verification of a theory as data is gathered instead of initiating with a theory that needs to be approved by testing (Martin and Turner 1986). Accordingly, grounded theory also deals with reverse engineered hypotheses based on the mentioned discovery of theory through analysis of data. This has both deductive and inductive thinking elements, with one goal being the formulation of hypotheses based on

conceptual ideas (Reichertz 2010). As with the other research methodologies, there is a lot of interesting literature debating potential benefits and criticism leading to recommendations for applying or rejecting a respective strategy like grounded theory. The scope of this study unfortunately does not allow a comprehensive discussion of this (as well as the other research strategies), and the interested reader is therefore referred to Reichertz (2010) for a further discussion on this topic.

3.2.4.3 Action Research

Action research aims to provide a twofold contribution, addressing the practical concerns of the people in an immediate problematic situation in order to increase knowledge, as well as to the broader aims of social science by joint collaboration within a mutually acceptable framework (Rapoport 1970). This strategy is especially useful for practitioners that require insights into social environments and that aim to facilitate social change and effective solutions for problems via close collaboration and empowerment of subjects (Atweh et al. 1998). A popular model starts with the identification of a problem and the consultation of an expert after which data is gathered and based on a preliminary diagnosis feedback is provided (Coghlan and Brannick 2000). This is followed by a joint diagnosis action planning and execution as well as post-review (Coghlan and Brannick 2000). In connection with this, a typical Plan, Act, Observe, and Reflect Cycle starts with a systematic collection of data followed by an analysis that then feeds results back in and evaluates it (Atweh et al. 1998).

3.2.5 Methods for Data Collection within Methodologies

Data collection is important in order to deliver data with rich meanings for the focus area of the study in the form of knowledge or opinions of individuals. The research strategy used in this PhD, the Delphi study, deals with mixed data analysis. To understand this, the following sections review key data collection methods, distinguishing quantitative, qualitative and mixed methods.

3.2.5.1 Quantitative Methods for Data Collection within Methodologies

3.2.5.1.1 Questionnaires

Questionnaire instruments reflect quantitative design (Creswell 2013). In order to produce valid and reliable findings, questionnaires necessitate a thorough management of the purpose, instrument design, administration and analysis of any survey (Lapan et al. 2012). The most critical element is the choice of question and answer types such as Likert-scales

with ranges, closed questions for discrete data or open questions which permit the participants to present qualitative feedback (Foddy 1993). When this data collection method is applied for qualitative instead of quantitative objectives, it is necessary that the selection of the sample focuses on respondents that can provide a wide array of reflective input that covers the research topic, rather than a true representation of the whole population (Foddy 1993).

3.2.5.1.2 Observations

Observations are conducted in many forms such as structured, overt, covert or participant observations (Berg 2012). These can be tracked by recording, note-taking or diaries and produce primary and secondary observations as well as experimental and contextual data (Berg 2012). However, the literature highlights the ethical considerations that may arise from this method of data collection (Lapan et al. 2012), that can also be connected with qualitative elements.

3.2.5.2 Qualitative Methods for Data Collection within Methodologies

3.2.5.2.1 Interviews

In reference to questionnaires, interviews aid to retrieve understanding of respondents' experience and the meaning they make out of that (Lapan et al. 2012). If the interviewer is suitably skilled and adept at interviewing then highly detailed attitudes can be gathered via open questions that enable the interviewee to respond in any way of preference (Seidman 1998). In order to further promote this, semi-structured interviews are conducted to obtain an appropriate level of detail from open questions, as it enables the interviewee to elaborate on thoughts. Initially, closed questions are typically applied to gather factual data (Seidman 1998). Seidman (1998) especially highlights the risk of influence and bias from the researcher that may affect an interviewee's intentions to provide frank feedback.

3.2.5.2.2 Focus Groups

Focus groups enable the researcher to receive opinions from a number of individuals in a resource-effective way. This is achieved by hosting organised discussions in a collective manner which results in findings being derived from interaction within the group that are sparked by comments from the individuals involved (Morgan 1997). For this purpose, the researcher selects the participants of the discussion group to elaborate and comment on the research topic based on personal experiences, opinions, feelings and reactions (Kitzinger 1995). By drawing upon these, this method stimulates a multitude of different views and

thoughts that are further promoted by open style facilitating statements instead of using pre-defined questions in a set way (Kitzinger 1995). The outcomes are not only richer than those from individual interviews, but focus groups are particularly useful in case of power differences amongst the stakeholders or when consensus around the research topic is to be explored (Kitzinger 1995).

3.2.5.2.3 Document Analysis

Document analysis is mainly applied along with primary data collection (Berg 2012). Examples of types of data are meeting minutes, news reports or correspondence. For the choice of this method, it is important for the researcher to ascertain that the chosen data supports the actual research question and that access is possible to the right data in a (cost) effective manner (Berg 2012).

3.2.5.3 Triangulation and Mixed Methods Methods

A research project's interpretation can be positioned by referencing it to three or even more data sources, so-called Triangulation (Schreier and Fielding 2001). This data collection by different methods provides a variety of data types that includes a wider perspective on the topic and data that increases richness, contextual basis as well the robustness of a piece of research through the enabling of cross-validations (Schreier and Fielding 2001). By checking results from a different perspective with several methods, more evidence is also provided as part of a "multi-strategy" design (Schreier and Fielding 2001). In line with the objectives and characteristics of the Delphi method, mixed methods provide a deeper understanding of the social situation that is studied than mere statistical measures (Schreier and Fielding 2001).

3.3 Delphi Research Strategy

After having reviewed relevant and existing research-approach strategies and methods with a focus on the distinction of qualitative, quantitative and mixed method strategies, the following section discusses the justification of the Delphi approach as the chosen research strategy-approach and links it to pragmatism.

3.3.1 Changing Paradigms of PM: Researching the Actuality of PM

One main outcome of the previously reviewed Rethinking Project Management Network is the promotion of a refocus on praxis by an enhanced understanding of the project actuality. This means the complex social processes during and beyond projects, that should support

the intellectual basis for both theoretical diversity and practical relevance and ultimately better results (Cicmil et al. 2006). The researchers propose, linking with pragmatism, a change of thinking to solve the previously identified but neglected themes from practitioner experience and away from purely model-based, instrumental approaches to include praxis-relevancies, taking into consideration issues of *learning* but also complexity, social processes and communication (Winter 2005). There is a demand for pragmatic theory and the development of social know-how and insights into the limitations of best practice dissemination in PM theory, as a result of being concerned with the critically observed "progressive rationalisation of social action and [of] commoditised PM body of knowledge" (Cicmil et al. 2006: p.677).

In line with this, the approach of this thesis also follows a combination of practical philosophical considerations and conceptual diversities from various fields for theorising practice with hands-on empirical input and review, supported by practitioners-experts from the field. Here the research method ensures a co-produced body of knowledge by researchers and practitioners ("the researched"). This supports a connection of reflective action with fused cooperation of theory and practice, to entirely consider the reality of projects and organisations being ambiguous, fragmented, political and messy (Cicmil et al. 2006). This follows Calori (2002), who depicts a pragmatic epistemology including pragmatic researchers and reflective practitioners to co-develop theory and knowledge that is contextual, pragmatic and instant, in order to gain a holistic understanding of human practices and the inseparable relationships between the structures (e.g. procedures) and agency (e.g. individual's actions) in context. This "becoming" ontology (contrary to "being") considers topics like heterogeneity, multiple perspectives, holistic thinking, complex human interacting and promotes refocus from theory "for" practice to theory "of" practice, analysing also the contradictions between "espoused" theories and "theories in use" (Winter 2005). The reviewed studies also methodologically promote the demand for more PM research grounded in real-life experience of project members and stakeholders beyond the traditional focus on project managers. This should be done to explore the PM activities and realities of the PM experience that should develop explanations due to inter-related sets of causal factors that go beyond the sum of results derived from individual cause-analysis (Cicmil et al. 2006). It is important to understand that this actuality model is not competing with mainstream approaches, but should be seen as a new lens to enhance current PM understanding and tools which should be balanced with traditional approaches

that relate failure to inadequate attention to existing PM procedures (Cicmil et al. 2006).

One interesting observation from the literature review is the fact that PM theory is mainly linked with a hard paradigm. This paradigm is generally connected with a positivist epistemology, deductive reasoning as well as reductionists and quantitative techniques. These support the traditional PM arguments around expert project managers and objectivity, efficiency, delivery, control and structure (Pollack 2007). This stands in contrast with the so-called soft paradigm that experiences increasing acceptance in the PM theory and that is coined more by interpretative and reflective epistemology, inductive reasoning as well as exploratory and mixed techniques. These deal more with a facilitating project manager and *learning*, contextual relations, interaction and essential social processes (Pollack 2007). This also fits well with the overall exploratory-explanatory approach of this thesis, as it supports the new pragmatic and soft tendency to consider problem structuring. The general understanding is not that the PM theory undergoes an entire paradigm change, but an enrichment of accepted paradigms that are applied in this area. This is in response to the statements in literature that: PM theory requires further development as it lacks partially a coherent core theory foundation; and is also mainly implicit whereas a demand for more explicit development is promoted (Koskela and Howell 2002).

3.3.2 Chosen Paradigm and Strategy

Again, paradigms are shared sets of assumptions or values of a community that produce a general tendency of thought and that impact a practice as to what is viewed as effective auctioning or value and how situations are perceived (Pollack 2007). Due to this fact along with being concerned with the context within which the observed phenomena taking place, this also justifies the chosen approach for this thesis.

It has to be considered that there are increasing numbers of publications for combining qualitative and quantitative approaches (cf. Jones 2004 or Kaplan and Duchon 1988). For previously explained reasons and for the match with the quantitative questionnaire instrument, this research in this thesis objectifies responses through statistics with some minor emphasis on open-ended statements within the questionnaire instrument. Therefore the design and analytical steps represent pragmatism as the chosen research stance (Creswell 2013). A mixed data collection and analysis technique with small sample size and in-depth investigation is accordingly chosen, in line with Lapan et al. (2012). In terms

of epistemological assumptions of knowledge and its management as introduced in the definition chapter, this thesis refers mostly to the Connectionist view. This also reviews virtual communities and the important connections via ICT to broker and manage knowledge (Krogh and Kleine 1998). This is supported as this PhD study is based on *problem-oriented research* that, initiated by a problem, develops an improvement and consequently experiments with new topics and existing technologies (Clarke 2000)

The research of this thesis is conducted mainly within the social science area of organisational research and the approach bases besides pragmatism also on key elements of grounded theory that uses a systematic arrangement of procedures to produce a theory about the area of concern (Bryman 2003).

3.3.3 Chosen Research Strategy

When formulating a research strategy it is important to ensure that the research method is a means to an end rather than an end in itself, or as Firebaugh (2008: p.207) puts it, a researcher should "let method be the servant, not the master". Accordingly, the selection process for the appropriate method started with the identification of purposes followed by a match-analysis of predominant research methods. As the Delphi method was chosen due to the fact that the knowledge pertaining to the focus area is incomplete and unclear, the following section provides further references and justification for the choice of this particular method (Skulmoski et al. 2007).

Linking with pragmatism and after the review of suitable research methods for management and social research as well as IS science, the Delphi method is identified as being the most appropriate one for achieving the objectives of this PhD thesis. This decision is based on various factors, such as achievability, credibility and availability of resources (Sackman 1975). The comprehensive review of the description: "The Delphi Method: Techniques and Applications" provided the author with a deeper understanding of the methodology (Linstone and Turoff 2002).

Although a traditional survey could have been conducted to obtain feedback, the Delphi methodology is judged to be a more robust tool for a rigorous interrogation of relevant experts in the researched case (Okoli and Pawlowski 2004):

- Complexity of problem necessitates knowledgeable respondents who are able to understand and review it carefully.

- The research design is flexible and required expert-panel-sizes are modest. Combined with the option of follow-up discussions it enables a richer data gathering which support a profounder understanding of the targeted fundamental research topics.
- It allows soliciting expert opinions and importance or relevance ranking.
- Also, Delphi is preferable to other established group decision analysis tools, as, for example, it does not require international experts to physically meet.

On top of this the Delphi approach enables controlled feedback via well-organised summaries, to decrease the impact of noise, which is defined as the communication taking place in group processes and falsifying data through people's interests dominating over the actual problem resolution, resulting in bias (Hsu and Sandford 2007).

Thus, the following chapter contains a short summary of the Delphi method based on the current understanding in literature. This structured communication method is built on a group of previously selected experts in order to systematically and interactively develop forecasts and solutions (Sackman 1975). In multiple rounds, the selected subject-matter experts are asked questions, which are anonymously summarised by the organiser (Linstone and Turoff 2002). This summary includes the reasons for the answers by all participants and is provided to the experts during the following round. This results in the fact that the experts will revise their initial statements based on the influence by the other experts' answers (Linstone and Turoff 2002). The final outcome will be a consensus towards a selected amount of highly developed statements (Sackman 1975). This group-decision-method is partially comparable to social judgement analysis that also applies (graphical) means to show panellists the outcome (and reasons) of other panellist's responses to gain consensus (Rohrbaugh 1981). Compared with unstructured groups, these decisions or forecasts are supposed to be more precise and this method has therefore been applied frequently for business forecasts and has even advantages over prediction markets, which is another form of structured forecasting (Brown 1968).

In comparison with traditional surveys, the Delphi study presents the following characteristics (Okoli and Pawlowski 2004):

- **Procedure**: Traditional survey design issues apply. But after the first round, another questionnaire is designed based on the initial responses, aiming at a revision of the original responses while also resolving potential new topics from first round responses. This process is repeated till a satisfactory degree of consensus is achieved.

- **Sample-representativeness**: As Delphi studies reviews issues of high speculation and uncertainties, a general population usually does not have necessary knowledge for a sufficient response. Despite its appearance as a complex survey, it may be classified as a group decision technique with its virtually meeting expert panel.
- **Sample-size**: Usually very small and up to maximum of 18 experts.
- **Response-revision and reliability**: Although pretesting is done to enhance reliability, test-retest reliability is irrelevant, as response revisions are anticipated intentionally.
- **Anonymity**: Researchers always ensure anonymity amongst the respondents.
- **Non-responses and attrition**: Usually relatively low due to previous engagement with and participation-assurance from experts.
- **Data-richness**: Relatively richer data due to multiple reviews based on revisions and obtained feedback. Additionally, usually openness from experts for follow-up consultations.

Accordingly, the Delphi study provides a combination of elements from the previously reviewed strategies such as action research or ethnographic traits with regards to the cyclic process of feeding results back in and evaluating them or the participation with and empowerment of subjects for ensuring multiple perspectives. In terms of the data collection method it also combines mixed elements of interviews, questionnaires and focus groups. This is done around open comment fields and scales, wide variety of expertise connected with subjects for obtaining opinions, rich feedback, cross validation as well as consensus and triggering thoughts by comments and feedback from others during previous rounds. Again, this is also in line with the common theme in related PM and KM literature of applying combined research approaches.

The justification for the usage is also provided by many other reasons, such as the fact that relevant literature from the area of knowledge brokering also uses this methodology (cf. Duan et al. 2010). This confirms that the Delphi-method is a reasonable method that has been used successfully in the field of this research before. Another very influencing factor is the personal motivation of the author of the thesis to use this method. In general, it is observed that the historic Delphi method is experiencing a renaissance. A famous promoter and devisor of the Delphi method is the RAND Corporation, who originated this methodology in the 1950s with a sequence of studies to develop an approach that produces the most dependable consensus from expert-groups (Brown 1968). Being mainly developed by Dalkey and Helmer at the RAND Corporation, the rationale behind the

execution of this thorough exchange around a precise topic is that a number of heads will produce better results than one head (Hsu and Sandford 2007). At their time this iterative feedback method for expert groups was still mainly used for forecasting and as a method for managing views and thoughts instead of objective actualities (Dalkey and Helmer 1963). This non-profit institution still helps improving policy and decision-making through research and analysis and provides various helpful articles in their online library (RAND 2013).

While many variations[1] of the initial Delphi study have been developed, general commonalities persist such as an effective constructing of communication processes of groups, reviewing of complex problems and allowing experts to review assessments while sustaining certain anonymity (Linstone and Turoff 2002). The latter is provided as the Delphi approach foresees controlled interaction by avoiding that experts are directly confronted, when they step-wise construct a considered judgement, without increasingly defending an initial stand, closing for new ideas or hasty reactions (Dalkey and Helmer 1963). An example of a variation of the expert problem-solving tool is the real-time Delphi (RTD). This is an innovative form of the original Delphi method, using computer technology to increase the efficiency of the process.

Also adapted in this thesis is a common alternative is also the ranking-type Delphi study. This seeks to construct consensus of a group regarding the relative importance or relevance of topics for forecasting, identification or prioritisation means (Schmidt 1997). This is also connected with the conceptual or framework developing Delphi approach, as aimed in combination with the ranking-approach in this research. This involves typically the identification and elaboration of topics, followed by a classification or development of taxonomies (Okoli and Pawlowski 2004). Another proof of relevance in the researched field is the fact that the Delphi approach is successfully used by the Institute for Futures Studies and KM, from the highly reputable European Business School in Reutlingen, Germany (EBS 2013).

A primary reason for applying a Delphi study is provided when judgemental facts are indispensable (Okoli and Pawlowski 2004). One major advantage is the universal applicability of the Delphi approach as it is found to also providing solutions for forecasts

[1] The International Institute of Forecasters provides for example an internet-based variation (International Institute of Forecasters 2013).

of future matters, policy research and target-setting (Hsu and Sandford 2007).

In summary, the case for the Delphi study is given by the attractiveness and flexibility of this strategy that is successfully applied in related literature (cf. Brancheau et al. 1996). The collection and anonymous distilling of feedback (following rounds are based on feedback from previous submission) as well as the re-administration provides a process that continues until a satisfactory degree of consensus is finally reached after multiple rounds (Sackman 1975). The thorough provision of feedback additionally enables the experts to produce supplementary understandings and a more comprehensive clarification of aspects generated in the previous iteration (Hsu and Sandford 2007). This is perfectly suited to situations where incomplete knowledge about a problem is given and the goal is set to improve our understanding of opportunities and solutions and to develop forecasts and speculations (Linstone and Turoff 2002) as intended in this PhD study.

Thoroughly managed Delphi studies cannot only be valuable for theory development. Also it is relevant for producing relevant theoretical research, to then contribute directly to both practice and theory, due to the study rigour and design and accessibility for practice via practical prioritisations and applicability of topics (Okoli and Pawlowski 2004). In summary, scientists are able to use the Delphi approach in multiple beneficial manners related to the building of theory although this was never the main target of Delphi science (Okoli and Pawlowski 2004):

1. Ranking outcomes can be valuable in early theory developing phases for identification and prioritisation of factors and derivation of propositions.
2. Due to the sourcing of information from wide-range expertise and the impact of the experiences and opinions, the empirical base for the theory development and therefore the generalizability of the theory results are enhanced. This supports the likeliness of a firm and grounded theory also in other settings.
3. By optionally requesting justifications of reasoning, another important source is provided that additionally eases comprehension e.g. of causal relationships between factors.
4. The contribution to validity construction, which necessitates a thorough definition of the construct in connection with clear definitions and consistencies e.g. for future studies.

3.4 Sampling and Respondents

As already known from studies with nominal group techniques, selecting appropriate experts is a very critical element of the research process as it directly impacts quality of the conclusions drawn (Hsu and Sandford 2007). It requires rigorous reflections to ensure that qualified experts are identified and given appropriate chance to take part (Delbecq et al. 1975). While not struggling to be representative of any population and therefore not depending on a statistical sample, the research design of the Delphi group decision technique foresees a thorough process for the selection of experts (Schmidt 1997). Accordingly, this PhD complies with this by conducting an initial detailed preparation and identification of categories and experts, an upfront investigation and exchange followed by subsequent invitations. In the literature no precise criteria for selection process are defined and descriptions remain partially ambiguous (Hsu and Sandford 2007). That said, however, in keeping with the recommendations from emergent literature, the selection of experienced and qualified experts were done using a multiple-lens approach. This was completed via in-depth examinations of individuals' related backgrounds, skills and disciplines as well as a review of related literature and concerned organisations and using the personal network as a supportive initial reference (Okoli and Pawlowski 2004).

The preliminary contacts were made via phone and e-mails, as this provided the researcher with an opportunity to outline the research topic and intended outcomes of the study as a means of securing the commitment and participation in multiple interrogation rounds. It was of grave importance to the research that eligible individuals were identified; eligible individuals within this context are those who possess more than related knowledge to the topic under investigation. As such, it was necessary that in addition to knowledge, target participants were both willing and capable of conveying and revising helpful judgements and solutions to achieve consensus (Hsu and Sandford 2007). Simultaneously, the identified experts were asked for nominations of additional experts based on the descriptions provided. Furthermore, a list for biographical and contact information was created that included all participants including a grouping into one of the four respective expertise-sections and for tracking their status of feedbacks per Delphi-round for progress tracing.

For such studies, it would be relevant to describe the selected panellists, in order for the reader to gain confidence in the reliability, relevance and validity of the findings of the study. The credentials of the panellists were thoroughly examined however these are unable to be communicated to the reader due to ethical constraints (Hsu and Sandford 2007)

as confidentiality was assured to the participants. In fulfilment of the study, it was necessary to undergo an ethical approval process, as it was necessary to obtain consent from all participants. As a means of ensuring thus respective information-sheets and consent-forms were distributed to all participants. After the selection of experts and the initial contacts, the nominated participants were invited via personalised emails that complied with the documents provided for the ethical approval obtained upfront from the University of Salford. As such, it contained a detailed information sheet, consent form, explanatory glossary for all 25 elements and a link to the online survey (See appendix numbers II, III and IV).

In compliance with the anonymity requirements, personal details of the participants have been withheld. That said, to provide the reader with a general insight into the participants, the participants were made up of senior consultants or subject-matter experts from the fields of KM, PM, (virtual) teamwork and organisational e-learning, all of which related to IS to some degree. Included within the participants there are those who hold job titles such as senior lecturers, trainers and consultants, in addition to CEOs of mid-size consulting companies or companies providing knowledge management solutions. The group of participants is further enriched due to the presence of a former project manager who has experience of heading projects (Global Head of PM) at a large, prominent multinational company. Furthermore, many of the experts were publishers and editors in related publications such as the Interdisciplinary Journal of E-Learning and Learning Objects (IJELLO). This variety was preferred as homogenous panels are less creative than heterogeneous ones, which is important when eliciting personal opinions and judgements, which are likely to be influenced by bias (Okoli and Pawlowski 2004). The following figure depicts in which of the four core-fields the selected experts have profound expertise. It assures that all participants were contributing with individual and profound expertise in one up to all of the four core fields PM, KM, virtual teamwork and e-learning management. Figure 3.3 summarises in which of these four fields the individual experts indicated profound expertise.

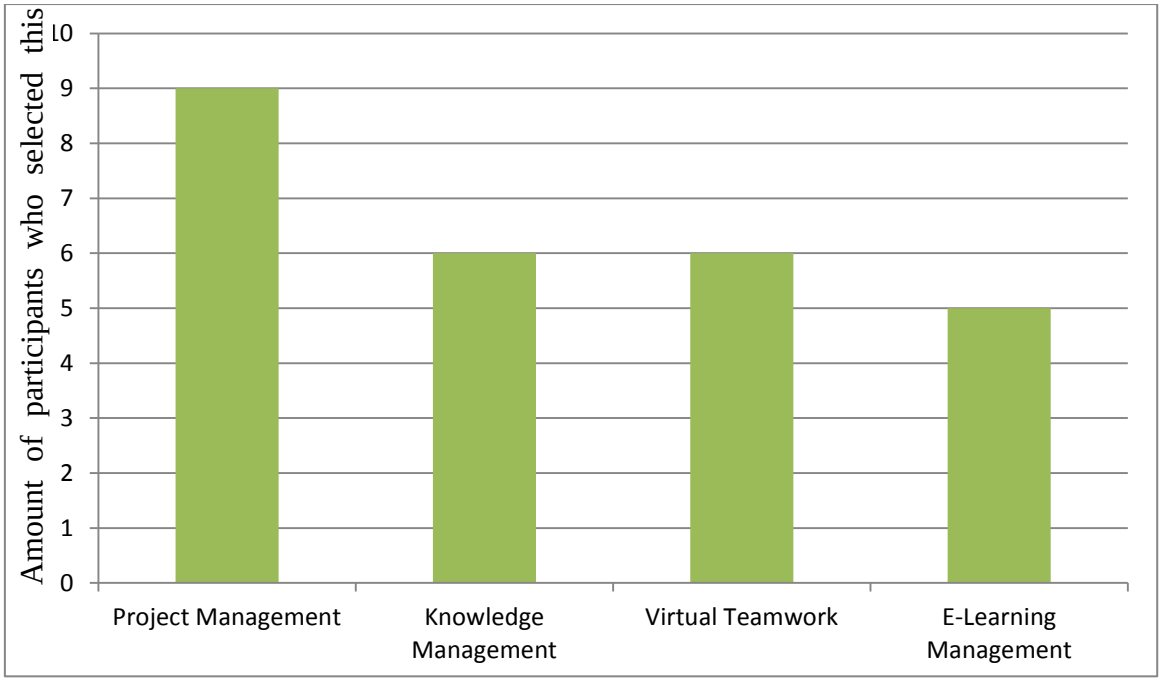

Figure 3.3 Response of panellists (k=14) to question: "In which of the following fields do you have profound expertise?"

This also ensures coverage of all four associated and influential fields from the conceptual framework and helps to defend the study's results. As outlined, the evolutionary approach from the EPSRC Network research, mainly the first documented research project in PM adhered to this particular approach. In this respect, the seminal research relied on the participation of practitioners, consultants and academics, all of whom were used in the Delphi study and its selection of experts. Again, names were excluded for confidentiality-reasons. Five of the respondents, for example, possess in-depth knowledge in the combined PKM fields, including experts for solutions specialising also in the combination of KM and PM around teamwork.

Finally, the selection of most suitable candidates was at the discretion of the researcher and therefore depended on his own judgment; the suitability of each participant was therefore assessed upon making contact with each individual and ensuring that they not only possessed the necessary experience but also held an interest into the topic that was being explored (Hsu and Sandford 2007). In general, it cannot be expected that all chosen experts have the same level of a particular expertise, as often falsely anticipated in Delphi studies. This is especially valid for such complex and technology-related issues as in this study, where the heterogeneous expertise in the different related fields actually is a benefit for the intended cross-fertilisation and best practice transfer (Hsu and Sandford 2007). The related danger of producing too generic statements due to a lack of insights from certain

participants is also prevented by the referenced explanatory glossary, which provides background information for each of the 25 analysed e-learning practices.

Cross-fertilising between the experts from the particular areas further enhanced the quality and creativity of the produced solutions. With business experts being included with profound background knowledge from current issues in companies, another benefit of the study is the potential that the developed results can be applied to a real business setting. This also ensures applicability and usefulness of the final result, enriching the thought process of the other experts during the course of the study with further business-oriented ideas and impulses.

Besides the four core fields, the experts also bring in multi-faceted additional relevant knowledge that further stimulates the solution development. These additional fields include operations, lean, organisational, and process management as well as specialised HR techniques like 360-feedback, online questionnaires or learning methodologies for adults. From an industry-perspective there is also a variety of experience including the highly complex and integrated supply chain management.

Regarding the satisfactory amount of experts, literature suggests that this depends on the amount required for representative pooling as well as data processing capability by the researcher. As such, it is suggested that a minimally sufficient number of individuals should be chosen as this would allow the researcher with the option to verifying findings via follow-up communication (Delbecq et al. 1975). That said, however, there are risks associated with too large or too small samples and despite this, specific numbers or consensus on guidelines are not provided within the literature. There is indeed some basis to this as each study is unique in terms of size, aims and more importantly resources available to researchers. As such, to ensure a larger sample size, a vast number of experts were contacted and their participation requested so as to maximise the number of final participants. The final number of participants chosen was aligned with findings from the literature where mostly around fifteen to twenty experts are chosen whereas ten to fifteen experts were also often sufficiently interviewed (Delbecq et al. 1975).

The following sections summarises the sampling strategy, population and timeframe. The selected sampling strategy derives from the selected research method and design and considers also ethics. Sample size and selection are critical issues in Delphi studies. Although the expert-panellists in scope have to be articulate, motivated, ideally affected by

and knowledgeable about the wide-ranging researched field, it was challenging to define the sample, as no single limited community of appropriate experts exists. Here literature also confirms challenges in determining the research strategy between a too homogenous panel vs. diversity required (Day and Bobeva 2005). As there is an enormous potential expert population, the sample strategy had to be decided between probability and the chosen non-probability (purposive) sampling. For practical purposes the decision was subject to the nature of the research issue, which is narrow in scope and therefore requires in-depth expertise for the purposive intention of the Delphi study (Day and Bobeva 2005). This differs from wide social studies that can work with random sampling. The sampling frame is also biased by the initial and personal contact with the experts, which required the explained preparations based on the discussed criterion and contributed to the positive feedbacks and willingness to participate. Regardless of the original sampling strategy, research literature confirms that the results and selections will be deducted from data gathered from a self-selected sub-set of the original population (Day and Bobeva 2005). Overall practicalities have also been considered while choosing the sampling strategy (e.g. access to experts and time available), and as previously discussed, anonymity and neutrality was applied as it is found useful within IS and business Delphi studies that try to trim the extremes (Schmidt 1997). As advised in the Delphi literature, self-rating of their own expertise by the panellists during the survey, confirmed the initial criterion assessment carried out by the researcher (Schmidt 1997).

3.5 Online Survey-Questionnaire Design, Constructs-Items and Administration

The research design requires thorough selections, decisions and choices during diverse points of the research process. In general, Delphi studies are executed, following a defined approach that is divided in different major steps for the research-process and analysis of issues (Schmidt 1997). Schmidt's (1997) detailed tutorial and guidelines for data collection, analysis and result reporting are taken as a basis for the research design of the described ranking-type Delphi study. Retrieved via non-parametric statistical techniques as described in this chapter, the final results will be presented and discussed in the following chapters. Besides, this rigorous approach supports the actual refinement of the most important and feasible aspects via valid rankings for the relative outcomes. The rating was retrieved via a provision of multi-item scales. This is justified by the enhanced reliability and given complexities that are not properly measurable by single-item scales. These end

results will ultimately support the reassessment of the theoretical reviews and observations in literature to develop relevant recommendations based on the indicated relationships (Okoli and Pawlowski 2004).

Overall, the research process followed recommendations that emerged from the literature, more specifically the best practice that was identified in related literature; particularly assertions made by Schmidt (1997). This author presents straightforward, effective approaches, imbued with rigour, which can be applied to Delphi research, which intends to pursue non-parametric statistical techniques in a way that is accessible for both academics and practitioners. The compliance with this rigour is extremely important as in the past arbitrary practices were often applied for Delphi studies, therefore resulting in inconsistent applications and uneven results. The lack of rigour pursued previously therefore subjected Delphi studies to a greater degree of scrutiny as the validity of related studies were brought into question (Schmidt 1997).

3.5.1 Face Validity

In order to gain a more comprehensive understanding and analysis in relation to PKM and brokering, the following study will rely on the participation of experts from the four core-perspectives of the conceptual framework (PM, KM, virtual team management and e-learning). Consequently, for the Delphi study of this thesis the author started preparation upon completion of the literature review chapter as doing so served to produce the various e-learning-practice review sections that underpinned the final questionnaire. The research intends to use a panel of fourteen different experts (cf. Dalkey and Helmer 1963) in order to gain an understanding and insight into the most applicable e-learning best practices to PKM and virtual teams. The present study goes beyond the identification of technical factors, humanistic issues are also given considerations thereby addressing key issues including with cross-linked concerns, risks, trends and future potentials derived from the sections reflected in the conceptual framework. Concrete questions to which the Delphi study will develop an answer are thoroughly justified and defined based on existing literature.

The literature focused for the review consists of a selection of relevant publications with emphasis on academic origins instead of trade publications, as well on those published within the last fifteen years. The sources that were used within the literature were critically reviewed, interpreted and synthesized, most of which were derived from research on electronic platforms like EBSCO, IEEE Xplore, Emerald Insight, Sciencedirect.com and

Wiley Online Library. In addition to these sources, literature was also sourced directly via various journals and conference publications. Reference chapters of selected publications and seminal papers also supported the overall literature review process. Additionally, discussions with experts, information librarians as well as attendance of webinars and workshops brought up further thought-provoking impulses. Ultimately, the assertion of Rudestam and Newton (1992: p.49) to "build an argument, not a library" underpinned the research journey, particularly in reference to the literature review.

After the literature review addressed initial questions (e.g. what is currently lacking for successful knowledge brokering in virtual team environments? or what are the requirements that need to be matched in the future in order to be successful?) the final Delphi panel shall verify and substantiate:

- Of those identified within the literature review, which are the most important e-learning factors for the improvement of project knowledge management and brokering in virtual team-environments?
- Which practices from e-learning emerge as the most feasible as far as application to the context in question (improving knowledge brokering in virtual teams)?
- What other comments or suggestions do the interviewed experts have (e.g. add new items to the list of relevant e-learning practices)?

As an example, one precise train of thought that will be assessed with the Delphi-panellists is the potential of transferring the success from the training of e-learning managers to knowledge brokers (Hargadon 1998). Additionally, a free-text field is provided to gain further qualitative insights and verify if additional aspects have to be taken into consideration according to the experts. For example, the respondents may wish to add particulars or specifics relating to issues such as the increasing challenge of generating benefits and value for various stakeholder groups. The survey consists of two core elements; determining which e-learning practices are best transferred to PKM and to gain insights into which practices could easily be implemented to gain the anticipated beneficial effects (feasibility). In this way, the candidates that rate feasibility and importance of each of the 25 proposed potential aspects based on a provided scale also have an opportunity to anonymously provide qualitative comments within the online questionnaire. This approach shall support the clarification of the concerned research questions.

3.5.2 Delphi Process Steps and Administration

The generic Delphi process presented in the literature differs. Usually, it is triggered by an iterative (open-ended) questionnaire cycle, where the results and findings form the first questionnaire are used to formulate the second (well-structured) questionnaire for distribution in round two (Hsu and Sandford 2007). However, it is found to be a common and accepted process modification, if (as in this study) the first round questionnaire is a pre-existing well-structured questionnaire. This is developed upon a comprehensive literature review, provided that basic information about the targeted problem already exists and is usable (Hsu and Sandford 2007). Table 3.1 illustrates these differences.

Table 3.1 Difference in main two Delphi-processes as found in the literature

Round:	Traditional Approach:	Applied common modification:
0		Comprehensive literature-review
1	Open-ended questionnaire	Well-structured questionnaire for preliminary priorities
2	Well-structured questionnaire for preliminary priorities	Well-structured questionnaire incl. previous round's results for further consensus
3	Well-structured questionnaire incl. previous round's results for further consensus	

The second cycle, or in this case the first one, requires the participants to rate or rank order provided items for identifying preliminary priorities and agreements as well as optionally disagreements, while starting to form a consensus (Schmidt 1997). Subsequent rounds of questionnaires then include summarised topics and ratings from the previous rounds.

This further round also includes the continued option of a free-text field encouraging participants to provide additional clarifications, for example, explaining why certain elements are continuously rated outside of the formed consensus (Hsu and Sandford 2007). As recommended in the literature, the survey used this additional free comment field for suggestions and additional items or comments (Schmidt 1997). The headline of this field asks for submission of comments in order to also justify and describe previous rankings. As Schmidt (1997) correctly outlines, without this option for feedback on descriptions and submission of additional issues there is no foundation to claim that the results of the survey have been based on a consolidated and valid list of issues. This is often a mistake made in Delphi studies. A summary of the comments provided during the second round ensures awareness amongst the participating experts about ranges of views and underlying reasoning and therefore, facilitates the reassessment of the original conclusions (Hsu and

Sandford 2007).

In line with the above standards, after the first round, all feedback was carefully analysed, condensed and shared with each participant, requesting a re-assessment on the previous submission. In compliance with general Delphi procedures, the following questionnaire included a provision of ranking and means of feasibility and importance rankings for each of the 25 items (Schmidt 1997). Kendall's Ws were also calculated and provided in order to further illustrate the degree of consensus for each round. This coefficient ranges from 0 (agreement) to 1 (complete agreement) and is a non-parametric statistic that is applied within Delphi studies for evaluating agreement among participants and their ratings (Kendall and Smith 1939). Although there are multiple means of assessing non-parametric rankings, Kendall's W is recognised as the most suitable (Okoli and Pawlowski 2004).

Besides this indicator in a transformed way (e.g. by stating "strong agreement" depending of the Kendall W value), the experts were provided with comments from previous rounds and the (mean) ranks of each e-learning practice to compare with the individual's own previous ranking. This ensures that all relevant feedback elements are included in order to also transmit an indication for the degree of consensus. Although the provision of Kendall's W can compensate for tied rankings, the respondents were asked to rank again all issues and avoid tied ranking in subsequent rounds (Schmidt 1997). The above ensures compliance with the speciality of Delphi studies to provide each round controlled feedback beyond only the mean-values, which is often omitted in previous Delphi attempts (Dalkey 1969). Although the "standard deviation" is discussed as another indicator for consensus, it does not apply for ordinal-scales and is, therefore, not of value for this study (Schmidt 1997).

3.5.3 Stopping Criteria and Risk Management

The rationale of round one and two are explained by the discussed best practices from existing research method literature, which recommends this process approach. A further in-depth explanation is also provided by the following explanation of risk and stopping criteria considerations, that all depended on the ongoing results. Before the survey, the author agreed on stopping criteria. This criteria included either a maximum of three rounds as promised in the initial invitation or Kendall's W was to be at a significant and increasing level after the second round, presenting sufficient consensus. This topic is important to consider, as too many rounds may waste valuable time of panellists and constrain

resources, whereas too few rounds decrease the meaningfulness of the results (Schmidt 1997). The amount of Delphi cycles highly depends on the degree of consensus targeted (Hsu and Sandford 2007). In regards to this, it was ensured that in case of repeatedly low Kendall's W values proving that there is no progress, this should also lead to a termination of the survey, as a continuation would only falsify the results. Before the first round, all participants were asked if they would be committed to continue until a substantial level of consensus was reached, which became an option as all experts agreed. If the second cycle does not provide a reasonable identification of certain outstanding top items, the researcher is required to take tough decisions on either arbitrarily set top-ranking values or terminate the study (Schmidt 1997).

Here, it is also important to remember that there are many topics considered as relevant but they may not be included in the final top-issue list, as listing too many topics may also be distracting. In general, it was complied with common Delphi practice that recommends to always question "should another cycle be executed to achieve superior consensus?" and to definitely discontinue additional circles when mean levels after two rounds did not differ significantly (Schmidt 1997). Consequently, two rounds were needed in order to reach the required consensus (respectively the plateauing of the responses). The exact findings are further described in the following data-analysis chapter. In line with general Delphi studies, the following rounds of surveys were always carefully designed and reviewed in order to also follow the same format as in previous rounds (Okoli and Pawlowski 2004).

For risk mitigation due to the reliance on the experts and their input, back-up candidates were identified. The thorough review of other related Delphi studies as well as theory material of this methodology ensures compliance to the standard process and research excellence. This ensures adherence to the key characteristics such as anonymity for avoiding influence of dominant individuals and gaining unbiased results, facilitation by the author as well as structured and controlled flows and feedback from questionnaires including filtering of commonalities and contradictions to provoke relevance and avoid group dynamics (Schmidt 1997). The above also ensures clear segregation from other methods and mitigation of their disadvantages, such as conventional pooling of opinions from group meetings in which participants often stick to initial statements and group pressure increases conformity (Hsu and Sandford 2007).

Overall and in compliance with Delphi literature, for the design and execution of this study, the areas of timeframes, selection of experts, potential bias and guidance, along with

low-response risks have been thoroughly considered (Hsu and Sandford 2007). As discussed, throughout the data collection, general survey design characteristics were applied and two to three rounds feedback rounds were targeted by using online questionnaires. In terms of data processing, a manual evaluation of maximum 42 feedbacks was conducted. Despite that common survey design issues apply, the Delphi method overcomes shortcomings for example with regards to non-responses or attrition (Foddy 1993). The virtual panel that provides the feedback was personally addressed by the author; prior to sending out the invitation to the online-questionnaires via email, explanations via phone were completed. During these calls also the openness for follow-up interviews were discussed, in case particular topics require further in depth investigations for the purpose of this study, or to propose areas and guarantee sources for future studies.

3.5.4 Constructs and Items

The review of the extant background-literature provided theoretical discussions of the 25 e-learning factors that were discussed in the literature-review and that form the basis of the constructs-items. This study avoids the common mistake of combining the issue-determination and issue-ranking steps, as often, panellists independently rank arbitrary numbers of issues, which is not a productive way of determining the final list of issues (Schmidt 1997). Besides this, these 25 items are sorted into the four described groups according to research literature for more structure and easier processing in the survey.

As outlined before, pre-testing is an essential element to ensure reliability of the Delphi research process, so this was done together with the assigned supervisor from Salford University, prior to the launch of the first and second round. As mentioned, the survey-invitation is sent together with an explanatory glossary (See Appendix II), which provides brief explanations on how each e-learning factor is currently used. This provides a clear definition for the quantitative-qualitative basis for assessing each practice. It also eases the reconciliation and understanding of each various panellist's feedbacks in the subsequent Delphi circles. The provision of clear understandings of each topic is essential for the data-collection management phase of ranking-type Delphi surveys (Schmidt 1997).

2.3. Consumerisation: Embrace reality of employees bringing own IT solutions into work-processes: Benefit from existing best practices for solutions for learners' demand for simple/chunked answers in any format linked to content rather than courses. Besides again connecting it with other areas like mobile-learning, existing knowledge processes have to be adapted resulting in "smart workers" with improved productivity in terms of finding/applying content + creating/sharing information on social web + joining/building communities. PKM of virtual project-teams can benefit by re-working learning + development strategies + embracing new *consumerisation of (e-)learning* bringing innovation opportunities by allowing personal, easy, effective and satisfactory state-of-the-art solutions + recognising that this trend is inevitable, companies' frontiers are blurry, security has to be managed + (cultural) differences have to be proactively addressed.

2.4. Custom Software Development / Customisation: Develop/use highly customisable + flexible open applications useable as modular solutions to avoid that IS changes natural patterns of work. PKM solutions to be accordingly conceptualised with internal structure serving a customisable shell. Due to complexities of global virtual project-works, again governance should be ensured to ensure user satisfactions in pedagogically sound way, application of proven solutions for effective re-use + customisation. Custom software development will become successful if specialists from all areas included + thorough process is followed. Success criteria from e-learning: Manageable project size, accurate requirements definition, executive sponsorship, simplicity, communication, feedback, courage + whole-team approach facilitated by structured meetings.

2.5. Virtual Worlds / Edutainment: Increase multi-user interaction/stimulation by promoting

Figure 3.4: Extract of explanatory glossary explaining each of the 25 potential e-learning best practices

The research sought to require minimum effort on the part of the participants and endeavoured to maximise convenience for the experts. Email was therefore identified as the most suitable tool through which to ensure this, eliminating the need to travel as well as associated costs and resources. Despite verbal commitment of participation by all experts and a zero drop-out-rate, the experts had to be reminded regularly due to overdue responses. Given the multiple circles and the additional exchange via phone or email, the Delphi study is more time-consuming for participants, as compared to regular surveys. In line with general Delphi practice, it was tested and assured that no survey response required more than 30 minutes (Schmidt 1997). In addition, the average response of the second round was for example only 11 minutes. Therefore initially during the first contact presented incentives were outlined again in written form during the invitation for the second round, to sustain commitment and decrease dropouts from the busy experts. These helped to convince the experts to participate in this study, where they potentially declined already other study participations included (Okoli and Pawlowski 2004):

- Selection for a limited but diverse panel of well-chosen experts
- Chances for personal learning and takeaways from consensus building
- Additional personal visibility and given early access to the final published PhD thesis and potential future publications, via free copies

General mechanisms for the survey-administration were followed and the online questionnaire was designed carefully considering general survey design principles. In such way, the administration complied with the recognised and presented ranking-type approach, including an upfront brainstorming (in this case via literature-review) and gathering of relevant factors followed by a narrowing down and ranking to reliably identify most important and feasible topics (Okoli and Pawlowski 2004). Complying with best practices from literature, the ranking-type Delphi approach is executed in the following three steps (Schmidt 1997):

- Data collection management:
    - Issue discovery (Researcher to provide single list with consolidated definitions)
    - Most important issue determination (Paring into groups)
    - Issue ranking (Panellists to rank all issues, that are provided in random order)
- Data analysis (Via suitable statistics-calculation)
- Discussion and data presentation to support the research results

As outlined, the research approach foresees that the chosen experts are presented with the synthesised e-learning aspects to assess and rank feasibility and importance of each aspect in the online survey in order to collect the quantitative results.

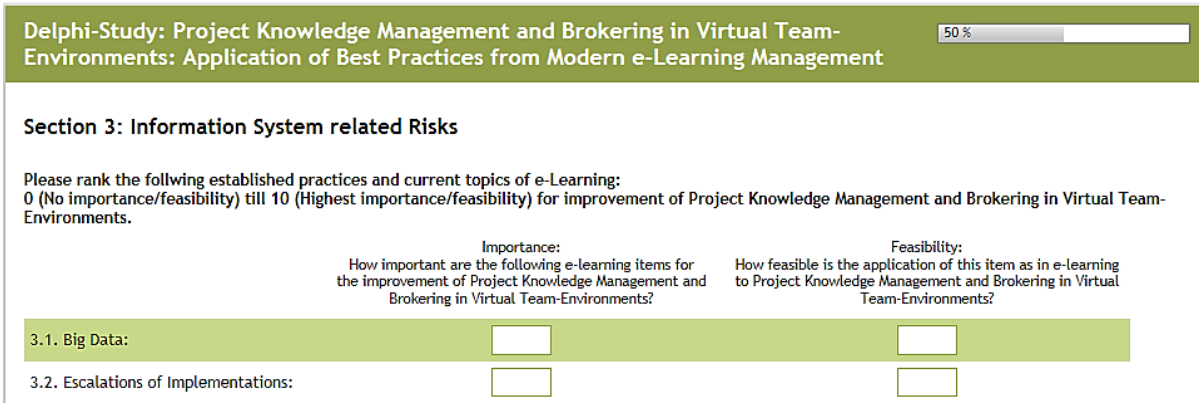

Figure 3.5 Screenshot from first round Delphi questionnaire with e-learning practices, presenting two example elements

Likewise the following figure explains the qualitative data collection procedure with a screenshot of the open-statement caption. These comments were also required and thoroughly analysed, as elaborated in the chapter "Analysis of Open Statements".

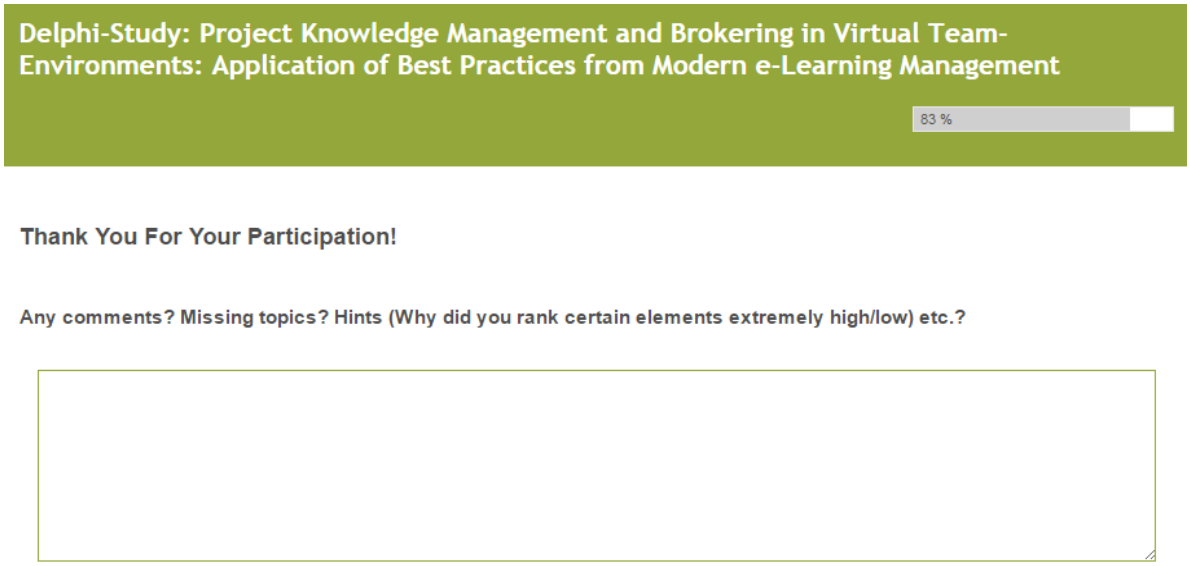

Figure 3.6 Screenshot from first round Delphi questionnaire with e-learning practices, presenting the open comment field

The above discussion and screenshots have signposted the survey-questionnaire constructs-items and administration procedures. In addition to this, the following table describes all constructs-items and scales.

Table 3.2 Constructs-Items and Scales of the Delphi study

Construct	Importance Scale	Feasibility Scale
1. IS Set-up:		
1.1. State-Of-The-Art Information Systems	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
1.2. Distinction of IT: Leading to Sustainability / Competitive Advantage	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
1.3. Governance / Learning Objects	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
1.4 Information/ Data Management and Tools	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
1.5. Procurement of IT Tools	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
1.6. Outsourcing	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
2. IS-related Trends and Potentials:		
2.1. EP / Web 2.0	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)

2.2. Cloud	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
2.3. Consumerisation	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
2.4. Custom Software Development / Customisation	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
2.5. Virtual Worlds / Edutainment	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
3. IS-related Risks:		
3.1. Big Data	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
3.2. Escalations of Implementations	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4. Management theory, models, and management of social aspects:		
4.1. Knowledge Marketing	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.2. Ownership of Learner	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.3. Interactivity / Integration	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.4. Ease of Use/Usefulness	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.5. Team-Cooperation	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
Entities and roles within the execution:	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.6. E-learning Manager = Knowledge Broker	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.7. Learning Individual = User of Previous Projects' Knowledge	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.8. Reflection and Progression	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.9. New Trainings: Integration of Pedagogy and Technology	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.10. Required Management Buy-In and Incentives	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)
4.11.	0 (No importance) to 10	0 (No feasibility) to 10

Visualisation/Imagination	(Highest importance)	(Highest feasibility)
4.12. Incorporation of Society's Paradigm Shift for Knowledge Society	0 (No importance) to 10 (Highest importance)	0 (No feasibility) to 10 (Highest feasibility)

The adaption was influenced by research method literature (e.g. Brown 1986) and existing studies and related publications that adopted a similar Delphi study approach (e.g. Brancheau et al. 1996). The full scale range is 0 (No importance/feasibility) to 10 (Highest importance/feasibility. This translates for feasibility to a (practicality) scale from no hindrance to implementing the best-practice till cannot be implemented. In terms of importance the (relevance/priority) scale would define the most relevant best-practice till no relevance/priority or measurable effect, so that this best practice should not be considered.

3.6 Data Analysis

After the identification of the philosophical position and definition of strategies for exploratory-explanatory studies as well as (mixed) data collection methods and the research instrument design, the final section of the research methodology chapter describes the process of the appropriate data analysis mode and interpretation choice. Overall, no standard approach in science exists, but of course the choice has to be consistent with the defined research philosophy and strategy (Schmidt 1997). The analysis was conducted in electronic form and involved according to the mixed method both qualitative and quantitative data. For the data analysis of Delphi studies as well other studies decision-criteria must be fixed to govern the gathering and processing of the feedback, which especially relates in this case to consensus determination, which can be interpreted differently (Hsu and Sandford 2007).

Depending on the level of feedback and consensus, it has resulted that data of two rounds has to be processed. This has led to 28 pieces of feedback being returned via the online-tool of esurveycreator.com in the form of data recorded via the filled out questionnaire for subsequent analysis. In preparation for the next round, the ranking and mean of the previous round (e.g. importance of outsourcing is rated on average 4.8 out of 10 and ranked as number 25) is analysed and provided in the next round's questionnaire as a statement of the whole group to stimulate reflection and consensus amongst participants. Particular comments returned are also added as anonymous quotes during the second

round for the same purpose as the mean indication. The discussed comment field additionally provides the potential of adding general further comments that are not related to any of the 25 topics. Although software is available for analysis of mixed data (e.g. NVIVO) this is not required for the limited amount of feedback that has to be processed.

The suitability of the Delphi technique for a variety of statistical analysis techniques to interpret the data and a thorough execution of these statistical analyses ensures not only consensus but also that individual opinions are well represented in the final step, as a significant spread of opinions may persist (Hsu and Sandford 2007). Also, this approach allows an impartial and objective analysis and further diminishes the described issue of conformity due to group pressures (Hsu and Sandford 2007).

For the data analysis, it is important to understand the meaning of each derived value, like with the usage of Kendall's W, to assess in a realistic manner if any consensus is achieved, if it is increasing and to determine the relative strength of agreement (Kendall and Gibbons 1990). In line with the literature, a value of Kendall's coefficient of concordance (W) that is 0.7 or higher indicates consensus on a strong level (Schmidt 1997). Values lower than 0.7 were found in this study's Delphi research, which still represented significant results for agreements, although being relatively weak. Table 3.3 presents an indication for the understanding of Kendall's W values, but it does not provide strict endpoints.

Table 3.3 Kendall's W Value Interpretation (Kendall and Gibbons 1990)

W	Interpretation of Agreement	Confidence in Ranks
0.1	Very Weak	None
0.3	Weak	Low
0.5	Moderate	Fair
0.7	Strong	High
0.9	Unusually Strong	Very High

Kendall's W for determining present agreement in a simple way, has higher popularity than alternatives like those assessing for example, the least absolute distance solution, which establishes various results that are all practical but therefore impractical for Delphi studies (Armstrong et al. 1982). The Kendall's W and other statistical measures were calculated manually with the help of Excel and the guidance of related literature (Bortz 2013). The results were also carefully crosschecked with the help of the online program from Statstodo (Statstodo 2015).

Another key indicator that is often used in Delphi studies is the variance (of rank) (D^2):

This is the squared difference between total grand mean and the individual mean ranks ($Di^2=Ri-R)^2$. This is also calculated and provided in the results chapter for reference, however focus is set on Kendall's W figures.

Besides the previously discussed mechanisms for the study-administration, the usage of the electronic "fast" media internet and email supported an acceleration of the study and particularly also the data analysis before, between and after the Delphi circles. This reduced turnaround times and achieved a completion well within regular lead times of about 45 days to five months (Delbecq et al. 1975).

Again, the literature review has already identified key themes and patterns and the development of theories based on these patterns. These findings were already synthesised during the content analysis of the literature review and will be further compared, contrasted and validated by the Delphi study. The data analysis will afterwards ultimately support the drawing of conclusions that will be defined and discussed in the subsequent chapters. Delphi literature states that three iterations or cycles are sufficient, which is in line with the approach of this study's Delphi research that consists of two rounds plus the extensive literature review that worked as round zero (or "one") by forming the initial basis for the first structured questionnaire (Hsu and Sandford 2007).

3.6.1 Variables

The following table provides a list of variables defined for this study. This is in reference to the raw data provided in appendix V, and allows anyone to repeat this experiment and calculate values for these variables. This definition makes the experiment reproducible.

Table 3.4 List of variables (n=sample size)

Variable	Description	Coding	Value Definitions
Project Management	Response of judge about their Project Management expertise. Of the 14 judges, 9 judges had PM expertise.	PM	Expertise Yes = 1 Expertise No = 0
Knowledge Management	Response of judge about their Knowledge Management expertise. Of the 14 judges, 6 judges had KM expertise.	KM	Expertise Yes = 1 Expertise No = 0
Virtual Teamwork	Response of judge about their Virtual Teamwork expertise. Of	VT	Expertise Yes = 1

	the 14 judges, 6 judges had VT expertise.		Expertise No = 0
E-learning Management	Response of judge about their E-Learning Management expertise. Of the 14 judges, 5 judges had EL expertise.	EL	Expertise Yes = 1 Expertise No = 0
Information System Set-Up	Response of each judge about ranking of the individual IS Set-Up topic in terms of first importance and second feasibility. Six potential best practices from e-learning derived from the area of information system related risks listed.	1. IS Set-up (6 sub-sections)	No Importance/ Feasibility = 0 till Highest Importance/ Feasibility = 10
Information System related Trends and	Response of each judge about ranking of the individual IS-related Trends and Potentials in terms of first importance and second feasibility. Five potential best practices from e-learning derived from the area of information system related trends and potentials listed.	2. IS-related Trends and Potentials (5 sub-sections)	No Importance/ Feasibility = 0 till Highest Importance/ Feasibility = 10
Information System related Risks	Response of each judge about ranking of the individual IS-related Risks topic in terms of first importance and second feasibility. Two potential best practices from e-learning derived from the area of information system related risks listed.	3. IS-related Risks (2 sub-sections)	No Importance/ Feasibility = 0 till Highest Importance/ Feasibility = 10
Management Theory, Models, and Management of Social Aspects	Response of each judge about ranking of the individual Management topic in terms of first importance and second feasibility. Twelve potential best practices from e-learning derived from the area of management theory, models, and management of social aspects listed.	4. Management (12 sub-sections)	No Importance/ Feasibility = 0 till Highest Importance/ Feasibility = 10

In this Delphi study, variables are both categorical 0/1 and ordinal 1-10, and the categories are without an intrinsic order. There are no transformations. These variables presented are reviewed in the following results and discussion chapters.

3.6.2 Analysis of Open Statements

The following section elaborates on and explains the qualitative data analytical steps that were guided by the qualitative research literature (Denzin and Lincoln 2011). Although the Delphi study is mainly quantitative, it also contains highly relevant qualitative aspects. The related qualitative results, retrieved from the mentioned open comment-field, are also systematically evaluated for both rounds individually. This is done by clear coding of the experts' comments and a categorisation of all comments into the four expert-fields (PM, KM, virtual teamwork and EL) ((Denzin and Lincoln 2011). Furthermore a thematic analysis of main themes as well as corroboration is executed for each comment. This is executed and pinpointed in two different steps: initially this is done individually in comparison with the overall results and then in relation to the individual's expert-groups and their quantitative findings. This is to confirm and give support of the quantitative findings and the general robustness of the study. The thorough analysis of open statements also includes an examination of differences, to highlight potential discrepancies.

3.6.3 Practical and Ethical Considerations

It is prudent that every research is designed and conducted in a practical but also ethical manner. In regard to ethics, this means that data collection and analysis is executed without detrimental effects for the participants and that the study has methodical soundness. Although there are only very limited ethical issues anticipated for the case of this study, an informed consent was gained by means of providing the necessary information. As such, the researcher endeavoured to outline not only the purpose of the study to the participants, but also the intended outcomes, importance of their participation and how this is likely impacting the overall findings. This was not only facilitated through letters, emails and associated documentation, rather further clarifications were made during, pre-call discussions with the panellists of experts, prior to gaining their written acceptance for the study. Furthermore, the decision to withhold personal details and thus grant the experts anonymity prevents any anticipated ethical problems. Lastly, the ethical approval was obtained upfront from the University of Salford.

3.7 Chapter Summary

Thorough content analysis of existing literature has acted as the basis for the subsequent Delphi study. According to Weber (1990) this versatile research-tool obliges careful review, categorisation, analysis and interpretation including consideration of the contexts

of each publication. It is important to highlight that these investigations also take into account literature beyond conventional project and KM theories, such as strategic, operations or change management, not depicted in the scope of the conceptual framework. After the thorough review of philosophical stances, strategies for related studies and relevant methods for mixed data collection, the Delphi study has been chosen. The choice is based on this review and its apparent match with the research objectives as well as stand in alignment with the overall pragmatic stance and approach adopted by the study. This chapter has therefore sought to describe the underpinning research philosophy and the extent to which this has shaped the subsequent research tools and techniques selected (including the research design and data collection) in the fulfilment of the research objectives. The methodology chapter has further provided details of the approaches pursued by this study in addition to the most relevant other aspects to a certain extent. Further in-depth reviews of topics such as general validity, bias, anonymity, collection of data and its analysis were not feasible in the limited scope of this thesis and are therefore only partially discussed.

4 Chapter Four: Results of the Delphi Study Analysis

4.0 Chapter Overview

KM is important as the productivity of companies nowadays resides not only in the underpinning system that governs organisations, rather intellectual competencies of human resources also play a key role in both productivity and efficiency considering that it is intellectually elusive describing knowledge is generally abstract and comprehensive (Despres and Chauvel 1999). The generally applicable approach of this study also caters for a balanced consideration of all mentioned KM steps or stages of the knowledge management process. This includes the knowledge application stage, which received the least research attention despite the fact that, compared with the creation or codification of knowledge, this step actually adds the most value if knowledge is applied to create effective performance, for example, resolving a problem (Alavi and Tiwana 2002).

The results of the Delphi study will be presented through the use of statistical illustrations such as charts and graphs, allowing the reader to easily understand what is conveyed, which is in line with best practices from Delphi literature (Mahotra et al. 1994). In line with other similar studies, this study follows a rigid presentation using tables to depict the descriptive statistics such as final ranks and mean values. It is important to highlight that main statistics generally applied for the Delphi technique are measurements for levels of dispersion (ref. Kendall's W), as well as the central tendency (besides the used means, medians and modes) for the representation of collective statements (Hsu and Sanford 2007). For the latter, generally median and modes are preferred in literature but, as in this study, the mean is also suitable in case the scales are delineated as equal intervals (Okoli and Pawlowski 2004). Based on the applied Likert-scale, the median is also depicted in literature as a preferred option (Hsu and Sanford 2007).

4.1 Key Quantitative Results of the Delphi Study – Importance and Feasibility Pooled

In line with the general process steps of Delphi studies, the following factors were narrowed down and chosen as the most important ones via ranking and thus, a final consensus was formed (Okoli and Pawlowski 2004). The following two tables (table 4.1, table 4.2) present the results of the importance and feasibility assessment from rounds one and two for all 25 e-learning items, divided into the four main categories (1. IS Set-up, 2. IS-related Trends and Potentials, 3. IS-related Risks and 4. Management Theory, Models,

and Management of Social Aspects). Again, the number of participants per round is also outlined below and confirms the statistical relevance and continued commitment from the panellists. The following two tables (table 4.1, table 4.2) show that both increasing Kendall's Ws (for importance from 0.31 to 0.38 and for feasibility from 0.18 to 0.22) demonstrate that the respondents' results are fairly converging in round two.

Table 4.1 Summary e-learning practices' IMPORTANCE statistics results from panellists

		Round 1 (k=14)			Round 2 (k=14)	
Topic Number / Name	Mean	Rank	D^2	Mean	Rank	D^2
1.1. State-Of-The-Art Information	7.07	14	9	**7.36**	**10**	**4**
1.2. Distinction of IT	6.00	22	7	6.29	19	6
1.3. Governance / Learning	**7.86**	**7**	**5**	**7.93**	**5**	**6**
1.4. Information / Data	**7.36**	**11**	**5**	**7.43**	**9**	**4**
1.5. Procurement of IT Tools	6.29	18	8	6.29	20	5
1.6. Outsourcing	4.86	25	8	4.21	25	6
2.1. EP / Web 2.0 (E-learning 2.0)	**7.14**	**13**	**5**	6.50	17	4
2.2. Cloud (e-learning)	7.07	15	10	7.00	14	7
2.3. Consumerisation	5.86	23	7	5.64	23	7
2.4. Cust. Softw. Dev. / Customis.	6.29	19	7	6.29	21	5
2.5. Virtual Worlds / Edutainment	4.93	24	7	5.36	24	6
3.1. Big Data	6.29	20	9	6.50	18	7
3.2. Escalations of	**7.50**	**9**	**6**	6.86	16	4
4.1. Knowledge Marketing	7.00	16	6	**7.14**	**13**	**7**
4.2. Ownership of Learner	6.86	17	6	**7.29**	**11**	**6**
4.3. Interactivity / Integration	7.79	8	5	7.00	15	7
4.4. Ease of Use / Usefulness	**9.50**	**1**	**2**	**8.79**	**1**	**5**
4.5. Team-Cooperation	**8.93**	**2**	**3**	**8.36**	**3**	**7**
4.6. E-learning Mgr=Knowledge	**7.43**	**10**	**7**	**7.50**	**8**	**4**
4.7. Learning-Individual=User	**8.21**	**5**	**4**	**7.79**	**7**	**4**
4.8. Reflection and Progression	**8.43**	**4**	**5**	**7.93**	**6**	**6**
4.9. New Trainings: Integ.	**7.93**	**6**	**5**	**7.21**	**12**	**5**
4.10. Mgt. Buy-In / Incentives	**8.64**	**3**	**5**	**8.71**	**2**	**6**
4.11. Visualisation / Imagination	**7.21**	**12**	**6**	**8.07**	**4**	**4**
4.12. Paradigm Sh. Knowl.	6.29	21	7	6.14	22	6
	Grand	W	X^2	Grand	W	X^2
Totals	7.15	0.31	105.09*	7.02	0.38	126.

*$p < 0.001$

Table 4.2 Summary e-learning practices' FEASIBILITIES statistics results from panellists

		Round 1 (k=14)			Round 2 (k=14)	
Topic Number / Name	Mean	Rank	D^2	Mean	Rank	D^2
1.1. State-Of-The-Art Information	6.21	15	6	**6.43**	**11**	**6**
1.2. Distinction of IT	5.07	23	7	6.00	18	3
1.3. Governance / Learning	**6.50**	**12**	**5**	**6.43**	**12**	**5**
1.4. Information / Data	**6.57**	**10**	**8**	**6.57**	**10**	**4**
1.5. Procurement of IT Tools	5.93	18	7	**7.21**	**3**	**4**
1.6. Outsourcing	5.29	21	9	5.93	19	5
2.1. EP / Web 2.0 (E-learning 2.0)	**6.71**	**8**	**6**	**7.00**	**5**	**6**
2.2. Cloud (e-learning)	**7.36**	**2**	**10**	**6.93**	**6**	**6**
2.3. Consumerisation	5.64	19	8	5.36	23	5
2.4. Cust. Softw. Dev. / Customis.	5.57	20	8	5.64	21	6
2.5. Virtual Worlds / Edutainment	4.07	25	4	5.00	25	7
3.1. Big Data	4.71	24	7	5.43	22	6
3.2. Escalations of	**6.50**	**13**	**7**	6.21	16	6
4.1. Knowledge Marketing	**6.86**	**6**	**5**	**6.79**	**8**	**5**
4.2. Ownership of Learner	**6.93**	**5**	**5**	6.36	14	5
4.3. Interactivity / Integration	**6.57**	**11**	**5**	5.93	20	8
4.4. Ease of Use / Usefulness	**7.86**	**1**	**5**	**7.50**	**1**	**4**
4.5. Team-Cooperation	**7.00**	**4**	**5**	**7.43**	**2**	**4**
4.6. E-learning Mgr=Knowledge	6.21	16	8	**6.71**	**9**	**4**
4.7. Learning-Individual=User	**6.71**	**9**	**6**	**7.14**	**4**	**4**
4.8. Reflection and Progression	**7.21**	**3**	**4**	**6.93**	**7**	**5**
4.9. New Trainings: Integ.	6.50	14	5	6.29	15	6
4.10. Mgt. Buy-In / Incentives	**6.79**	**7**	**4**	6.14	17	5
4.11. Visualisation / Imagination	6.21	17	6	**6.43**	**13**	**6**
4.12. Paradigm Sh. Knowl.	5.29	22	6	5.14	24	4
	Grand Means	W	X^2	Grand Means	W	X^2
Totals	6.25	0.18	61.31	6.36	0.22	73.62

*$p < 0.001$

In the above two tables, those items ranked by the experts above average are highlighted in bold. For the ranking of importance there were twelve during the first round and thirteen in the second round. Likewise, the feasibility assessment distilled finally thirteen elements to be ranked above average, initially from fourteen in the first round. It is interesting that most top ranked elements were already visible after the first Delphi round, while low ranked elements often remained low (e.g. the importance of outsourcing (round 1 mean = 4.86 and round 2 mean = 4.21). What is important is to understand that the results prove the high quality of the study. This is because the findings are in line with literature suggesting that cultural and individual social obstacles, instead of technical root causes, should be in focus. This is supported by the fact that most high ranked elements are derived from the fourth section, which also reviews the management of social aspects.

4.1.1 Results for Each Judge Individually

The following section provides an overview of the quantitative results for each individual judge. The full dataset, which encompasses 14 tables, is displayed in appendix VI. The following table (table 4.3) summarises all individual results. The results show total grand means of around 6.70 across all rounds and panellists. The agreements, portrayed via the Kendall's W values in the table below (table 4.3) differ between the 14 judges. The lowest value (0.37) is for panellist 12, and suggests weak agreement. The highest Kendall's W is for panellist 11 (0.65), suggesting strong agreement. The range of Kendall's W values is 0.38 (lowest) to 0.65 (highest).

Table 4.3 Summary results e-learning practices' importance and feasibility from all 14 panellists

Panellist	Mean Importance		Mean Feasibility		Grand	W	X
	Round I	Round II	Round I	Round II	Mean		
1	6.92	7.56	6.00	6.28	6.69	0.60	58.05
2	7.88	7.64	7.04	6.92	7.37	0.47	45.05
3	6.88	7.28	6.60	5.76	6.63	0.47	44.81
4	7.28	6.96	6.36	6.28	6.72	0.41	38.89
5	7.40	6.64	6.52	5.48	6.51	0.38	36,86
6	7.20	7.52	6.08	6.92	6.93	0.41	39.10
7	7.08	6.76	7.72	6.60	7.04	0.59	56.75
8	6.08	6.96	4.76	6.48	6.07	0.55	53.03
9	7.20	7.32	7.24	6.92	7.17	0.60	57.81
10	6.36	7.04	5.32	6.56	6.32	0.44	42.48
11	7.08	7.04	6.04	6.12	6.57	0.65	61.95
12	7.16	5.68	6.88	6.64	6.59	0.37	35.16
13	8.28	6.40	5.80	5.76	6.56	0.47	45.17
14	7.28	7.52	5.16	6.28	6.56	0.38	36.29

4.1.2 Results for Each Judge and Between Groups

Reference is also made to the results for the distinctive experts from the fields of PM, KM, virtual team-management and e-learning. It is possible to distinguish between all experts, as said experts indicated their field(s) of profound expertise during the survey. Some experts indicated expertise in multiple fields. Accordingly, their voting is considered and counted for multiple of the four expert groups summaries below. In general, the comparison of group responses is feasible, as all groups participate in the two rounds collectively, which is otherwise difficult due to subjectivity of heterogeneous and independent rankings of different groups (Schmidt 1997). Table 4.4 and table 4.5 depict the differences between the four expert groups. For cohesion with the previous result-presentation, the 13 highest

ranked elements are again highlighted below while the top 3 elements are underlined.

Table 4.4 Comparison second round's (n=14) final ranks and mean-values between expertise-groups for IMPORTANCE

Expertise	PM		KM		Virtual Team		E-learning	
E-learning practice								
1.1. State-Of-The IS	**7.22**	**11**	**7.33**	**12**	**7.50**	**12**	**7.80**	**8**
1.2. Distinction of IT	6.33	18	6.67	19	7.17	16	6.20	20
1.3. Gov./Learn. Obj.	**8.22**	**3**	**7.67**	**8**	**8.17**	**5**	6.40	18
1.4. Data Mgt./Tools	**7.11**	**12**	**7.83**	**6**	**8.00**	**6**	**7.80**	**9**
1.5. Procurm. IT Tools	5.89	21	6.00	22	6.67	20	6.60	17
1.6. Outsourcing	3.67	25	3.67	25	5.00	24	4.00	25
2.1. EP / Web 2.0	6.22	19	6.83	18	6.83	18	7.00	14
2.2. Cloud	6.44	17	6.17	20	**8.00**	**7**	6.40	19
2.3. Consumerisation	5.44	23	5.00	24	5.83	23	4.40	24
2.4. Customisation	5.89	22	7.17	15	7.17	17	**7.60**	**12**
2.5. Virt. Worlds/Edut.	5.33	24	5.33	23	4.83	25	5.80	22
3.1. Big Data	6.89	14	7.00	17	6.83	19	7.00	15
3.2. Escal. Implement.	6.89	15	**7.33**	**13**	7.33	14	7.00	16
4.1. Know.-Marketing	**7.44**	**9**	7.17	16	6.50	22	5.80	23
4.2. Ownersh. Learner	**7.33**	**10**	7.33	14	7.33	15	**7.80**	**10**
4.3. Interact./Integrat.	6.56	16	**7.50**	**10**	**7.83**	**8**	**8.00**	**7**
4.4. Ease Use/Usefuln.	**8.44**	**2**	**8.83**	**3**	**9.33**	**1**	**8.80**	**1**
4.5. Team-Cooperation	**8.22**	**4**	**9.17**	**1**	**9.33**	**2**	**8.60**	**2**
4.6. E-learning-Mgr.	**7.67**	**7**	**7.50**	**11**	**7.83**	**9**	**7.20**	**13**
4.7. Learning-Individ.	**7.78**	**6**	**8.33**	**4**	**7.83**	**10**	**8.20**	**5**
4.8. Reflect./Progres.	**7.67**	**8**	**8.17**	**5**	**8.33**	**4**	**8.60**	**3**
4.9. New Trainings	**7.11**	**13**	**7.83**	**7**	**7.50**	**13**	**8.20**	**6**
4.10. Mgt. Buy-In	**8.56**	**1**	**9.17**	**2**	**9.17**	**3**	**8.60**	**4**
4.11. Visual./Imagin.	**8.22**	**5**	**7.67**	**9**	**7.83**	**11**	**7.80**	**11**
4.12. Knowledge Soc.	6.00	20	6.17	21	6.67	21	6.20	21
Grand Means		W	Grand Means	W	Grand Means	W	Grand Means	W
	6.90	0.35	7.15	0.53	7.39	0.51	7.11	0.57

Table 4.5 Comparison second round's (n=14) final ranks and mean-values between expertise groups for FEASIBILITY

Expertise	PM		KM		Virtual Team		E-learning	
E-learning practice								
1.1. State-Of-The IS	5.78	17	**7.33**	**12**	5.83	20	**6.80**	**8**
1.2. Distinction of IT	5.89	15	6.67	19	6.17	16	5.80	19
1.3. Gov./Learn. Obj.	**6.22**	**9**	**7.67**	**8**	**6.67**	**9**	5.80	20
1.4. Data Mgt./Tools	**6.22**	**10**	**7.83**	**6**	**7.00**	**8**	**6.80**	**9**
1.5. Procurm. IT Tools	**7.22**	**2**	6.00	22	**6.50**	**11**	**6.80**	**10**
1.6. Outsourcing	5.67	19	3.67	25	6.00	18	5.60	21
2.1. EP / Web 2.0	**6.78**	**7**	6.83	18	5.83	21	**7.00**	**6**
2.2. Cloud	**6.22**	**11**	6.17	20	**7.33**	**6**	6.00	17
2.3. Consumerisation	5.11	24	5.00	24	5.33	24	4.20	25
2.4. Customisation	5.56	20	7.17	15	6.00	19	6.40	15
2.5. Virt. Worlds/Edut.	5.22	23	5.33	23	3.83	25	4.80	23
3.1. Big Data	5.33	22	7.00	17	6.33	14	**6.80**	**11**
3.2. Escal. Implement.	6.11	14	**7.33**	**13**	5.83	22	6.00	18
4.1. Know.-Marketing	**7.11**	**4**	7.17	16	6.17	17	**7.60**	**1**
4.2. Ownersh. Learner	**6.22**	**12**	7.33	14	**6.67**	**10**	**6.60**	**13**
4.3. Interact./Integrat.	5.56	21	**7.50**	**10**	**6.50**	**12**	**6.80**	**12**
4.4. Ease Use/Usefuln.	**7.22**	**3**	**8.83**	**3**	**8.00**	**1**	**7.60**	**2**
4.5. Team-Cooperation	**7.44**	**1**	**9.17**	**1**	**7.83**	**2**	**7.60**	**3**
4.6. E-learning-Mgr.	**7.11**	**5**	**7.50**	**11**	**7.50**	**3**	6.40	16
4.7. Learning-Individ.	**7.00**	**6**	**8.17**	**5**	**7.33**	**7**	**7.40**	**4**
4.8. Reflect./Progres.	**6.22**	**13**	**9.17**	**2**	**7.50**	**4**	6.60	14
4.9. New Trainings	**6.44**	**8**	**7.67**	**9**	**6.50**	**13**	**7.20**	**5**
4.10. Mgt. Buy-In	4.89	25	**6.67**	**12**	6.33	15	5.60	22
4.11. Visual./Imagin.	5.78	18	**7.33**	**4**	**7.50**	**5**	**7.00**	**7**
4.12. Knowledge Soc.	5.89	16	5.17	22	5.67	23	4.80	24
Grand Means		W	Grand Means	W	Grand Means	W	Grand Means	W
	6.24	0.19	6.36	0.36	6.49	0.38	6.40	0.34

What was found out is that, there is mostly agreement across the expert-groups, for example, with reference to the leading e-learning best practices Ease of Use/Usefulness, Team-Cooperation and Required Management Buy-In/Incentives. As it is more challenging to bring different expert-groups to an overall consensus, the Kendall's Ws are, like in this Delphi study, generally lower than single-field studies. Accordingly, outstanding agreement is found within expertise-groups where more than moderate agreement on importance (Kendall's W 3 x >0.5) was achieved among each of the KM, virtual team management and e-learning experts. This proves also the success of the results. Obviously, there are also slight disagreements between the expert-groups in regards to certain elements. Like for example the comparatively outstandingly high and top

assessment of KM-experts for the feasibility (9.17) of transferring e-learning's reflection and progression "best" practice to PKM in virtual teams, which is in total across all four expert groups still ranked as a relatively high element.

The following tables (table 4.6, table 4.7) report the full data results for each judge and between the 4 groups (PM n=9, KM n=6, virtual teamwork (VT) n=6, EL n=5). This is provided for both rounds individually in order to present the developments between the two rounds.

Table 4.6 Results e-learning practices' IMPORTANCE round I from PM panellists (n=9)

	Panellist									
Topic Number / Name	1	2	3	4	5	6	7	8	9	Me
1.1. State-Of-The-Art IS	8	10	6	1	9	5	6	10	9	7.11
1.2. Distinction of IT	5	7	5	1	6	8	7	8	5	5.78
1.3. Govern./Learning Objects	7	9	8	7	9	5	10	10	9	8.22
1.4. Info./Data Mgt & Tools	8	7	8	5	10	9	8	8	5	7.56
1.5. Procurement of IT Tools	6	10	6	2	5	7	7	5	5	5.89
1.6. Outsourcing	3	6	7	1	3	2	6	4	9	4.56
2.1. EP/Web 2.0 (EL 2.0)	5	10	8	8	7	9	6	8	5	7.33
2.2. Cloud (e-learning)	8	10	6	9	6	0	6	10	5	6.67
2.3. Consumerisation	4	7	7	1	8	5	2	7	7	5.33
2.4. Cust. Softw. Dev./Custom.	8	7	8	1	2	8	7	7	5	5.89
2.5. Virtual Worlds/Edutain.	4	4	6	7	1	5	2	4	6	4.33
3.1. Big Data	7	3	6	1	6	2	8	10	9	5.78
3.2. Escalations Implement.	8	8	6	9	3	8	8	8	9	7.44
4.1. Knowledge Marketing	9	3	8	8	8	9	6	8	5	7.11
4.2. Ownership of Learner	8	4	7	5	7	5	7	10	5	6.44
4.3. Interactivity/Integration	9	10	5	8	10	9	7	8	5	7.89
4.4. Ease of Use/Usefulness	9	10	8	10	10	10	10	10	10	9.67
4.5. Team-Cooperation	7	10	8	10	10	8	10	10	10	9.22
4.6. EL Mgr=Knowl. Broker	7	3	8	8	10	3	7	8	10	7.11
4.7. Learn.Indivi.=User Knowl.	7	8	7	9	10	8	9	8	10	8.44
4.8. Reflection/Progression	8	8	8	10	10	9	8	10	9	8.89
4.9. New Train.: Pedag./Techn.	9	9	8	8	7	8	5	9	10	8.11
4.10. Mgt. Buy-In/Incentives	6	7	9	10	10	5	10	10	10	8.56
4.11. Visualisat./Imagination	8	10	8	5	7	9	8	9	5	7.67
4.12. Shift Knowledge Society	4	5	9	8	6	3	7	8	5	6.11
Grand Mean	7.08									
W	0.37									
X^2	79.08*									

*$p < 0.001$

Table 4.7 Results e-learning practices' IMPORTANCE round II from PM panellists (n=9)

	Panellist									
Topic Number / Name	1	2	3	4	5	6	7	8	9	Mean
1.1. State-Of-The-Art IS	6	8	5	7	8	8	5	9	9	7.22
1.2. Distinction of IT	8	9	3	6	5	6	6	7	7	6.33
1.3. Govern./Learning Objects	10	7	9	9	6	7	8	9	9	8.22
1.4. Info./Data Mgt & Tools	9	7	5	8	8	8	6	5	8	7.11
1.5. Procurement of IT Tools	6	5	4	4	8	7	4	7	8	5.89
1.6. Outsourcing	2	4	5	3	4	5	3	3	4	3.67
2.1. EP/Web 2.0 (EL 2.0)	6	7	5	7	7	7	7	3	7	6.22
2.2. Cloud (e-learning)	8	8	9	5	2	7	5	6	8	6.44
2.3. Consumerisation	5	6	5	7	2	4	7	9	4	5.44
2.4. Cust. Softw. Dev./Custom.	8	8	3	6	8	7	4	3	6	5.89
2.5. Virtual Worlds/Edutain.	6	7	5	5	7	2	3	5	8	5.33
3.1. Big Data	8	8	5	5	7	8	8	3	10	6.89
3.2. Escalations Implement.	9	6	6	5	8	8	5	9	6	6.89
4.1. Knowledge Marketing	8	3	9	10	7	7	7	9	7	7.44
4.2. Ownership of Learner	6	10	8	8	5	8	5	8	8	7.33
4.3. Interactivity/Integration	7	7	9	6	9	9	4	2	6	6.56
4.4. Ease of Use/Usefulness	10	8	9	7	9	9	5	9	10	8.44
4.5. Team-Cooperation	10	9	9	9	8	10	3	8	8	8.22
4.6. EL Mgr=Knowl. Broker	8	8	5	7	7	8	9	9	8	7.67
4.7. Learn.Indivi.=User Knowl.	8	7	5	9	9	9	7	9	7	7.78
4.8. Reflection/Progression	7	9	9	8	8	9	3	8	8	7.67
4.9. New Train.: Pedag./Techn.	8	8	8	6	9	8	5	4	8	7.11
4.10. Mgt. Buy-In/Incentives	10	9	9	10	9	8	8	4	10	8.56
4.11. Visualisat./Imagination	10	6	8	6	9	8	10	9	8	8.22
4.12. Shift Knowledge Society	6	8	9	6	5	6	5	3	6	6.00
Grand Mean	6.90									
W	0.35									
X^2	74.96*									

*p < 0.001

The previous two tables present the results from the nine PM judges. These depict how the PM experts ranked the 25 discussed e-learning practices' in terms of importance during round one and two. The results from round one lead to a Kendall's W of 0.37, which is relatively weak. Round two lead to a calculated Kendall's W of 0.35, which is also interpreted as relatively weak. Overall the core result, which is the level of agreement across the PM experts in terms of importance, remained relatively stable across both rounds.

Table 4.8 Results e-learning practices' IMPORTANCE round I from KM panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	8	10	9	5	6	10	8.00
1.2. Distinction of IT	7	7	6	8	7	8	7.17
1.3. Govern./Learning Objects	6	9	9	5	10	10	8.17
1.4. Info./Data Mgt & Tools	7	7	10	9	8	8	8.17
1.5. Procurement of IT Tools	7	10	5	7	7	5	6.83
1.6. Outsourcing	8	6	3	2	6	4	4.83
2.1. EP/Web 2.0 (EL 2.0)	7	10	7	9	6	8	7.83
2.2. Cloud (e-learning)	6	10	6	0	6	10	6.33
2.3. Consumerisation	7	7	8	5	2	7	6.00
2.4. Cust. Softw. Dev./Custom.	8	7	2	8	7	7	6.50
2.5. Virtual Worlds/Edutain.	7	4	1	5	2	4	3.83
3.1. Big Data	8	3	6	2	8	10	6.17
3.2. Escalations Implement.	7	8	3	8	8	8	7.00
4.1. Knowledge Marketing	8	3	8	9	6	8	7.00
4.2. Ownership of Learner	5	4	7	5	7	10	6.33
4.3. Interactivity/Integration	6	10	10	9	7	8	8.33
4.4. Ease of Use/Usefulness	9	10	10	10	10	10	9.83
4.5. Team-Cooperation	8	10	10	8	10	10	9.33
4.6. EL Mgr=Knowl. Broker	7	3	10	3	7	8	6.33
4.7. Learn.Indivi.=User Knowl.	8	8	10	8	9	8	8.50
4.8. Reflection and Progression	7	8	10	9	8	10	8.67
4.9. New Train.: Pedag./Techn.	9	9	7	8	5	9	7.83
4.10. Mgt. Buy-In/Incentives	9	7	10	5	10	10	8.50
4.11. Visualisation/Imagination	5	10	7	9	8	9	8.00
4.12. Shift Knowledge Society	8	5	6	3	7	8	6.17
Grand Mean	7.27						
W	0.35						
X^2	50.55*						

*p = 0.0012

Table 4.9 Results e-learning practices' IMPORTANCE round II from KM panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	6	8	7	8	8	7	7.33
1.2. Distinction of IT	8	9	6	5	6	6	6.67
1.3. Govern./Learning Objects	10	7	9	6	7	7	7.67
1.4. Info./Data Mgt & Tools	9	7	8	8	8	7	7.83
1.5. Procurement of IT Tools	6	5	4	8	7	6	6.00
1.6. Outsourcing	2	4	3	4	5	4	3.67
2.1. EP/Web 2.0 (EL 2.0)	6	7	7	7	7	7	6.83
2.2. Cloud (e-learning)	8	8	5	2	7	7	6.17
2.3. Consumerisation	5	6	7	2	4	6	5.00
2.4. Cust. Softw. Dev./Custom.	8	8	6	8	7	6	7.17
2.5. Virtual Worlds/Edutain.	6	7	5	7	2	5	5.33
3.1. Big Data	8	8	5	7	8	6	7.00
3.2. Escalations Implement.	9	6	5	8	8	8	7.33
4.1. Knowledge Marketing	8	3	10	7	7	8	7.17
4.2. Ownership of Learner	6	10	8	5	8	7	7.33
4.3. Interactivity/Integration	7	7	6	9	9	7	7.50
4.4. Ease of Use/Usefulness	10	8	7	9	9	10	8.83
4.5. Team-Cooperation	10	9	9	8	10	9	9.17
4.6. EL Mgr=Knowl. Broker	8	8	7	7	8	7	7.50
4.7. Learn.Indivi.=User Knowl.	8	7	9	9	9	8	8.33
4.8. Reflection and Progression	7	9	8	8	9	8	8.17
4.9. New Train.: Pedag./Techn.	8	8	6	9	8	8	7.83
4.10. Mgt. Buy-In/Incentives	10	9	10	9	8	9	9.17
4.11. Visualisation/Imagination	10	6	6	9	8	7	7.67
4.12. Shift Knowledge Society	6	8	6	5	6	6	6.17
Grand Mean	7.15						
W	0.53						
X^2	75.71*						

*p < 0.001

The previous two tables present the results from the six KM judges. These depict how the KM experts ranked the 25 discussed e-learning practices' in terms of importance during round one and two. The results from round one lead to a Kendall's W of 0.35, which suggests weak agreement. However, round two lead to a calculated Kendall's W of 0.53, which is interpreted as relatively moderate agreement. Overall the core result, which is again the level of agreement across the KM experts in terms of importance, improved substantially between the rounds.

Table 4.10 Results e-learning practices' IMPORTANCE round I from VT panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	7	8	10	5	6	10	7.67
1.2. Distinction of IT	8	7	7	5	7	8	7.00
1.3. Govern./Learning Objects	8	6	9	8	10	10	8.50
1.4. Info./Data Mgt & Tools	5	7	7	7	8	8	7.00
1.5. Procurement of IT Tools	8	7	10	7	7	5	7.33
1.6. Outsourcing	8	8	6	5	6	4	6.17
2.1. EP/Web 2.0 (EL 2.0)	8	7	10	5	6	8	7.33
2.2. Cloud (e-learning)	10	6	10	8	6	10	8.33
2.3. Consumerisation	7	7	7	8	2	7	6.33
2.4. Cust. Softw. Dev./Custom.	5	8	7	7	7	7	6.83
2.5. Virtual Worlds/Edutain.	6	7	4	5	2	4	4.67
3.1. Big Data	9	8	3	5	8	10	7.17
3.2. Escalations Implement.	7	7	8	7	8	8	7.50
4.1. Knowledge Marketing	8	8	3	7	6	8	6.67
4.2. Ownership of Learner	7	5	4	9	7	10	7.00
4.3. Interactivity/Integration	8	6	10	9	7	8	8.00
4.4. Ease of Use/Usefulness	9	9	10	10	10	10	9.67
4.5. Team-Cooperation	9	8	10	8	10	10	9.17
4.6. EL Mgr=Knowl. Broker	9	7	3	8	7	8	7.00
4.7. Learn.Indivi.=User Knowl.	8	8	8	6	9	8	7.83
4.8. Reflection and Progression	9	7	8	9	8	10	8.50
4.9. New Train.: Pedag./Techn.	9	9	9	6	5	9	7.83
4.10. Mgt. Buy-In/Incentives	8	9	7	9	10	10	8.83
4.11. Visualisation/Imagination	7	5	10	8	8	9	7.83
4.12. Shift Knowledge Society	10	8	5	6	7	8	7.33
Grand Mean	7.50						
W	0.33						
X^2	47.32*						

*p = 0.0031

Table 4.11 Results e-learning practices' IMPORTANCE round II from VT panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	6	8	8	8	8	7	7.50
1.2. Distinction of IT	8	7	9	7	6	6	7.17
1.3. Govern./Learning Objects	10	9	7	9	7	7	8.17
1.4. Info./Data Mgt & Tools	9	9	7	8	8	7	8.00
1.5. Procurement of IT Tools	6	7	5	9	7	6	6.67
1.6. Outsourcing	2	8	4	7	5	4	5.00
2.1. EP/Web 2.0 (EL 2.0)	6	7	7	7	7	7	6.83
2.2. Cloud (e-learning)	8	9	8	9	7	7	8.00
2.3. Consumerisation	5	7	6	7	4	6	5.83
2.4. Cust. Softw. Dev./Custom.	8	8	8	6	7	6	7.17
2.5. Virtual Worlds/Edutain.	6	5	7	4	2	5	4.83
3.1. Big Data	8	5	8	6	8	6	6.83
3.2. Escalations Implement.	9	5	6	8	8	8	7.33
4.1. Knowledge Marketing	8	7	3	6	7	8	6.50
4.2. Ownership of Learner	6	9	10	4	8	7	7.33
4.3. Interactivity/Integration	7	9	7	8	9	7	7.83
4.4. Ease of Use/Usefulness	10	9	8	10	9	10	9.33
4.5. Team-Cooperation	10	9	9	9	10	9	9.33
4.6. EL Mgr=Knowl. Broker	8	7	8	9	8	7	7.83
4.7. Learn.Indivi.=User Knowl.	8	7	7	8	9	8	7.83
4.8. Reflection and Progression	7	9	9	8	9	8	8.33
4.9. New Train.: Pedag./Techn.	8	7	8	6	8	8	7.50
4.10. Mgt. Buy-In/Incentives	10	9	9	10	8	9	9.17
4.11. Visualisation/Imagination	10	8	6	8	8	7	7.83
4.12. Shift Knowledge Society	6	7	8	7	6	6	6.67
Grand Mean	7.39						
W	0.51						
X^2	73.78*						

*p < 0.001

The previous two tables present the results from the six VT judges. This is depicting accordingly how the VT experts ranked the 25 discussed e-learning practices' in terms of importance during round one and two. The results from round one lead to a Kendall's W of 0.33, which is as with the PM and KM judges a relatively weak result for round one. However, round two lead to a calculated Kendall's W of 0.51, which is interpreted as relatively moderate agreement, similar to the round two result from the KM panellists. Consequently, the core result, which is again the level of agreement across the VT experts in terms of importance, increased substantially between the rounds.

Table 4.12 Results e-learning practices' IMPORTANCE round I from EL panellists (n=5)

	Panellist					
Topic Number / Name	1	2	3	4	5	Mean
1.1. State-Of-The-Art IS	7	10	5	8	10	8.00
1.2. Distinction of IT	5	7	8	7	8	7.00
1.3. Govern./Learning Objects	6	9	5	8	10	7.60
1.4. Info./Data Mgt & Tools	8	7	9	8	8	8.00
1.5. Procurement of IT Tools	7	10	7	6	5	7.00
1.6. Outsourcing	2	6	2	4	4	3.60
2.1. EP/Web 2.0 (EL 2.0)	8	10	9	6	8	8.20
2.2. Cloud (e-learning)	8	10	0	7	10	7.00
2.3. Consumerisation	5	7	5	7	7	6.20
2.4. Cust. Softw. Dev./Custom.	7	7	8	8	7	7.40
2.5. Virtual Worlds/Edutain.	8	4	5	4	4	5.00
3.1. Big Data	6	3	2	8	10	5.80
3.2. Escalations Implement.	8	8	8	9	8	8.20
4.1. Knowledge Marketing	3	3	9	8	8	6.20
4.2. Ownership of Learner	8	4	5	9	10	7.20
4.3. Interactivity/Integration	8	10	9	7	8	8.40
4.4. Ease of Use/Usefulness	8	10	10	10	10	9.60
4.5. Team-Cooperation	8	10	8	9	10	9.00
4.6. EL Mgr=Knowl. Broker	8	3	3	8	8	6.00
4.7. Learn.Indivi.=User Knowl.	8	8	8	9	8	8.20
4.8. Reflection and Progression	8	8	9	5	10	8.00
4.9. New Train.: Pedag./Techn.	8	9	8	6	9	8.00
4.10. Mgt. Buy-In/Incentives	8	7	5	10	10	8.00
4.11. Visualisation/Imagination	8	10	9	4	9	8.00
4.12. Shift Knowledge Society	5	5	3	4	8	5.00
Grand Mean	7.22					
W	0.40					
X^2	47.87*					

*p = 0.0026

Table 4.13 Results e-learning practices' IMPORTANCE round II from EL panellists (n=5)

	Panellist					
Topic Number / Name	1	2	3	4	5	Mean
1.1. State-Of-The-Art IS	8	7	8	8	8	7.80
1.2. Distinction of IT	9	6	5	6	5	6.20
1.3. Govern./Learning Objects	7	8	6	7	4	6.40
1.4. Info./Data Mgt & Tools	7	8	8	8	8	7.80
1.5. Procurement of IT Tools	5	6	8	7	7	6.60
1.6. Outsourcing	4	4	4	5	3	4.00
2.1. EP/Web 2.0 (EL 2.0)	7	7	7	7	7	7.00
2.2. Cloud (e-learning)	8	7	2	7	8	6.40
2.3. Consumerisation	6	5	2	4	5	4.40
2.4. Cust. Softw. Dev./Custom.	8	8	8	7	7	7.60
2.5. Virtual Worlds/Edutain.	7	5	7	2	8	5.80
3.1. Big Data	8	7	7	8	5	7.00
3.2. Escalations Implement.	6	6	8	8	7	7.00
4.1. Knowledge Marketing	3	7	7	7	5	5.80
4.2. Ownership of Learner	10	7	5	8	9	7.80
4.3. Interactivity/Integration	7	6	9	9	9	8.00
4.4. Ease of Use/Usefulness	8	9	9	9	9	8.80
4.5. Team-Cooperation	9	8	8	10	8	8.60
4.6. EL Mgr=Knowl. Broker	8	6	7	8	7	7.20
4.7. Learn.Indivi.=User Knowl.	7	8	9	9	8	8.20
4.8. Reflection and Progression	9	8	8	9	9	8.60
4.9. New Train.: Pedag./Techn.	8	7	9	8	9	8.20
4.10. Mgt. Buy-In/Incentives	9	10	9	8	7	8.60
4.11. Visualisation/Imagination	6	8	9	8	8	7.80
4.12. Shift Knowledge Society	8	6	5	6	6	6.20
Grand Mean	7.11					
W	0.57					
X^2	68.34*					

*p < 0.001

The previous two tables present the results from the five EL judges. These depict again how the EL experts ranked the 25 discussed e-learning practices' in terms of importance during round one and two. The results from round one lead to a Kendall's W of 0.40, which is the highest agreement across all expert groups during round one. Round two even lead to a calculated highly moderate Kendall's W of 0.57, which is also the highest round two result across the four judge groups in terms of importance. Consequently, the core result, which is again the level of agreement across the EL experts in terms of importance, was outstandingly high and increased again substantially between the rounds.

Table 4.14 Results e-learning practices' FEASIBILITY round I from PM panellists (n=9)

	Panellist									
Topic Number / Name	1	2	3	4	5	6	7	8	9	Mean
1.1. State-Of-The-Art IS	9	9	6	5	7	4	8	3	5	6.22
1.2. Distinction of IT	5	8	6	1	4	5	7	3	1	4.44
1.3. Govern./Learning Objects	5	7	7	7	7	5	6	7	5	6.22
1.4. Info./Data Mgt & Tools	9	8	7	5	8	9	7	1	5	6.56
1.5. Procurement of IT Tools	5	8	4	2	5	5	6	7	9	5.67
1.6. Outsourcing	4	9	8	1	5	1	4	3	5	4.44
2.1. EP/Web 2.0 (EL 2.0)	5	9	8	8	9	9	3	6	8	7.22
2.2. Cloud (e-learning)	9	9	6	9	10	0	6	7	8	7.11
2.3. Consumerisation	4	4	6	1	9	8	2	4	5	4.78
2.4. Cust. Softw. Dev./Custom.	9	5	6	1	5	5	6	3	5	5.00
2.5. Virtual Worlds/Edutain.	6	2	5	5	3	3	2	2	6	3.78
3.1. Big Data	6	3	5	1	7	2	8	4	1	4.11
3.2. Escalations Implement.	5	6	8	9	5	6	6	8	2	6.11
4.1. Knowledge Marketing	8	5	6	6	10	9	5	7	5	6.78
4.2. Ownership of Learner	6	7	5	6	9	5	7	8	5	6.44
4.3. Interactivity/Integration	6	8	5	6	10	5	6	5	5	6.22
4.4. Ease of Use/Usefulness	7	9	5	5	10	6	10	7	10	7.67
4.5. Team-Cooperation	8	8	5	5	10	5	9	8	5	7.00
4.6. EL Mgr=Knowl. Broker	6	1	7	6	8	3	7	8	3	5.44
4.7. Learn.Indivi.=Us. Knowl.	4	5	7	5	7	8	9	8	3	6.22
4.8. Reflection/Progression	8	8	8	7	6	5	6	9	5	6.89
4.9. New Train.: Pedag./Techn.	9	4	4	5	5	9	5	8	8	6.33
4.10. Mgt. Buy-In/Incentives	7	9	8	6	7	5	7	6	5	6.67
4.11. Visualisat./Imagination	7	9	4	3	6	8	5	8	5	6.11
4.12. Shift Knowledge Society	8	3	6	4	9	3	4	5	5	5.22
Grand Mean	5.95									
W	0.20									
X^2	42.77*									

*p = 0.0106

Table 4.15 Results e-learning practices' FEASIBILITY round II from PM panellists (n=9)

	Panellist									
Topic Number / Name	1	2	3	4	5	6	7	8	9	Mean
1.1. State-Of-The-Art IS	3	4	5	8	8	6	5	7	6	5.78
1.2. Distinction of IT	7	6	7	5	4	6	6	5	7	5.89
1.3. Govern./Learning Objects	7	6	9	7	4	6	8	5	4	6.22
1.4. Info./Data Mgt & Tools	7	6	6	7	7	7	7	5	4	6.22
1.5. Procurement of IT Tools	6	5	9	6	7	7	8	8	9	7.22
1.6. Outsourcing	3	6	5	5	3	7	7	8	7	5.67
2.1. EP/Web 2.0 (EL 2.0)	4	3	5	8	9	7	8	8	9	6.78
2.2. Cloud (e-learning)	8	4	5	7	3	7	7	8	7	6.22
2.3. Consumerisation	5	3	5	6	3	5	8	7	4	5.11
2.4. Cust. Softw. Dev./Custom.	6	5	5	6	7	8	8	3	2	5.56
2.5. Virtual Worlds/Edutain.	6	3	5	5	8	2	9	5	4	5.22
3.1. Big Data	8	8	5	4	6	7	2	3	5	5.33
3.2. Escalations Implement.	6	3	5	7	9	6	5	8	6	6.11
4.1. Knowledge Marketing	4	9	6	8	8	7	7	9	6	7.11
4.2. Ownership of Learner	6	6	5	7	6	8	5	4	9	6.22
4.3. Interactivity/Integration	6	4	5	7	8	9	7	1	3	5.56
4.4. Ease of Use/Usefulness	9	7	5	8	9	7	8	5	7	7.22
4.5. Team-Cooperation	7	8	5	8	7	9	9	6	8	7.44
4.6. EL Mgr=Knowl. Broker	8	9	5	6	5	8	5	9	9	7.11
4.7. Learn.Indivi.=User Knowl.	8	7	5	7	9	8	6	8	8	7.33
4.8. Reflection and Progression	6	9	5	8	4	8	7	8	8	7.00
4.9. New Train.: Pedag./Techn.	6	6	5	5	9	8	7	3	7	6.22
4.10. Mgt. Buy-In/Incentives	7	5	5	8	7	6	8	3	7	6.22
4.11. Visualisation/Imagination	8	8	5	6	8	8	2	5	8	6.44
4.12. Shift Knowledge Society	6	4	5	6	4	6	7	3	3	4.89
Grand Mean	6.24									
W	0.19									
X^2	41.16*									

*p = 0.016

The previous two tables present the results from the nine PM judges. This time they show how the PM experts ranked the 25 discussed e-learning practices' in terms of feasibility during round one and two. The results from round one lead to a Kendall's W of 0.20, which is extremely weak. Round two lead to a calculated Kendall's W of 0.19, which is also interpreted as weak. Overall the core result, which is the level of agreement across the PM experts in terms of feasibility, remained relatively low but stable across both rounds, which is similar to the results from the importance ranking.

Table 4.16 Results e-learning practices' FEASIBILITY round I from KM panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	7	9	7	4	8	3	6.33
1.2. Distinction of IT	7	8	4	5	7	3	5.67
1.3. Govern./Learning Objects	5	7	7	5	6	7	6.17
1.4. Info./Data Mgt & Tools	7	8	8	9	7	1	6.67
1.5. Procurement of IT Tools	7	8	5	5	6	7	6.33
1.6. Outsourcing	8	9	5	1	4	3	5.00
2.1. EP/Web 2.0 (EL 2.0)	6	9	9	9	3	6	7.00
2.2. Cloud (e-learning)	5	9	10	0	6	7	6.17
2.3. Consumerisation	7	4	9	8	2	4	5.67
2.4. Cust. Softw. Dev./Custom.	7	5	5	5	6	3	5.17
2.5. Virtual Worlds/Edutain.	5	2	3	3	2	2	2.83
3.1. Big Data	7	3	7	2	8	4	5.17
3.2. Escalations Implement.	7	6	5	6	6	8	6.33
4.1. Knowledge Marketing	7	5	10	9	5	7	7.17
4.2. Ownership of Learner	5	7	9	5	7	8	6.83
4.3. Interactivity/Integration	6	8	10	5	6	5	6.67
4.4. Ease of Use/Usefulness	7	9	10	6	10	7	8.17
4.5. Team-Cooperation	6	8	10	5	9	8	7.67
4.6. EL Mgr=Knowl. Broker	6	1	8	3	7	8	5.50
4.7. Learn.Indivi.=User Knowl.	7	5	7	8	9	8	7.33
4.8. Reflection and Progression	7	8	6	5	6	9	6.83
4.9. New Train.: Pedag./Techn.	7	4	5	9	5	8	6.33
4.10. Mgt. Buy-In/Incentives	6	9	7	5	7	6	6.67
4.11. Visualisation/Imagination	5	9	6	8	5	8	6.83
4.12. Shift Knowledge Society	5	3	9	3	4	5	4.83
Grand Mean	6.21						
W	0.23						
X^2	33.10*						

*p = 0.102

Table 4.17 Results e-learning practices' FEASIBILITY round II from KM panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	3	4	8	8	6	6	5.83
1.2. Distinction of IT	7	6	5	4	6	6	5.67
1.3. Govern./Learning Objects	7	6	7	4	6	7	6.17
1.4. Info./Data Mgt & Tools	7	6	7	7	7	6	6.67
1.5. Procurement of IT Tools	6	5	6	7	7	5	6.00
1.6. Outsourcing	3	6	5	3	7	5	4.83
2.1. EP/Web 2.0 (EL 2.0)	4	3	8	9	7	7	6.33
2.2. Cloud (e-learning)	8	4	7	3	7	7	6.00
2.3. Consumerisation	5	3	6	3	5	5	4.50
2.4. Cust. Softw. Dev./Custom.	6	5	6	7	8	5	6.17
2.5. Virtual Worlds/Edutain.	6	3	5	8	2	4	4.67
3.1. Big Data	8	8	4	6	7	4	6.17
3.2. Escalations Implement.	6	3	7	9	6	7	6.33
4.1. Knowledge Marketing	4	9	8	8	7	7	7.17
4.2. Ownership of Learner	6	6	7	6	8	7	6.67
4.3. Interactivity/Integration	6	4	7	8	9	7	6.83
4.4. Ease of Use/Usefulness	9	7	8	9	7	8	8.00
4.5. Team-Cooperation	7	8	8	7	9	7	7.67
4.6. EL Mgr=Knowl. Broker	8	9	6	5	8	6	7.00
4.7. Learn.Indivi.=User Knowl.	8	7	7	9	8	6	7.50
4.8. Reflection and Progression	6	9	8	4	8	7	7.00
4.9. New Train.: Pedag./Techn.	6	6	5	9	8	6	6.67
4.10. Mgt. Buy-In/Incentives	7	5	8	7	6	7	6.67
4.11. Visualisation/Imagination	8	8	6	8	8	6	7.33
4.12. Shift Knowledge Society	6	4	6	4	6	5	5.17
Grand Mean	6.36						
W	0.36						
X^2	51.22*						

*p < 0.001

The previous two tables present the results from the six KM judges. These show how the KM experts ranked the 25 discussed e-learning practices' in terms of feasibility during round one and two. The results from round one lead to a Kendall's W of 0.23, which is again as with the PM judges extremely weak. However, round two lead to a calculated Kendall's W of 0.36, which is interpreted as a substantially stronger but still relatively weak agreement. Overall the core result, which is as usual the level of agreement across the KM experts in terms of feasibility, increased again substantially between the rounds.

Table 4.18 Results e-learning practices' FEASIBILITY round I from VT panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	6	7	9	7	8	3	6.67
1.2. Distinction of IT	6	7	8	7	7	3	6.33
1.3. Govern./Learning Objects	7	5	7	10	6	7	7.00
1.4. Info./Data Mgt & Tools	7	7	8	7	7	1	6.17
1.5. Procurement of IT Tools	8	7	8	7	6	7	7.17
1.6. Outsourcing	8	8	9	10	4	3	7.00
2.1. EP/Web 2.0 (EL 2.0)	7	6	9	5	3	6	6.00
2.2. Cloud (e-learning)	10	5	9	10	6	7	7.83
2.3. Consumerisation	9	7	4	8	2	4	5.67
2.4. Cust. Softw. Dev./Custom.	5	7	5	8	6	3	5.67
2.5. Virtual Worlds/Edutain.	5	5	2	5	2	2	3.50
3.1. Big Data	7	7	3	4	8	4	5.50
3.2. Escalations Implement.	7	7	6	6	6	8	6.67
4.1. Knowledge Marketing	6	7	5	7	5	7	6.17
4.2. Ownership of Learner	8	5	7	10	7	8	7.50
4.3. Interactivity/Integration	8	6	8	8	6	5	6.83
4.4. Ease of Use/Usefulness	7	7	9	10	10	7	8.33
4.5. Team-Cooperation	6	6	8	9	9	8	7.67
4.6. EL Mgr=Knowl. Broker	9	6	1	8	7	8	6.50
4.7. Learn.Indivi.=User Knowl.	7	7	5	8	9	8	7.33
4.8. Reflection and Progression	9	7	8	9	6	9	8.00
4.9. New Train.: Pedag./Techn.	6	7	4	8	5	8	6.33
4.10. Mgt. Buy-In/Incentives	7	6	9	8	7	6	7.17
4.11. Visualisation/Imagination	5	5	9	8	5	8	6.67
4.12. Shift Knowledge Society	6	5	3	6	4	5	4.83
Grand Mean	6.58						
W	0.29						
X^2	41.06*						

*p = 0.0164

Table 4.19 Results e-learning practices' FEASIBILITY round II from VT panellists (n=6)

	Panellist						
Topic Number / Name	1	2	3	4	5	6	Mean
1.1. State-Of-The-Art IS	3	8	4	8	6	6	5.83
1.2. Distinction of IT	7	6	6	6	6	6	6.17
1.3. Govern./Learning Objects	7	8	6	6	6	7	6.67
1.4. Info./Data Mgt & Tools	7	8	6	8	7	6	7.00
1.5. Procurement of IT Tools	6	7	5	9	7	5	6.50
1.6. Outsourcing	3	7	6	8	7	5	6.00
2.1. EP/Web 2.0 (EL 2.0)	4	7	3	7	7	7	5.83
2.2. Cloud (e-learning)	8	9	4	9	7	7	7.33
2.3. Consumerisation	5	7	3	7	5	5	5.33
2.4. Cust. Softw. Dev./Custom.	6	7	5	5	8	5	6.00
2.5. Virtual Worlds/Edutain.	6	5	3	3	2	4	3.83
3.1. Big Data	8	5	8	6	7	4	6.33
3.2. Escalations Implement.	6	5	3	8	6	7	5.83
4.1. Knowledge Marketing	4	6	9	4	7	7	6.17
4.2. Ownership of Learner	6	7	6	6	8	7	6.67
4.3. Interactivity/Integration	6	7	4	6	9	7	6.50
4.4. Ease of Use/Usefulness	9	8	7	9	7	8	8.00
4.5. Team-Cooperation	7	8	8	8	9	7	7.83
4.6. EL Mgr=Knowl. Broker	8	7	9	7	8	6	7.50
4.7. Learn.Indivi.=User Knowl.	8	7	7	8	8	6	7.33
4.8. Reflection and Progression	6	7	9	8	8	7	7.50
4.9. New Train.: Pedag./Techn.	6	7	6	6	8	6	6.50
4.10. Mgt. Buy-In/Incentives	7	7	5	6	6	7	6.33
4.11. Visualisation/Imagination	8	7	8	8	8	6	7.50
4.12. Shift Knowledge Society	6	6	4	7	6	5	5.67
Grand Mean	6.49						
W	0.38						
X^2	55.13*						

*p < 0.001

The previous two tables present the results from the six VT judges. These depict how the VT experts ranked the 25 discussed e-learning practices' in terms of feasibility during round one and two. The results from round one lead to a Kendall's W of 0.29, which is as again with the PM and KM judges a very weak result for round one. As during the importance ranking, the VT experts enhanced again their agreement during round two in terms of feasibilities. Kendall's W however only reached 0.38, which is still interpreted as a relatively weak agreement. Again, the core result provided a substantial increase of agreement across both rounds in terms of the level of agreement across the VT experts in terms of feasibility.

Table 4.20 Results e-learning practices' FEASIBILITY round I from EL panellists (n=5)

	Panellist					
Topic Number / Name	1	2	3	4	5	Mean
1.1. State-Of-The-Art IS	4	9	4	7	3	5.40
1.2. Distinction of IT	5	8	5	6	3	5.40
1.3. Govern./Learning Objects	7	7	5	6	7	6.40
1.4. Info./Data Mgt & Tools	4	8	9	8	1	6.00
1.5. Procurement of IT Tools	4	8	5	6	7	6.00
1.6. Outsourcing	2	9	1	6	3	4.20
2.1. EP/Web 2.0 (EL 2.0)	4	9	9	7	6	7.00
2.2. Cloud (e-learning)	8	9	0	6	7	6.00
2.3. Consumerisation	5	4	8	7	4	5.60
2.4. Cust. Softw. Dev./Custom.	6	5	5	7	3	5.20
2.5. Virtual Worlds/Edutain.	4	2	3	4	2	3.00
3.1. Big Data	4	3	2	7	4	4.00
3.2. Escalations Implement.	8	6	6	8	8	7.20
4.1. Knowledge Marketing	7	5	9	8	7	7.20
4.2. Ownership of Learner	8	7	5	8	8	7.20
4.3. Interactivity/Integration	8	8	5	6	5	6.40
4.4. Ease of Use/Usefulness	8	9	6	9	7	7.80
4.5. Team-Cooperation	6	8	5	8	8	7.00
4.6. EL Mgr=Knowl. Broker	8	1	3	7	8	5.40
4.7. Learn.Indivi.=User Knowl.	8	5	8	8	8	7.40
4.8. Reflection and Progression	8	8	5	6	9	7.20
4.9. New Train.: Pedag./Techn.	6	4	9	7	8	6.80
4.10. Mgt. Buy-In/Incentives	5	9	5	9	6	6.80
4.11. Visualisation/Imagination	8	9	8	6	8	7.80
4.12. Shift Knowledge Society	5	3	3	5	5	4.20
Grand Mean	6.10					
W	0.37					
X^2	44.61*					

*p = 0.0065

Table 4.21 Results e-learning practices' FEASIBILITY round II from EL panellists (n=5)

	Panellist					
Topic Number / Name	1	2	3	4	5	Mean
1.1. State-Of-The-Art IS	4	7	8	6	9	6.80
1.2. Distinction of IT	6	6	4	6	7	5.80
1.3. Govern./Learning Objects	6	7	4	6	6	5.80
1.4. Info./Data Mgt & Tools	6	7	7	7	7	6.80
1.5. Procurement of IT Tools	5	7	7	7	8	6.80
1.6. Outsourcing	6	6	3	7	6	5.60
2.1. EP/Web 2.0 (EL 2.0)	3	7	9	7	9	7.00
2.2. Cloud (e-learning)	4	7	3	7	9	6.00
2.3. Consumerisation	3	5	3	5	5	4.20
2.4. Cust. Softw. Dev./Custom.	5	4	7	8	8	6.40
2.5. Virtual Worlds/Edutain.	3	5	8	2	6	4.80
3.1. Big Data	8	6	6	7	7	6.80
3.2. Escalations Implement.	3	6	9	6	6	6.00
4.1. Knowledge Marketing	9	7	8	7	7	7.60
4.2. Ownership of Learner	6	6	6	8	7	6.60
4.3. Interactivity/Integration	4	7	8	9	6	6.80
4.4. Ease of Use/Usefulness	7	8	9	7	7	7.60
4.5. Team-Cooperation	8	8	7	9	6	7.60
4.6. EL Mgr=Knowl. Broker	9	5	5	8	5	6.40
4.7. Learn.Indivi.=User Knowl.	7	7	9	8	6	7.40
4.8. Reflection and Progression	9	7	4	8	5	6.60
4.9. New Train.: Pedag./Techn.	6	6	9	8	7	7.20
4.10. Mgt. Buy-In/Incentives	5	6	7	6	4	5.60
4.11. Visualisation/Imagination	8	6	8	8	5	7.00
4.12. Shift Knowledge Society	4	4	4	6	6	4.80
Grand Mean	6.40					
W	0.34					
X^2	40.81*					

*p = 0.0175

Once more, the previous two tables present the results from the five EL judges. These display how the EL experts ranked the 25 discussed e-learning practices' in terms of feasibility during round one and two. The results from round one lead to a Kendall's W of 0.37, which is relatively weak and especially low in consideration of the strong agreement of the EL experts in terms of importance during round one. Round two even lead to a slightly weaker agreement, with a Kendall's W of 0.34. This is again in contrast with the importance ranking of the EL experts, which has the highest round two result across the four judge groups. Finally, as the core result being the level of agreement across the EL experts in terms of feasibility, is was found that the weak agreement even decreased slightly between the rounds.

4.1.2.1 Key Pooled Results Between Groups and High Ranked Best Practices

The following two tables (table 4.22, table 4.23) summarise the findings of the group analysis across the four groups. According means and Kendall's W results are reflecting the increasing agreement over the two rounds across three groups, except for the PM panellists.

Table 4.22 Summary results e-learning practices' IMPORTANCE rounds I and II between all panellist-groups

	Round I				Round II			
Topic Number / Name	PM	KM	VT	EL	PM	KM	VT	EL
1.1. State-Of-The-Art IS	7.11	8.00	7.67	8.00	7.22	7.33	7.50	7.80
1.2. Distinction of IT	5.78	7.17	7.00	7.00	6.33	6.67	7.17	6.20
1.3. Govern./Learning Objects	8.22	8.17	8.50	7.60	8.22	7.67	8.17	6.40
1.4. Info./Data Mgt & Tools	7.56	8.17	7.00	8.00	7.11	7.83	8.00	7.80
1.5. Procurement of IT Tools	5.89	6.83	7.33	7.00	5.89	6.00	6.67	6.60
1.6. Outsourcing	4.56	4.83	6.17	3.60	3.67	3.67	5.00	4.00
2.1. EP/Web 2.0 (EL 2.0)	7.33	7.83	7.33	8.20	6.22	6.83	6.83	7.00
2.2. Cloud (e-learning)	6.67	6.33	8.33	7.00	6.44	6.17	8.00	6.40
2.3. Consumerisation	5.33	6.00	6.33	6.20	5.44	5.00	5.83	4.40
2.4. Cust. Softw. Dev./Custom.	5.89	6.50	6.83	7.40	5.89	7.17	7.17	7.60
2.5. Virtual Worlds/Edutain.	4.33	3.83	4.67	5.00	5.33	5.33	4.83	5.80
3.1. Big Data	5.78	6.17	7.17	5.80	6.89	7.00	6.83	7.00
3.2. Escalations Implement.	7.44	7.00	7.50	8.20	6.89	7.33	7.33	7.00
4.1. Knowledge Marketing	7.11	7.00	6.67	6.20	7.44	7.17	6.50	5.80
4.2. Ownership of Learner	6.44	6.33	7.00	7.20	7.33	7.33	7.33	7.80
4.3. Interactivity/Integration	7.89	8.33	8.00	8.40	6.56	7.50	7.83	8.00
4.4. Ease of Use/Usefulness	9.67	9.83	9.67	9.60	8.44	8.83	9.33	8.80
4.5. Team-Cooperation	9.22	9.33	9.17	9.00	8.22	9.17	9.33	8.60
4.6. EL Mgr=Knowl. Broker	7.11	6.33	7.00	6.00	7.67	7.50	7.83	7.20
4.7. Learn.Indivi.=User Knowl.	8.44	8.50	7.83	8.20	7.78	8.33	7.83	8.20
4.8. Reflection and Progression	8.89	8.67	8.50	8.00	7.67	8.17	8.33	8.60
4.9. New Train.: Pedag./Techn.	8.11	7.83	7.83	8.00	7.11	7.83	7.50	8.20
4.10. Mgt. Buy-In/Incentives	8.56	8.50	8.83	8.00	8.56	9.17	9.17	8.60
4.11. Visualisation/Imagination	7.67	8.00	7.83	8.00	8.22	7.67	7.83	7.80
4.12. Shift Knowledge Society	6.11	6.17	7.33	5.00	6.00	6.17	6.67	6.20
Grand Means	7.08	7.27	7.50	7.22	6.90	7.15	7.39	7.11
W	0.37	0.35	0.33	0.40	0.35	0.53	0.51	0.57
X^2	79.08	50.55	47.32	47.87	74.96	75.71	73.78	68.34
p	*	0.0012	0.0031	0.0026	*	*	*	*

*p < 0.001

Table 4.23 Summary results e-learning practices' FEASIBILITY rounds I and II between all panellist-groups

	Round I				Round II			
Topic Number / Name	PM	KM	VT	EL	PM	KM	VT	EL
1.1. State-Of-The-Art IS	6.22	6.33	6.67	5.40	5.78	5.83	5.83	6.80
1.2. Distinction of IT	4.44	5.67	6.33	5.40	5.89	5.67	6.17	5.80
1.3. Govern./Learning Objects	6.22	6.17	7.00	6.40	6.22	6.17	6.67	5.80
1.4. Info./Data Mgt & Tools	6.56	6.67	6.17	6.00	6.22	6.67	7.00	6.80
1.5. Procurement of IT Tools	5.67	6.33	7.17	6.00	7.22	6.00	6.50	6.80
1.6. Outsourcing	4.44	5.00	7.00	4.20	5.67	4.83	6.00	5.60
2.1. EP/Web 2.0 (EL 2.0)	7.22	7.00	6.00	7.00	6.78	6.33	5.83	7.00
2.2. Cloud (e-learning)	7.11	6.17	7.83	6.00	6.22	6.00	7.33	6.00
2.3. Consumerisation	4.78	5.67	5.67	5.60	5.11	4.50	5.33	4.20
2.4. Cust. Softw. Dev./Custom.	5.00	5.17	5.67	5.20	5.56	6.17	6.00	6.40
2.5. Virtual Worlds/Edutain.	3.78	2.83	3.50	3.00	5.22	4.67	3.83	4.80
3.1. Big Data	4.11	5.17	5.50	4.00	5.33	6.17	6.33	6.80
3.2. Escalations Implement.	6.11	6.33	6.67	7.20	6.11	6.33	5.83	6.00
4.1. Knowledge Marketing	6.78	7.17	6.17	7.20	7.11	7.17	6.17	7.60
4.2. Ownership of Learner	6.44	6.83	7.50	7.20	6.22	6.67	6.67	6.60
4.3. Interactivity/Integration	6.22	6.67	6.83	6.40	5.56	6.83	6.50	6.80
4.4. Ease of Use/Usefulness	7.67	8.17	8.33	7.80	7.22	8.00	8.00	7.60
4.5. Team-Cooperation	7.00	7.67	7.67	7.00	7.44	7.67	7.83	7.60
4.6. EL Mgr=Knowl. Broker	5.44	5.50	6.50	5.40	7.11	7.00	7.50	6.40
4.7. Learn.Indivi.=User Knowl.	6.22	7.33	7.33	7.40	7.33	7.50	7.33	7.40
4.8. Reflection and Progression	6.89	6.83	8.00	7.20	7.00	7.00	7.50	6.60
4.9. New Train.: Pedag./Techn.	6.33	6.33	6.33	6.80	6.22	6.67	6.50	7.20
4.10. Mgt. Buy-In/Incentives	6.67	6.67	7.17	6.80	6.22	6.67	6.33	5.60
4.11. Visualisation/Imagination	6.11	6.83	6.67	7.80	6.44	7.33	7.50	7.00
4.12. Shift Knowledge Society	5.22	4.83	4.83	4.20	4.89	5.17	5.67	4.80
Grand Means	5.95	6.21	6.58	6.10	6.24	6.36	6.49	6.40
W	0.20	0.23	0.29	0.37	0.19	0.36	0.38	0.34
X^2	42.77	33.10	41.06	44.61	41.16	51.22	55.13	40.81
p	0.0106	0.102	0.0164	0.0065	0.016	*	*	0.0175

*p < 0.001

If further analysis is intended for the cross-group results by future researchers, it is advised in literature that Kendall's rank order correlation coefficient (T) should be applied (Kendall and Gibbon 1990). This is a preferred method to the Spearman's rank-order correlation coefficient, as it highlights relative ordering of issues instead of magnitude of discrepancies between ranks (Schmidt 1997). However, this is mainly applied by Delphi researchers for comparison of results from various independently operated studies (Schmidt 1997). The results of Kendall's rank order correlation coefficient (T) should then be referred to, with an overview of exact T-probabilities, which could prove if the four

groups of experts do or do not agree with the ranks of all the top items (Siegel and Castellan 1988). For this, the Fisher Exact Test can also be applied (Siegel and Castellan 1988), which in case of no significance, would prove that there is no relation of results between the groups. This is not pursued in this study, because it does not contribute to the actual research question and as there is not a focus on exact ranking orders, as indicated earlier.

4.2 Resulting Presentation of Highest Ranked (Best) Practices

The three practices that were rated best by the majority of the experts during the final round are shown in the table 4.24 below. Table 4.24 is primarily based on the summary of the round two results from all 14 panellists for all 25 e-learning practices' in terms of importance and feasibility, as depicted in the right columns of table 4.1 and 4.2.

It was found that both ease of use/usefulness and team-cooperation were ranked as top or "best" practices in terms of importance and feasibility. Whereas required management buy-in/incentives were also ranked extremely high in terms of importance, the experts ranked its feasibility as low, which hints at potential challenges when trying to imply this important e-learning best practice into virtual PKM. On the other side, the procurement of IT tools was also ranked with a leading feasibility rank hinting at an anticipated easy transfer of the state-of-the-art procurement process, while it was ranked with a relatively low importance and therefore should not make the biggest improvement impact on virtual PKM, according to the experts.

In comparison with the between group testing presented from section 4.1.2., it is obvious that there is a high level of agreement, especially on the top priorities for both importance and feasibility in round two across the four expert groups. This is depicted in the right columns of table 4.22 and 4.23, which summarise the results of e-learning practices' between all panellist-group. Some differences however exist as for example in the high ranking of the importance of the visualisation and imagination best practice among the PM experts (ref. also table 4.4). Likewise also in terms of feasibilities some differences exist, like with the similar realtively high ranking of visualisation and imagination among the VT experts (ref. also table 4.5).

As one is generally not that interested in the exact ranking order of all e-learning practices, as in the different levels of agreements, the below table (table 4.24) summarises all thirteen top elements for which the expert panel has achieved a consensus, while common practices

are highlighted in green and are underlined. The results prove that out of a comparatively large list of potential e-learning practices, certain items have been identified as most important and feasible, which is proven by the analysis of relative ranks and where the final whole ranks are unquestionably most interesting.

Noticeable is also that ownership of learner and new trainings (integration of pedagogy and technology) received a moderately high ranking for its importance whereas its feasibility was not credited well by the panellists of the study. This indicates potential challenges when implementing these two important e-learning "best" practices. Similarly, in terms of feasibility EP/WEB 2.0 and Cloud (e-learning) were ranked as "best" practices that should relatively easily been implemented for enhancing the stated issues, like context-creation or right awareness and opportunities for knowledge exchange for improving knowledge brokering of virtual project teams. However, its importance was ranked low, which indicates a comparatively low impact for the intended enhancements that should, as with all findings, contribute directly to both practice and theory.

Table 4.24 Summary relatively high ranked e-learning practices after second round

Importance	Feasibility
1. Ease of Use/Usefulness	**1. Ease of Use/Usefulness**
2. Required Management Buy-In/Incentives	**2. Team-Cooperation**
3. Team-Cooperation	**3. Procurement of IT Tools**
4. Visualisation/Imagination	4. Entities and roles within the execution: Learning Individual = User of Previous Projects' Knowledge
5. Governance / Learning Objects	5. EP / Web 2.0
6. Reflection and Progression	6. Cloud (e-learning)
7. Entities and roles within the execution: Learning Individual = User of Previous Projects' Knowledge	7. Reflection and Progression
8. Entities and roles within the execution: E-learning Manager = Knowledge Broker	8. Knowledge Marketing
9. Information/Data Management and Tools	9. Entities and roles within the execution: E-learning Manager = Knowledge Broker
10. State-Of-The-Art Information Systems	10. Information/Data Management and Tools
11. Ownership of Learner	11. State-Of-The-Art Information Systems
12. New Trainings: Integration of Pedagogy and Technology	12. Governance / Learning Objects
13. Knowledge Marketing	13. Visualisation/Imagination

4.3 Other Quantitative Results

Despite the selection of these above average-ranked elements, it was also found that overall high rankings were given (ref. to grand means > 7 for importance and > 6 for feasibility), which proves the overall high relevance of the 25 selected topics. Furthermore, the result of the grand means indicate that importance is overall ranked higher than feasibility, which further indicates the expectation from experts on high relevance paired with relatively complex transferring of the analysed e-learning practices. In addition, Kendall's W was ranked higher for importance than for feasibility, which signposts a higher agreement on prioritisation of the importance, further proving the respective complexities in terms of ease of transfer of the prioritised topics (Feasibility). Kendall's W results for agreement were all significant and consensus was already achieved after the first circle. It further increased substantially over the second round to 0.38 for importance and 0.22 for feasibility. This provides evidence that the interrogation of the experts achieved significant and weak to moderate consensus regarding the relative importance and feasibility of the 25 e-learning items. This relates to a low to fair confidence in rank-order. Despite the previously defined stopping criteria for the Delphi cycles, it has to be noted that the statistical significance of Kendall's W is actually not an appropriate factor for stopping the survey, as with studies of more than ten panellists, even quite small values are significant (Schmidt 1997). Accordingly, the actual Kendall's W value is only used as a metre for the consensus power. In circle two, the panellists were shifting to higher agreement levels for both importance and feasibility. However, related confidence in exact ranking order remains generally weak, which leads to the fact that the top rated e-learning practices should all be considered for potential optimisations of PKM, without necessarily prioritising certain items.

Statistically, it has also been analysed, where precisely and for which topic responses still had a high range. After round two on average the range of responses was around 5.52 for importance and 5.16 for feasibility but exceptional items like Distinction of IT (Feasibility: range 2) and Interactivity/Integration (Feasibility: range 8) still stood out. The latter obviously remains the most controversial item, stemming again from the feasibility assessment, and did consequently also not get a total high or above average ranking. Summaries of relevant key indicators that support the research-targets like consensus-levels per round are illustrated in this chapter. The entire database that is used as the source for the statistics calculations and that was extracted from all online questionnaires, is included in the appendices.

4.4 Key Qualitative Results of the Delphi Study

Besides the quantitative data, the analysis of the qualitative feedback also produces relevant findings. The initial communications and the questionnaire of both rounds encouraged the experts openly for additional comments and explanations at the end of each survey to state for example, why certain elements were ranked extremely high or low. The first round comments are overall in line with the results of the survey, as for example, the top ranked holistic management buy-in/incentives from a strategic to operational range are emphasised as being of top importance also in the comment section. Likewise, the comment field also included explanations for low rated e-learning practices like outsourcing, where the difficulties and risks of the e-learning practice transfer where outlined, like (un)acceptance amongst users. Potential risks are also confirmed by the qualitative feedback referring to the cluster three "IS related risks" (3.1. Big Data & 3.2. Escalations of Implementations). This especially emphasises related IT and data security issues. Besides this, the comments from the first round included some very interesting thoughts and recommendations, most notably: "As IT capabilities increase, it is not always necessary to make on-line learning more complex", "keep things simple and promote discussion" and "for development of virtual teams, buy-in to the process and communication between members is more important than technology". This also supports the quality of the literature review, as these comments link with its specific key findings.

For the second round the experts were provided with a summary of the comments from the first Delphi cycle. The evaluation of the second round's feedback confirmed again in a similar way the quantitative results and its main themes, like continuously highlighting the importance of management buy-in/incentives and related support. The comments also promoted underlying generic theories discussed in the literature, akin to the previous round. This is especially valid for the people-orientated perspective over the technology focus, as interaction, motivation, governance, incentives, and corporate sharing culture outweigh technological aspects by far. Overall, the challenges are also confirmed by the comments pertaining to the difficulties of achieving efficient and effective knowledge brokering for virtual project teams via IT, which supports the general motivation of this study. Still, it is also confirmed that state-of-the-art technology remains important, especially in virtual teams and in that sense, the use of technology is assured to be key to support PKM in virtual teams.

Besides these valuable pointers, the comment field precisely asked the experts for any

missing topics that should be added to the list of the 25 identified e-learning practices. There were no suggestions for additional topics, both in the comment-section as well as the telephone and email exchange with the participants. This supports the claim of comprehensiveness of the list and the quality of the pre-work, including extensive literature review.

The following paragraphs present results pertaining to the open statements including corroborating the findings and examining differences. This is done in a structure that replicates the one from the quantitative analysis.

4.4.1 Results for Each Judge Individually

The following table (table 4.25) presents the qualitative results for each judge individually and for both rounds.

Table 4.25 Summary qualitative results for each judge (n=14) for question: "Any comments? Missing topics? Hints (Why did you rank certain elements extremely high/low) etc.?"

Round I	Round II
(1)	(1) "I still feel the main requirement for success is management buy in, and ongoing support. Lead from the top by utilising the tools etc for ALL learning, including Mgmt reporting down to staff."
(2)	(2)
(3)	(3)
(4)	(4)
(5)	(5)
(6)	(6)
(7) "As IT capabilities increase, it is not always necessary to make on-line learning more complex. For development of virtual teams, buy-in to the process and communication between members is more important than technology. Keep things simple and promote discussion. Let the team establish their own agreed learning goals."	(7) "Governance, incentives, motivation and corporate sharing culture outweigh technological aspects by far. However, technology is important especially in virtual teams and in that respect the use of state-of-the art technology can both support the usage of such systems as well as actually provide features which make a difference in effectively and efficiently distributing and creating knowledge."
(8)	(8)
(9)	(9)
(10)	(10) "In e-learning interaction and user centred design are extremely important for motivation, but achieving these in IT is difficult. Perhaps motivation to use and continue with something is also important in knowledge brokering."
	(11)
(11) "Management buy in is a MUST - there needs to be a clear, committed, long term strategy to move workwards with the planned changes."	
(12)	(12)
(13)	(13)
	(14)
(14) "1.6 Outsourcing: topic with high importance, though difficult to implement a good solution which does not foster knowledge drain and ensures high acceptance amongst users. 3.1 and 3.2 high importance, but difficult to achieve high feasibility on IT Risk topics. More attention should be drawn on IT&data security, as a lot of the data are sensitive and knowledge + standards for cloud solutions + big data are limited."	

The qualitative feedback from round one mostly confirms the quantitative findings. In that sense for example the highlight of the importance of (management) buy-in (top 3 ranked aspect for importance: "management buy-in/incentives") and communication between (team-) members (top 3 ranked aspect for importance: "team-cooperation") is stated as being more important than technology (aspects), which is supported by the quantitative findings. Also, the confirmation that solutions should not be complex (top 3 ranked aspect for importance: "ease of use/usefulness") and that they should be sustainably long-term oriented (e.g. top ranked aspect for importance: "reflection/progression") with establishing (and management) of own goals (e.g. top ranked aspect for importance: "ownership of learner"), matches with the quantitative findings.

In terms of differences, one comment from round one states that outsourcing is highly important (4.21 mean of round two for importance) but difficult to implement (5.93 mean of round two for feasibility). This is not in line with the overall quantitative findings. Furthermore it is argued by one expert that big data and escalations of implementations have high importance (6.50 mean in round two for importance of "big data" / 6.86 mean in round two for importance of "escalations of implementations"), but are difficult to achieve (5.45 mean in round two for feasibility of "big data" / 6.21 mean in round two for feasibility of "escalations of implementations"). This is confirmed by the results being > 5 for importance, however feasibility is in total also rated > 5, which does not support the by this expert anticipated difficulties in terms of application.

Also the qualitative feedback from round two gives support to the quantitative findings. Again buy-in and leadership from the top (top 3 ranked aspect for importance: "management buy-in/incentives") are highlighted as most important. Also it is argued that governance, incentives/motivation (top 3 ranked aspect for importance: "management buy-in/incentives") and a resulting "corporate sharing culture outweigh technological aspects by far", which are still important. This is supported by the quantitative findings, as also "state-of-the-art IS" (7.36 mean in round two for importance) is rated as more important than "governance" (7.93 mean in round two for importance). However, there is a slight difference, as the total variance is not as huge as anticipated by this panellist. Again, as also in round one, continuity and motivation are also rightly highlighted as important, which is in line with the quantitative results, as mentioned above.

4.4.2 Results for Each Judge and Between Groups

After having pinpointed the results for each judge individually, this section presents now the Delphi study results for each judge and between the four expertise groups. For this purpose, the following table (table 4.26) provides a summary of the quantitative results, divided into the four groups. As in the previous table, the results are provided for both rounds.

Table 4.26 Summary qualitative results between the 4 groups (PM n=9, KM n=6, virtual teamwork (VT) n=6, EL n=5) for the question "Any comments? Missing topics? Hints (Why did you rank certain elements extremely high/low) etc.?"

Round I	Round II
	(PM) "I still feel the main requirement for success is management buy in, and ongoing support. Lead from the top by utilising the tools etc for ALL learning, including Mgmt reporting down to staff."
(PM) "Management buy in is a MUST - there needs to be a clear, committed, long term strategy to move workwards with the planned changes."	
"1.6 Outsourcing: topic with high importance, though difficult to implement a good solution which does not foster knowledge drain and ensures high acceptance amongst users. ; 3.1 and 3.2 high importance, but difficult to achieve high feasibility on IT Risk topics. More attention should be drawn on IT and data security, as a lot of the data are sensitive and knowledge + standards for cloud solutions + big data are limited."	"Governance, incentives, motivation and corporate sharing culture outweigh technological aspects by far. However, technology is important especially in virtual teams and in that respect the use of state-of-the art technology can both support the usage of such systems as well as actually provide features which make a difference in effectively and efficiently distributing and creating knowledge."
(KM) "Management buy in is a MUST - there needs to be a clear, committed, long term strategy to move workwards with the planned changes."	(KM) "I still feel the main requirement for success is management buy in, and ongoing support. Lead from the top by utilising the tools etc for ALL learning, including Mgmt reporting down to staff."
	"Governance, incentives, motivation and corporate sharing culture outweigh technological aspects by far. However, technology is important especially in virtual teams and in that respect the use of state-of-the art technology can both support the usage of such systems as well as actually provide features which make a difference in effectively and efficiently distributing and creating knowledge."
	(VT) "I still feel the main requirement for success is management buy in, and ongoing support. Lead from the top by utilising the tools etc for ALL learning, including Mgmt reporting down to staff."
(VT) "As IT capabilities increase, it is not always necessary to make on-line learning more complex. For development of virtual teams, buy-in to the process and communication between members is more important than technology. Keep things simple and promote discussion. Let the team establish their own agreed learning goals."	
"Management buy in is a MUST - there needs to be a clear, committed, long term strategy to move workwards with the planned changes."	
(EL)	
	(EL) "In e-learning interaction and user centred design are extremely important for motivation, but achieving these in IT is difficult. Perhaps motivation to use and continue with something is also important in knowledge brokering."

For the PM experts, the qualitative results of both rounds mostly confirm the final findings

from the quantitative PM group results such as the stated high importance of management buy-in/incentives/motivation (8.56 mean in round two for importance) and the resulting corporate sharing culture. In this group they also outweigh in total the technological aspects (e.g. 7.22 mean in round two for importance of "state-of-the-art IS"), although again not by much, as argued by one of the PM experts. A remarkable difference is found in one PM individual's statement that outsourcing is an EL practice with high importance, but difficult to implement. The related quantitative results of that group however actually indicated no major hindrance to an implementation (5.67 mean in round two for feasibility), while only confirming a low overall importance (3.67 mean in round two for importance). Another difference is that while the PM group results confirm the high importance of "big data" and "escalation of implementations" (6.89 mean in round two for importance of both aspects), the by one individual argued difficulty in achieving these two practices cannot be confirmed by the quantitative results (5.33 mean in round two for feasibility of "big data" and 6.11 mean in round two for feasibility of "escalation of implementations").

For the KM panellists also, the importance of ongoing management buy-in/incentives/motivation (9.17 mean in round two for importance) and the resulting corporate sharing culture are highlighted by both the quantitative and qualitative group results. In this group they outweigh technological aspects (e.g. 7.33 mean in round two for importance of "state-of-the-art IS") significantly, as mentioned in one KM expert's comment. Also, the sustainable long-term oriented approach is not only confirmed by the qualitative feedback as important (e.g. 8.17 mean in round two for importance of "reflection/progression").

Besides the constantly confirmed importance of sustainable management buy-in (9.17 mean in round two for importance), the experts of virtual team-management confirmed with their group's comments the quantitative results in the sense that communication between (team-) members (9.33 mean in round two for importance of "team-cooperation") is supported as being more important than technology (aspects). Also, again the confirmation that solutions should not be complex (9.33 mean in round two for importance of "ease of use/usefulness") and that they should simply support team communication (team cooperation) with establishing (and management) of own goals (7.33 mean in round two for importance of "ownership of learner"), matches with the quantiative findings of this group.

Finally the e-learning experts confirmed with their comments besides the repeatedly high ranked sustainability and incentives/motivation (8.60 mean in round two for importance of "management buy-in/incentives") that interaction (8.00 mean in round two for importance of "interactivity/integration") and user-centric design (8.20 mean in round two for importance of "learning individual = user of previous projects' knowledge" + 7.00 mean in round two for importance of "EP/web 2.0") are extremely important but achieving these might be difficult. Although the importance is also confirmed for this group, the summarised quantitative study-results of all EL experts again do not confirm this EL expert's statement in terms of difficulties in achieving those best practices (6.80 mean in round two for feasibility of "interactivity/integration", 7.40 mean in round two for feasibility of "learning individual = user of previous projects' knowledge" & 7.00 mean in round two for feasibility of "EP/web 2.0").

4.5 Success of the Delphi-Process

It was found that the overall response-rate was extremely high. Out of the 18 initially addressed experts, 14 assured their participation and replied during both rounds with robust feedback, which illustrates that this Delphi study was perceived as relevant and important. A low response rate is a risk for the soundness of Delphi results, as it may be subject to critical scrutiny or become discounted (Okoli and Pawlowski 2004). This shows also that the thorough management and activity of the researcher has prevented this potential Delphi weakness as well as the danger of moulding opinions arising from subtly conveyed pressure by the group-ratings indicated (Hsu and Sandford 2007). This was prevented by cautious execution and crosschecks to safeguard these risks.

4.6 Chapter Summary

In summary, the Delphi study narrowed down the most important and feasible factors from e-learning that could potentially be transferred into PKM to support related processes like social interactions, exploitation of IS tools, maintaining organisational structures and repositories as well as developing and transferring knowledge outside of projects. It was proven that business projects are a useful fundament for further research when combined with other related management theories in a business-orientated approach encompassing various perspectives and being concerned with the intensifying challenges for delivering value to different stakeholders (Winter et al. 2006a). Having presented the results derived with the aid of statistics to demonstrate the value of the Delphi method, the following

chapter focuses on a discussion based on these. The subsequent conclusion section is further reviewing the achievement of the research questions and pinpoints the successful answers to the research questions achieved with the help of extensive literature review and the Delphi study. It is emphasised that the presented results were only possible, given the compliance with most advanced Delphi methods that support the solidification and streamlining of studies as well as enhancing their validities which benefits the end users of the research results (Schmidt 1997).

5 Chapter Five: Critical Discussion of Results

5.0 Chapter Overview

In the previous section, the survey's raw-results were processed and analysed based on certain observations and related implications of the presented statistics. These results will be discussed in greater depth as well as to emphasise the utility of the methods applied. When discussing the new research findings, it is important for the reader to take into context the key findings that emerged from the review of the literature, heeding issues such as the precise challenges of virtual project teams in the context of KM, including restraining trans-active memory, absence of non or para-verbal hints or failure to transfer and retain contextual-knowledge.

With this in mind, the Delphi study has taken a comprehensive and non-biased approach. The 25 potential best practices proposals have heeded the previously presented barriers and enablers for PKM and consequentially covered influential factors ordered by increasing significance. These relate indirectly for example to authority to perform knowledge activities, cultural support, familiarity with KM, and coordination among staff and units. Additionally, due to the significance of extrinsic and intrinsic motivation for knowledge efforts as well as an adequate holistic system for handling project-knowledge, these factors have also been covered (Ajmal et al. 2010). The literature mentions time and time again, that learning does not derive from the design of learning content but from how it is actually applied. Accordingly state-of-the-art e-learning theory is experimenting with how professional or user-authored learning content could be applied as a basis for learning activities rather than a channel for learning content (Downes 2005). This sets an interesting framework for the results of this study and future studies in the PKM and virtual team knowledge brokering: to focus not necessarily on the knowledge creation but its knowledge application systems and supporting elements to catalyse the actual knowledge brokering.

Regarding the final-ranks, it is important that the reader comprehends the confidence-level associated with results, as for example a moderate consensus level does not guarantee high confidence in the relative standing of the topics (Schmidt 1997). Therefore, it is not the actual ranking that is important but the overall consensus on above average votes for the thirteen identified e-learning best practices for feasibility and importance. Here, applicants of the findings of this research should take care in potentially shifting up or down certain

elements of these thirteen “best”-practices in their priority-list. As depending on the actual situation in their company where they apply them, it is necessary to give consideration to influential factors from the environment. Issues such as the lack of incentivizing, mechanisms for codifications, confusing databases or lack of awareness, consistency, transparency and appreciation of existing knowledge were all discussed and have to be targeted with the generic improvement-attempt of virtual PKM. Besides this, Schmidt (1997) rightly emphasises that there should be no meaning derived from mean rank distances, as some experts may presume that their top topics in terms of mean rank distances are much more relevant than the remaining ones or that the last three topics are of same importance-levels.

5.1 Discussion and Conceptualisation

This research confirms the assertions of Dash (1998) as to the need for a skilful mix of people, IT and business processes in order to engage in effective KM. Returning to the findings from the Delphi study, mainly the solution to the targeted enhancement via a best practice application, the following organisational change models, are well describing the interrelatedness and comprehensiveness of the results.

For this, both the PSO (People System Organisation)-model and Leavitt’s Diamond are very suitably describing models. Leavitt (1965) foresees that all aspects edges of the diamond (tasks, structure, people and technology) are interrelated and that every change initiative has to include all four sides in order to be successful. As such, the recommendation of the Delphi study encompasses all areas including both the management and IT aspects.

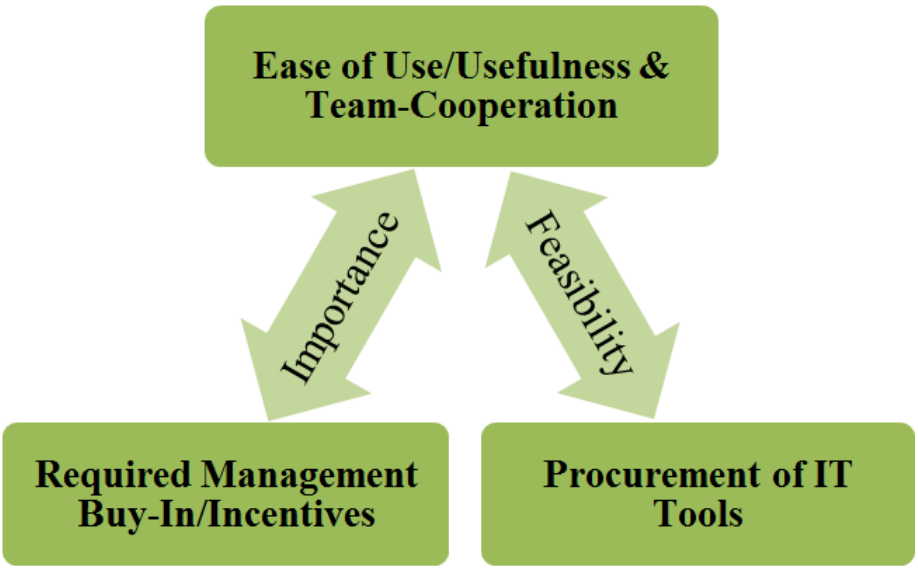

Figure 5.1 Visualisation of main imperatives for improving virtual PKM

In this regard it is also important to discuss the relevant suggestions by Winter et al. (2006a) that refined the following four conceptual perspectives deducted from other disciplines thought still applicable to (virtual) business projects; with the last two being especially relevant for the results of this thesis. These perspectives are (Winter et al. 2006a):

- **Value creation**: This includes understanding of customers' businesses and focusing on related value creation processes.
- **Service delivery**: This perspective describes that projects can become businesses in themselves. In line with the on-going and discussed conversions of organisations, this is resulting from differing sets of values.
- **Organisational change**: This contains initially the People System Organisation (PSO) development, stating that change is successful if many things are changed at the same time. Those three elements together are interrelated and change in one section has implications for all others. Leavitt's referenced diamond with the four aspects of tasks, structure, people and technology is another model to describe this. Besides this, in projects several objects of change are being worked on simultaneously, which is a cultural topic involving a high degree of context-consciousness. Here it is also noted that business projects differ from their non-business counterparts, as coordination of various processes is required simultaneously. Adaption of pace of one activity in synchronization with another one is a requirement in order to tailor and synchronise related processes. The interlinked development determines how project and base-organisation are cooperating and proposed changes from projects are implemented. Producing severe

internal coordination challenges, it is especially important for successful knowledge brokering that companies understand to produce deliverables to the organisation from the project when it is the right time and acceptable.

- **Intervention**: This perspective is described by the perception of a company as a dynamic and open system that tries to achieve defined business targets in a certain environment, where all activities are continuously enhancing since the company adjusts to related changes. This requires planned change when the present situation is not ideal, which can be facilitated by projects. Here the contribution to the value chain lies in improving organisational performance, capability and resources. Again here also lies an opportunity for P(K)M theory to be enhanced by other disciplines like strategic or change management, in line with the claim of this study.

5.2 Core Contribution of the Study

The significance of this study is manifold. Firstly, it extends the disciplines of PM and KM by its creation and interpretation of new knowledge as outlined in the findings. The major contribution is, however, that the thesis has relevance for both the academic and the practical spheres and bridges between the two areas. The comprehensive literature review, which was conducted in accordance with the emergence of a new conceptual framework, contributes to the project-based learning literature and understanding, as it analyses and structures the related literature and the complex underlying principles. The structure of the literature in accordance with the conceptual framework is therefore a contribution in itself as it synthesises also related insufficiencies.

The engagement in this kind of research connecting the academic and practical world was as expected complex and challenging, but the bridging outcome was rewarding because it contributes to the oft-cited “Rethinking PM” project. The research in this thesis was necessary as current research in this field is mostly still at an early stage, especially for challenges of virtual teams, where a gap persists between theoretically available solutions for PKM and their successful application in today’s changing business environments. Accordingly, the thesis supported the exploratory research demand of this field. In close connection of praxis and science, the study approach produced comprehensive and expert-based new knowledge by highlighting current trends and issues and by respectively analysing their importance and feasibility. The thesis also supported to put more science behind observed art, as described in the reviewed project-based learning literature, whose research is still in its early stages, especially in regards to the repeatedly outlined

challenges of virtual teams.

Important theoretical contributions are delivered and illustrated through the extension of existing research via the systematic analysis of the main topics from (virtual) PM, KM and according potentials from e-learning to improve them. As expected, the research did not produce the ultimate solution but supported its advancement via the analysis suggesting that companies should focus on transferring those selected e-learning best practices that may have the strongest improvement impact and are most feasible to be applied. Also, the research only intended to provide guidance, as a uniform solution is very difficult to achieve as projects and environments differ, and relative initiatives therefore have to be adapted accordingly.

Furthermore, as outlined, this research also stimulates recommendations and potentials for future research. The results are very relevant for future interests and improvements, especially with regards to examining topics like sustainability, change management or analysing risks such as potential bias and maintenance of status quo via reinforcements of single loop learning.

5.3 Reference to Existing Studies-Literature

The following paragraph positions the findings within the literature. This is done by outlining how they support, contrast and extend previously performed studies-literature from the related fields.

5.3.1 Project Management Studies

Modern PM research also suggests that traditional control-oriented assumptions need to be enriched with KM, learning and experimental and innovative approaches (Reich et al. 2012). Accordingly, this is supported by the cross-functional approach and outcomes of this thesis. This study's results extend the recommendations from existing PM literature. In existing PM studies it is for example correspondingly requested for future research, to gain an understanding and consideration of contextual factors such as governance (e.g. Governance / Learning Objects) or project manager competence (e.g. E-learning Manager = Knowledge Broker), which is important for enabling more sophisticated support for PM scientist and practitioners (Reich et al. 2012).

The proven relevance and application of the innovative EL approach is also in line with existing PM literature, where for example keywords related to education are increasingly found and where researchers increasingly apply experiences from related disciplines to

address issues in PM (Pollack and Adler 2015). Considering recent PM studies such as those of Agile PM, it is claimed for more focus on collaboration, learning and coordination (Dyba and Dingsoyr 2015), which is clearly supported by this thesis' results.

Education, adaptation/progression and reflective learning ahead of IS reliance, are not only key findings from this study but also from related literature (Svejvig and Andersen 2013), that in light of increasing project complexities and the quickly evolving virtual PKM area promote improvements of the discussed project actuality. The study results confirm in that sense also the referenced rethinking PM strategy, which also highlights the focused topics like learnability, uncertainty, complexity multiplicity, temporality and sociability (Svejvig and Andersen 2013).

Related literature from IS PM (Reich et al. 2012), has precisely also highlighted that improvements like from the identified best practices can only be achieved if the new approach is also considering processes (e.g Governance / Learning Objects) and organisational change (e.g. Required Management Buy-In/Incentives and Reflection & Progression), which are elements that are also highly important and feasible according to this new study. Overall this study's results are positioned well with the claim in PM literature for more research connected with KM and highlighting the importance of communication between individuals (e.g. Team-Cooperation) for successful PKM (Duffield and Whitty 2015).

5.3.2 Knowledge Management Studies

As discussed before, the findings and approach of this study are aligned with the knowledge-based theory of the firm, which states that companies primarily exist for knowledge creation, utilisation and management (Donate and Sanchez de Pablo 2014). Therefore this study advances existing research that has mainly focused on confirming the importance of knowledge for competitive advantage rather than providing useful guidance for companies to actually improve (P)KM (Donate and Sanchez de Pablo 2014).

Existing studies have proved a robust correlation between KM and PM practices, and accordingly good KM practices and PM performance (Reich et al. 2012), which is supported by the close cohesion of the results from the two PM and KM judge groups in this study. This research also provides guidance and therefore extends existing KM literature, which states that a confusing and incomprehensible amount of knowledge in the area of concern has led to the fact that companies are not sure which variables could

potentially enhance KM results (Lopez-Nicolas and Merono-Cerdan 2011).

Process-wise the results of the structured expert interrogation have confirmed the importance of the focus on the knowledge brokering and transfer activity (Calvo-Mora et al. 2015). As mentioned, the literature presents proof for the relevance of the e-learning best practices application for KM in general (Schmidt 2005). The findings fit well with literature explaining that e-learning, as a knowledge exchange via online means, can provide access to knowledge and accordingly presents similarities to basic KM processes (Wild et al. 2002).

This study's new findings also support the results of the analysis of existing frameworks in KM (Heisig 2009), which summarises critical success factors also under 1. human-oriented (e.g. Ownership of Learner) 2. organisation (e.g. Governance / Learning Objects) 3. technology (e.g. Information / Data Management & Tools) and 4. management aspects (e.g. Reflection & Progression). This is also supported by the results of the KM judge group, who confirm with their high ratings of those items, the consistency of the results in relation to existing KM literature. The ranking of the Delphi experts in general plus those of the KM expert group complement existing studies that also define strategic, organisational and resulting cultural followed by IS-support aspects as most critical for success of KM (Aggestam 2006).

From a strategic point of view, the new findings also extend existing literature as it is in line with literature not to focus only on one approach but balancing exploitation and exploration by explaining that both the personalisation and codification strategy enhance performance, although in different ways (Lopez-Nicolas and Merono-Cerdan 2011). The successful blend of EL and KM functionalities as resulted from this study is a theme supported by existing literature supporting the enhancement of becoming aware of knowledge gaps and providing "knowledge on demand" with consideration of real-world contexts (Schmidt 2005).

5.3.3 Virtual Team-Work Studies

As team-cooperation is for example rated as one of the highest relevant EL best practices in terms of feasibility and importance, the findings also support existing literature that states that team-approaches are essential for effectiveness of exchange and KM (Jones 1996).

Besides the focus on the (virtual) team, also the literature's emphasis on the significance of

the individual and his learning regarding the overall OL, PKM and company performance (Wand and Ahmed 2003), is supported by the Delphi study results (e.g. Learning Individual = User of Previous Projects' Knowledge). In line with the related literature that claims that companies are complex and learning systems, existing studies also claim that an overreliance on IS within (virtual) project-teams is ineffective and that IS should only be an enabling part of the knowledge brokering process (Williams 2008), which is supported by the Delphi-results.

Generally, this study also enlarged the knowledge base of virtual team leadership, as requested in related studies, which confirm that this is a key factor for effectiveness in teams but there is still a lack of research regarding the virtual element (Eubanks et al. 2016).

5.3.4 E-Learning Studies

The findings of the Delphi study support existing literature, as those highly rated e-learning practices that could potentially support PKM, relate to the eight dimensional framework, depicting interrelated key determinants of successful global e-learning (Khan 2010):

- **Institutional**: e.g. Knowledge Marketing
- **Management**: e.g. Required Management Buy-In / Incentives
- **Technological**: e.g. State-Of-The-Art Information Systems
- **Pedagogical**: e.g. New Trainings: Integration of Pedagogy and Technology
- **Ethical**: e.g. Team-Cooperation
- **Interface-design**: e.g. Ease of Use / Usefulness
- **Resource-support**: e.g. E-learning Manager = Knowledge Broker
- **Evaluation:** e.g. Reflection & Progression

This connects the new findings also well with the statements from Palacios-Marques et al. (2013), confirming that the right framework assures knowledge transfer. Accordingly the Delphi experts also confirmed with their ratings the overall similarities of key elements for EL and PKM. This is confirming that for successful transmission of knowledge being self-motivational, allowing participation and feedback from users, and being applicable to real business problems is vital (e.g. Web 2.0). As also in the EL literature, IS features received a considerable amount of high ratings translating in best practices proposals, as they potentially surrogate social aspects from traditional project teamwork.

Although having supplied robust results, this study contrasts studies that claim that KM(S) should actually in the other direction be built as a tool for (e-) learning to form a (learner)-community and that KM is vital for creating an e-learning culture (Rosenberg 2001). It also contradicts certain publications that still try to promote deficiencies of e-learning, such as a lack of direct contacts and facilitation of discussion (Poon et al. 2015), which is actually well enabled via state-of-the-art e-learning, as proven in this study and its literature review.

In general, it is also confirmed that, as in e-learning itself, no single best practice solution or standard has evolved, which seems also unrealistic in light of the varying working, teaching, learning and IS support options.

5.3.5 Organisational Learning Studies

For the critical discussion of the contributions in relation to existing studies, it is necessary to also consider organisational learning (OL) literature that has recently also been linked with KM and knowledge creation (Wang and Ahmed 2003). Although both OL and KM were two sciences that developed in parallel, they typically refer to each other in their processes and definitions (Fiol 1994). OL is accordingly also concerned with knowledge dissemination and the ability to manage and broker information to provide common understandings (Fiol 1994). This close cohesion is fostered by the interrelated results of the Delphi study.

Overall, the findings are in line with the shift in OL science towards creative and competency-based approaches and knowledge creation via radical changes (Wang and Ahmed 2003). This promotes also the for virtual PKM and brokering beneficial triple loop learning that constantly questions existing statuses as well as organisational unlearning that considers abandoning of existing statuses (Wang and Ahmed 2003).

Based on a deductive content analysis it was found that besides KM and PM literature also OL publications present study results that are in line with the findings of this study, by fostering for example the interconnected importance of the system (e.g. IS) and the people (e.g. learning) elements (Duffield and Whitty 2015).

The profound approach and connected outcomes of the study also sustain the theme in e-learning and OL, that by a lack of managing underlying topics (e.g. Integration of Pedagogy and Technology via New Trainings), programmes risk to only approach superficial IS and communication issues, rather than sustainably resolving hidden issues of

employees (Lockwood 2015).

The Delphi study also confirmed the potentials and connections of KM, which as an applied science with practises that resulted of OL research (Wang and Ahmed 2003). Here is another confirmation of the potentials of the promoted approach and contributions of this thesis, as it brings in well advanced e-learning practices from the OL field. Being derived from learning theory e-learning has overcome the initial criticism of being initially not developed by teaching individuals but computer scientists (Wang and Ahmed 2003). The Delphi study also confirmed the potentials and connections between PKM and e-learning, which is in line with literature confirming similarities.

The high ranking of aspects like team-cooperation and focus on the individuals and brokers fostered also the result of existing studies that argue that the highest value creation in e-learning derives from the interaction between peers and with the e-learning managers (Mayes and de Freitas 2004). As gaps persists between theoretically available solutions for PKM and application, existing studies support also the overall finding of the Delphi-study not to solely rely on IS, as it is proven that productivity-gains from pure IS investments have decreased since 2000 and do not generate anticipated values (anymore) (Reich et al. 2012).

5.3.6 Research Method Studies

Theoretically the Delphi study has also complied with advice from related literature that other studies and models fail to provide detailed descriptions of the elements and stay therefore too conceptually (Pawlowski and Bick 2012). The robust results from the Delphi study itself where due to compliance with Delphi research methods and research excellence, which supports existing studies claiming that poor results of previous Delphi studies are usually not caused by the weakness of the method itself but rather a bad application of it (Skulmoski et al. 2007).

As mentioned, the research did not produce the ultimate solution but supported its advancement. In this sense it complies with existing studies from the field that highlight the importance of PKM and demand concerned findings that are translatable into recommendations for practitioners via theory that is itself designed to be actionable and that impacts upon value creation (Reich et al. 2014)

5.4 Chapter Summary

The following table summarises the key theoretical and practical contributions that are

reviewed in this discussion as well as in the following conclusion chapter.

Table 5.1 Summary table of core theoretical and practical contributions

Science	Business
- **Consensus** from experts on (top) priorities/ feasibilities: Identified most relevant and suitably applied e-learning best practices (New approach) - High relevance/ranks - Qualitative results prove quantitative/ literature findings - **Extending discipline**: Creation/interpretation of new knowledge (Relevance for **academic & practical** spheres: **bridging!**) - Highlight **trends/issues** & analysed **importance/feasibilities** (putting more science behind observed art): Thorough critical appraisal of current literature/theory - Enhancement of underdeveloped theory - Literature review in accordance with **framework** (**structuring of literature** / complex underlying principles): contributed to project-based learning literature - **Satisfied exploratory research-demand**: Reviewed research process / Promotion Delphi study (renaissance) - Stimulate **potentials/recommendations for future research**	- Managerial implications: Pragmatic recommendations/ solutions enable companies to **improve PKM/brokering in virtual projects:** - **More effective transfer of lessons learnt + avoiding re-development/loss of valuable knowledge from virtual project-work (competitive advantage)** - **Overall guidance**

This chapter has illustrated and discussed the main findings and contributions that emerged from the literature review and Delphi study. As anticipated no uniform solution resulted and the study-outcomes provide highly relevant general guidance, as projects, businesses and environments differ. The following conclusion chapter will summarise the major achievements along with outlooks on potential future research, including the necessity of continuous improvement of the discussed recommendations. There are multiple future areas that present valuable research opportunities, one such being the adoption of the view that virtual global project teams are temporary communities of practice. Furthermore, to build upon the suggestions that emerged from the literature, these communities enable exploration, trust and collaboration. The measure of success was the achievement and profound response of all research questions, which has been achieved as summarised in the next chapter. The targeted benefit for businesses is also theoretically realised, whereas it has to be evaluated what precisely the actual impact for companies will be after an

implementation. Although the above has presented and discussed facts in compliance with academic standard, it is important to also discuss the personal opinion of the author. With his experience and subsequent exchange with the Delphi experts about the study results, benefits for the companies and PKM in virtual team environments are anticipated.

6 Chapter Six: Conclusions

6.0 Chapter Overview

Knowledge is power and a valuable source for resolution of issues, building of core competences, learning new topics and initiating change. Since Polanyi (1969) started to promote the explicit and tacit dimensions of knowledge, KM theory developed a huge range of various theories, methods and recommendations along with systems and applications to improve KM and to enable companies to become knowledge companies in reference to the knowledge society they are in (Liao 2003). Sharing knowledge becomes power, and much attention and effort is put on ICT-enabled solutions that are supporting KM solutions (Liebowitz and Yan 2004).

In the previous section, insights into how and why the ranking type Delphi study was conducted were provided and justifications into the strategies used to analyse its outcomes based on the usage of non-parametric statistical techniques were made. If the findings from the Delphi study are thoroughly transferred and applied into PKM theory and praxis, the success of e-learning systems should support the improvement of this domain. The core philosophy behind this research was the philosophy of linking relevant theory and practice via an organised process-method of controlled interaction and consensus among academics and practitioners. This is aligned with the referenced "Rethinking" PM research-initiative, set out to analyse how common PM concepts and issues can be enhanced with new ideas and approaches in order to facilitate project-practitioners in the 21st century (Winter et al. 2006b). This research has promoted and proven the usefulness of applying findings from a related discipline like e-learning to better cope with the diversified, complex and multifaceted issues reviewed.

6.1 Review of the Research Objectives

In terms of research objectives, the thesis has presented the objectives and the degree to which said research objectives have been achieved. As a summary, this chapter communicates precise answers to the research questions with their respective headings. This is of course guided by the overall themes and the conceptual framework out of which most high ranked elements are derived from the fourth of the centred e-learning sections, summarising aspects of management theory, models and management of social aspects.

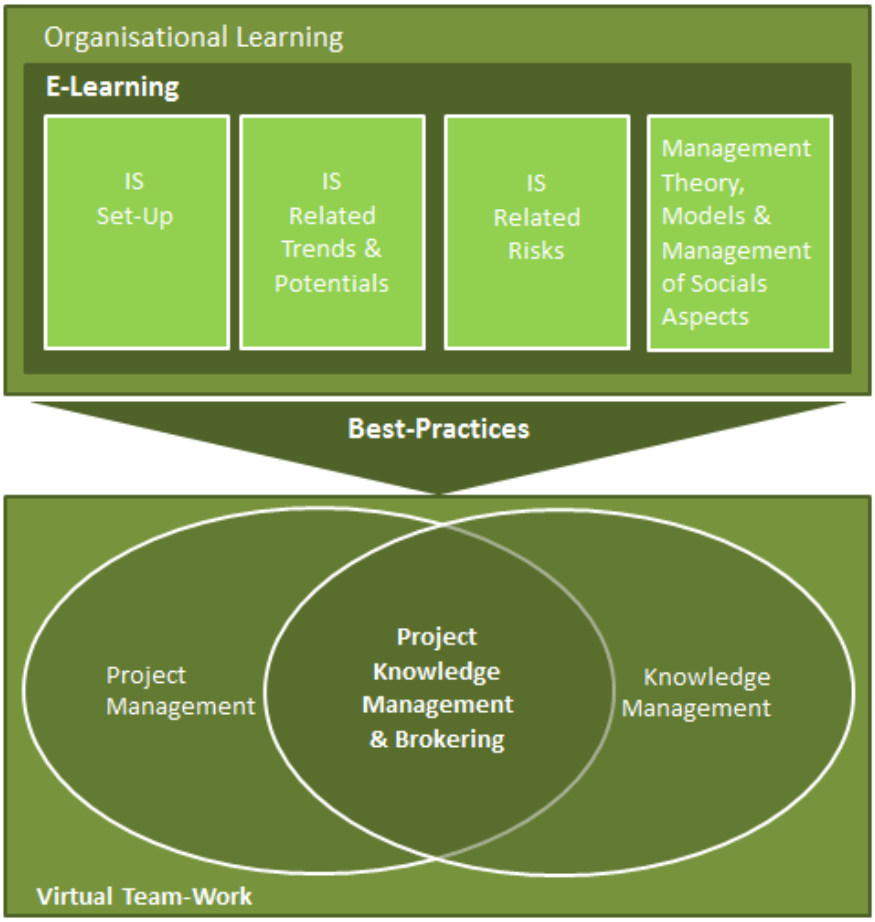

Figure 6.1 Conceptual framework of this PhD study

The first research question is "What are *key issues/status quo* in *PM, KM, PKM/brokering and virtual project teams?*" All four areas are thoroughly described and analysed in the first part of the literature review with their respective sections under the chapter "contemporary focus and limitations of related management research". This discusses the basis of the conceptual framework and presents justifications and motivation for the researched issues, which are targeted as needing improvement. The second research-focus requests an analysis on "Which characteristics *make e-learning state of the art* and successful?" This is responded to accordingly in the second part of the literature review, where potential best practices of modern e-learning management are systematically discussed. Guided by the conceptual framework these elements were grouped into the four sections: *IS Set-Up, IS-related trends and potentials, IS-related risks* and *management theory, models and management of social aspects.* This analysis distilled the distinct 25 potential e-learning practices that build the foundation for the subsequent best practices research that is the centre of this study as well as the conceptual framework.

The following research methodology, execution and evaluation responded to the last two

research questions, with the help of the Delphi study. In response to the third research question, this determined "which [e-learning] areas will have the *strongest impact (Importance)* **[**for improvement of Project Knowledge Management and Brokering in Virtual Team-Environments]?" Accordingly, the Delphi panellists were asked to rank each of the 25 established practices and current topics of e-learning, from 0 (No importance) till 10 (Highest importance). The question that was responded to in the Delphi survey was: "How important are the following e-learning items for the improvement of Project Knowledge Management and Brokering in Virtual Team-Environments?".

The Delphi research also enabled response to the fourth research question: "Which [e-learning] areas can potentially be *applied (Feasibility)* to improve knowledge brokering in virtual teams?" Accordingly, the participating Delphi experts responded to this question simultaneously, and in the same manner when they were asked to rank the presented e-learning practice by importance (0 = No feasibility till 10 = Highest feasibility to be successfully and easily transferred). The related and responded exact wording of the question in the survey was "How feasible is the application of this item as in e-learning to Project Knowledge Management and Brokering in Virtual Team-Environments?". Having ranked all 25 items that were identified based on literature review, as well as proven to be complete by the Delphi experts and the personal experience of the author, the latter two questions were successfully responded to as described in full detail in the corresponding results and conclusion chapters.

6.2 Evaluation of the Research Process

The research process with the selected method was carried out successfully and in strong compliance and support of the code of conduct of the University of Salford, which targets the provision of distinction in research facilities and supervision as well as intellectual opportunities, to stimulate postgraduate students to apply reason and imagination in an environment that is constantly changing. In this regard the University of Salford's postgraduate support framework is well established to enable outstanding research quality along the entire program of study. This process starts thoroughly with the choice of the study topic during which personal curiosity, background, and experience as well as the appropriateness and availability of research facilities and the supervisor is assessed with professional support of the College Research and Innovation Committee.

The end-to-end research process followed a very strict structure: initially the introduction

contained the motivation and context and referenced some key work and findings from literature while not repeating the literature review. The following literature review chapter discussed current evidence and synthesised relevant theory associated with the area that was underpinned by work relevant to the field. The literature review also analysed and revealed explicitly the gaps in concerned theory, knowledge and practice. The research methodology section then provided a critical analysis and appraisal of research options and justified the adopted research methodology. The following main body of research (research execution and its findings) was well supported by the literature and created unique contributions (ref. evidence in previous chapter).

The completed description of primary ideas, the research model as well as the theoretical and conceptual framework and finally the results were all relevant to the research objectives and field and provided a well-structured, accessible guidance for the reader and future researchers, who may intend to pursue a similar direction in their research process. In this regard, the research objectives and questions were well articulated and the correspondingly chosen research methodology had been well established and explained.

There is further reflection and progress discussed in the other chapters of the final section. But specifically in terms of the research process evaluation it was well demonstrated that the author is endowed with a profound understanding of underlying concerns and trends in the context of this research discipline as well as other related fields. Also, the nature of evidence and argument and accordingly relationships, between theory, practice and criticism are made obvious. In addition, research skill-sets and techniques, as well as practical methods appropriate to the thesis subject were presented and facilitated the research, throughout its entire process. This included the understanding and skills in analysis and synthesis of research material that supported the rich data collection and distillation, as well as the manual data analysis, its presentation and the critical discussion. Specialist knowledge such as additional languages to access additional literature as well as the familiarity with the Delphi approach further fostered the soundness of the research process and its framework. The contained qualitative and quantitative aspects of this mixed and exploratory methodology presented a suitable process through which to conduct research in an area with incomplete knowledge. The methodology allowed for the identification and analysis of problems and solutions, a mechanism through which to improve understanding of the related opportunities from the e-learning domain.

The accuracy of the results is also proven by the fact that it resembles existing literature,

like the cited work of Moffett et al. (2003) listing (P)KM enablers like top management commitment, employee involvement, training and trustworthy teamwork. Overall, the extensive preparation via literature reviews, discussions, and trials have supported the quality of the overall process of this research. It has, therefore, also overcome the weaknesses of many Delphi studies, consisting of no definitive research conduction process and no statistical backing for the conclusions that were deducted from the results of the study (Schmidt 1997 and ref. to discussion and conclusions chapters).

6.3 Recommendations for Future Work

In general, the greater the degree of rigour observed, the more confidence imbued within the researcher insofar as providing results of a Delphi study as basis for future studies or informed decision making in practice (Okoli and Pawlowski 2004). As outlined, the research supports the broadening of the existing PKM toolbox. That said, however, facilitating this end is not necessarily a simple feat. Change therefore remains a fundamental theme as far as the development of KM and PKM are concerned. More specifically, continual change is linked to improvement and this is likely to be facilitated by continuously improving the creation, sharing, learning and storage of knowledge, which will also be a vital source for sustainable KM theory enhancements (Liao 2003).

One precise contribution relates to the future directions in which the study can take. One such direction may be the application of one or few of the best practices identified to a real life virtual project team. Once the proposed most important and feasible e-learning best practices have been introduced for example in a case-study, future researchers should apply a specific measurement instrument (See Liebowitz and Megbolugbe 2003) as a means of testing overall success and effectiveness PKM and knowledge brokering.

When other scientists will advance and build upon the presented exploratory research, looking into the exact conversion and implementation of selected e-learning best practices into PKM, this should be done with extreme caution and rigour. This is due to the fact that it is opined that success will not be reached by simply focusing on the adoption of a tool but by giving consideration to complex, underlying issues relating to people, systems and organisations. Furthermore, taking into consideration assertions made by Levy (2009), in which it is stated that KM is yet to be sufficiently matured to, for example, let loose of control and shift to altruism without central organisational-governance.

As indicated, an interesting path of study is also a long-term view after the actual change

management of the application and transfer of e-learning best practices, particularly in terms of retention and sustainability. Successful solutions may be developed and implemented as a result, the aim of which is to manage reapplication and storage of successful solutions and avoidance of replicating previous work. Furthermore, in the event of the latter coming into fruition, it would be prudent to also look at these downsides of doing so and thus examine potential bias or maintenance of status quo via the reinforcements of a single loop learning of virtual project teams' knowledge base, that could also lead to the threat of change resistance (Argyris and Schoen 1978). Here, future research should consider the danger of too much emphasis on internal PKM and potentially negative impacts from an inward-looking perspective.

Unfortunately, the scope of this study only allowed a review of internal factors including the internalisation of external practices. A future piece of research should also purely identify and review the impact of external influences that may become critical issues also for the PKM and brokering in virtual teamwork scenarios – again potentially considering best practices from e-learning. An example of which could be in special industries or political environments. A potential question that could then be raised relates to how the management could factor in and control these externalities successfully. A future study should then also include considerations of actual internal and external stakeholders.

Future research may also take inspiration from Manuel Castells' highly related theory of the network society. Within this seminal work, project networks are defined as the key feature of social morphology and it is argued for the shift to horizontal cooperation (Stalder 2006). In this, new information- and communication-technology is described as a product of social forces that are formed by the context of the capitalised society in which they are entrenched. Herein information is of fundamental importance in determining productivity; this view could be combined with the findings of the presented research in order to produce new thoughts to enrich the actual discipline.

Despite criticism in the past for "Delphi-like research" (Schmidt 1997), one final reference is also the encouragement to new researchers to (properly) use the Delphi methodology, as not only the above recommendations may well be executed with the support of this. A recommendation is a complex subject, which is the outcome from a synergistic and combined conclusion from results of other inquiries (Okoli and Pawlowski 2004). It is the hope of the author that these discussed research recommendations and ideas of this thesis will stimulate further improvements and continued interest for future research within this

important and fascinating but also challenging domain. Due to its high relevance, the field may in future evolve into an academic discipline in its own right, underpinned by different schools of thought and theory. As explained, research in the e-learning and PKM area is still proceeding and continuously reveals new explanations and initiatives, which should encourage future researchers to stay tuned and connected to this fascinating field in view of newly upcoming potentials.

6.4 Learning of the Researcher and Connected Reflection on Personal Virtual Distance PhD PKM

Overall, this was an interesting endeavour into being able to conduct a research project in such a detailed manner across various fields, examining its current status and developing an evaluation proposal and future outlooks. During the research, the application of best practices was also necessitated by the researcher, especially with regards to PM. The following Gantt chart for example supported progress orientation and milestone adherence, which was also supported by the program of study of the Salford Business School, helping for example with tools like the learning agreement, which included agreed milestones and reference points.

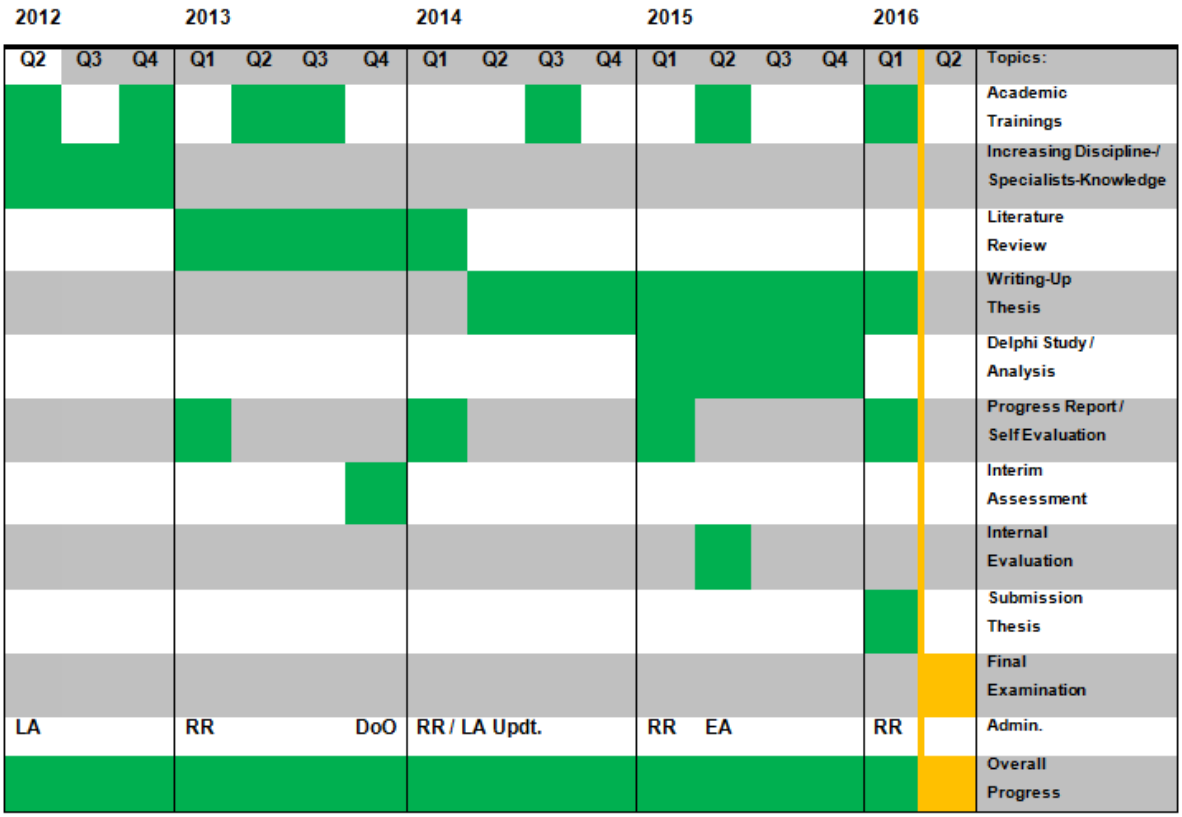

Figure 6.2 PhD Project Progress Gantt Chart, status quo 31st March 2016

Another useful means in this context was the guidance from the conceptual framework that assisted the structuring of this research "project". What also supported the overall PhD project, were directions and key findings from PhD literature, with inspiration being drawn from Dunleavy (2003) with their guide "Authoring a Ph.D.: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation". Besides strong diligence, seeking of advice has become a main virtue over the last few years of study. Therefore, also beneficial was the guidance from, and close relationship with, the supervisor, who supported the research with realistic assessments of plans and conceptual pointers for literature and academic excellence. At this stage, a sincere thank you is expressed again to the supervisors, examiners, co-students and staff at the University of Salford for all the support, guidance and expertise that supported this study.

This section intentionally also includes a short review on the distance PhD process and how this (virtual) project had to be approached accordingly. Besides the PM compliance, including strong discipline on project conceptualisation, design and implementation, it required good KM and self-organisation like the structuring and archiving of sources, activities and contacts etc. A substantial learning process took place here, from the effective and mostly virtual communication and knowledge exchange with new and diverse audiences (including new professional contacts) throughout this research project. This simultaneously also fitted with the research field. As issues of reviewed aspects are related and also challenging to the actual research process, this also influenced the learning of the researcher, like virtual communication with Delphi panellists and supervisors or concerns of big data. As Clemens (1986) outlined, scientists can scarcely remain experts in their own discipline anymore, given the drastic incline of science knowledge and related inclining influential aspects of scientific publications. These are challenges and necessitate proposed creative improvements or short cuts such as those presented in this study.

The virtual approach also urged for personal autonomy and crisis management skills, as it for example, requires students to build abilities to (remotely) adjust research designs in case of unforeseen issues. Becoming more reflective was an essential part of the learning curve for the development as a researcher, all in the context of the enormous workload and countless invested weekends and workday evenings. As a distance part-time student, time-pressure makes it much more difficult to allocate sufficient concentrated research time in comparison to full-time students. As single, uninterrupted longer periods are however much more effective, the researcher mostly dedicated holidays, annual leave and weekends

to the completion of this project, which benefited the research quality but simultaneously caused a lot of stress and lack of recovery phases. Working full-time in an international management position, the research, including dedication during evenings, was very exhausting and required a high level of discipline, also to stop from 'burning out' or overworking. Emotions like fear and stress also resulted from interacting with working systems, where sometimes frustration resulted from, for example, reading many papers without being able to use them or other challenges that delayed the intended progress.

On a positive note, the author's management work for a leading multinational logistics company, supporting the business development with global key account customers via multiple (virtual) projects, provided an opportunity for reality cross-checks of the derived theoretic assumptions and final solutions from the Delphi study. This is very valuable, as for example, in terms of the severe competition and challenges in the global logistics markets, like commoditisation of services. Logistics companies are urged to optimise themselves and increase efficiency everywhere, ideally also via knowledge brokerage in virtual teams. However, the logistics industry is not perceived as state-of-the-art in terms of PKM management, strategic management and leadership theory adaptation. Therefore, this background brings in very valuable pragmatic and operational impulses to the study. The above is a personal observation of the author proved for example by participations in logistics leadership executive exchange-circles and once again, it is highlighted that this was also a major motivation for the overall thesis, as the author himself perceives there being a lack of suitable solutions and management practices in the researched area from personal work experience.

Initial barriers or shortage in certain precise skills, were outbalanced by the attended trainings, consultations with experts and personally gained experience over the course of more than four years of project work for this thesis. In terms of personal development, the learning as a researcher during the PhD program surely enhanced the personal abilities for acquiring as well as understanding complex and substantial bodies of knowledge. It necessitated also the maturing of outcome-oriented PM skills as well as those for informed analysis and judgments. The development of reflective skills also supported the quality of the critical review of the outcomes. Finally, the research also further developed personal knowledge about advanced academic enquiry and the usage of suitable research techniques, supported by enhanced research integrity and confidence in innovations and creativity.

Accordingly, this research has clearly also reinforced points of learning relevant for professional development. Besides the mentioned research integrity around ethical and rigour considerations, the PhD research fostered the ability of systematic compilation and comprehension of extensive knowledge-bodies, which is relevant for both academic and professional practices. In the professional context, the developed PM skill-set for new knowledge generation and application are as highly relevant as the understanding of challenges and interconnections of examined elements.

A substantial part of the overall learning derived from the Delphi study and its research design considerations like methodological choices, focus-degree of questions, criteria for experts and the interaction with them (Skulmoski et al. 2007). Also, it was found, as previously indicated, that the sequential and iterative Delphi approach is very time-consuming due to a large number of data-feedbacks and dependency on a number of occupied individuals. Generally, the literature recommends more than 45 days for the administration of Delphi studies for full-time researchers, allowing participants more than two weeks to respond (Delbecq et al. 1975). But it was found that the overall execution of this study took the part-time researcher more than three months excluding the actual research preparation, instrument design, and final analysis. This leads to the recommendation that the method be avoided in contexts constrained by time and where other data-collection methods may not be slowed down by tedious questionnaire-rounds. On a positive note, the complexity and governance of the customisable and flexible Delphi iteration process clearly presented chances to enhance the result quality and the high efforts needed for reminders and follow-up exchange resulted in 100 per cent response rates throughout both rounds.

Regarding the amount of Delphi cycles, it was an interesting learning experience to assess the compromise between additional achievements versus feasibility of investing further resources, time and entertaining the panellists for another round (Nelms and Porter 1985). This became even more critical after achieving a low to moderate amount of consensus, measured using Kendall's W. These challenging aspects of the Delphi study, as well as the general distance part-time PhD research, further necessitated the development of the discussed accurate project, time and self-management throughout the entire course of the research. Finally the multi-facetted backgrounds of the participating experts enabled very valuable exchange thus contributing to the author's own learning.

In light of this, despite the Delphi approach being unsuited to time constrained studies, the

researcher does not shy away from encouraging its use for research relating to new sectors which are yet to be fully explored. Interestingly the Delphi approach targets the examination of what should or could be in contrast to traditional questionnaires that mostly seek to determine the status quo (Hsu and Sandford 2007). The Delphi study is and will hopefully continue to be a respectable solution for supporting the improvement of real-world issues as in this study. It is obvious that availability of modern electronic solutions ease and speed-up the Delphi management further.

Interestingly, there is virtual project knowledge brokering itself involved in the interdisciplinary approach of this research and its reviewed sources that seek to transfer existing knowledge and establish new potential connections with e-learning best practices. Despite certain challenges, the experience has been a highly rewarding and satisfactory one, enriching the researcher in both mind and spirit and taking on the huge responsibility to become an independent academic researcher and expert in this field. This research has sought to increase the researcher's passion insofar as academia is concerned, providing inspiration to pursue publications and contributions to the academic community, sparked via various inspirations like the review of the theory of the network society.

6.5 Summary of Solutions

This research has studied the use of PKM and brokering for leveraging the knowledge, experiences and learning gained across projects. The thesis set to examine the improvement of knowledge brokerage in virtual project teams and its relevance for companies. The current status of the topic is reviewed and portrayed as being insufficient for current and future business demands, since neither underlying PKM practices have been adopted nor proper processes for knowledge brokering have been implemented. Paradoxically, virtual set-ups are increasingly used to facilitate access, transfer and application of knowledge that is dispersed and stuck globally within company silos and social-networks. These temporary set-ups actually restrain aspects of KM as teams never or rarely meet (See Figure 6.3), which is actually strong supportive aspect for knowledge brokering in traditional project teams that meet physically for socialisation and exchange.

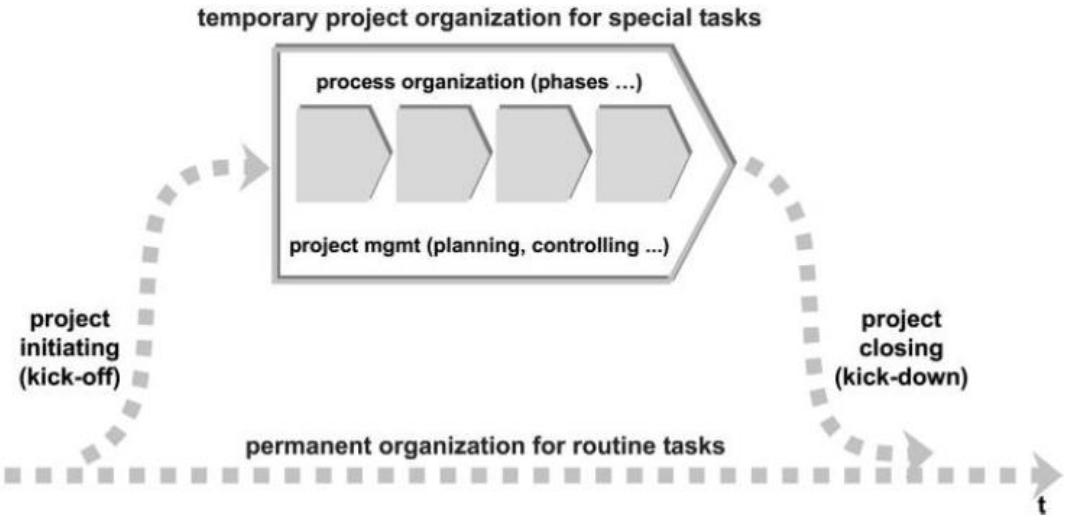

Figure 6.3 Difference of permanent and temporary organisation (Disterer 2002)

Due to identified similarities to e-learning practices, the thesis provides a solution by suggesting to apply thoroughly identified best practices from most advanced e-learning management to the knowledge brokerage in virtual project teams. Both e-learning and virtual project teams deal with distance and IS-supported knowledge exchange of individuals who never or rarely meet and both areas have tight general links with OL and KM theory. By providing information when and where needed, e-learning satisfies the demand of information liquidity via smart usage of multimedia by facilitating peer interaction and contextual aspects. As a result, it is well justified in the literature review why e-learning was chosen as the best practice source (Wild et al. 2002). Accordingly and in line with the knowledge based theory, which focuses and considers knowledge as the vital asset and competitive advantage for companies to sustain in super competitive markets and rapidly changing business environments (Alava and Leidner 1999), this thesis has contributed to the enhancement of this area. Here, it is vital to understand that companies have to succeed in transferring knowledge and learning achieved in (virtual) projects that are disconnected from the permanent organisation back into the latter and onto new upcoming projects.

6.6 Managerial Implications

The following paragraphs discuss the highlights, trends and highest ranked elements that emerged within the findings. This serves as a reference for future theorists and practitioners, by recapturing the main elements and success factors of these e-learning best practices. These should be transferred to enhance PKM and brokering in virtual teams and to establish the discussed and required social networks with trust and informal, regular and

rich exchange including reciprocity and supportive culture. This is based on previously referenced sources from the literature-review that form the basis of the explanatory glossary provided to all Delphi panellists (See Appendix 8.2.). This reference source is accordingly without strict adherence to the rank-order, despite the fact that the top three and outstandingly ranked best practices (printed in bold) have to be considered as most critical success factors in regards to both importance and feasibility for overcoming the stated issues in virtual PKM. Commonly for importance and feasibility high ranked practices are again highlighted are underlined. This section does not contain quotes and references for easier readability by practitioners. All used external work is already properly referenced in the previous sections.

6.6.1 Importance of Best Practices

1. Ease of Use/Usefulness

As a top priority, companies should ideally focus on ease of use and usefulness, as doing so enhances user confidence and this is likely to impact on improving the intent to use as far as systems/technologies are concerned. This is achieved by quality of information systems and related sufficiency for the tasks aimed to be performed. It is to be assured by structured and standardised data (formats), metadata and managed content, referring holistically to information, communication and learning or knowledge material. This should include areas for interaction and exchange. E-learning best practices accordingly rivet on formative design of platforms, training contents and training agents.

2. Required Management Buy-In/Incentives

According to the experts from the Delphi study, it is of critical importance that companies ensure comprehensive buy-in from senior management in order to push for initial change, operational implementation and long-term sustainability of the new approach by top-down adaption of related processes in their organisation. In keeping with e-learning, it is important that knowledge brokering set-ups are firstly understood as serious endeavours involving important aspects. This may include the necessary change of processes involving internal and external areas around strategy, organisation, economy and culture. The management has to be didactic and consider all effected stakeholders, which can only be facilitated by top-down management commitment. Here a holistic approach and support act as integral success factors. Overall, the utilisation of knowledge should be intensively encouraged by the senior management including a raise of a corresponding corporate

culture.

Companies should combine this with a thorough evaluation of utilisation and results. Besides extrinsic and intrinsic motivation and in link with the central leadership buy-in, appropriate incentive measures are highly important and relevant and so contribute to forming supportive behaviour as well as culture and finally to success. This latter point was explicitly raised by the Delphi experts and served to only echo the opinions expressed within the KM literature. With this in mind, it is necessary that a multi-faceted approach of KMS be adopted, one which heed factors that are not directly related to technology and its use. These include important organisational and cultural aspects, such as the shift from traditional award of staff for individual performance and know-how towards incentivising for sharing and contributing. It is important to note that this item is not assessed with high ranks in term of feasibility. This means companies should have attention on this as the Delphi experts anticipate relatively high challenges when transferring this top important e-learning best practices into virtual PKM.

3. Team-Cooperation

Companies should likewise seek to gain a deeper understanding and insight into the importance of team cooperation in order to effectively leverage the associated benefits. Modern e-learning solutions are widely recognised as providing the necessary support tools for cooperation within organisations and teams. As such, in order to benefit from these tools and apply them robustly, it is recommended that an understanding of teams and their dynamics is firstly gained. This becomes even more pertinent within the context of virtual project-teams that rarely meet; it is extremely important to understand the high significance of this factor and that state-of-the art e-learning solutions like the also highly feasible e-learning 2.0 for example to increase team cooperation and in turn knowledge brokering accordingly.

4. Visualisation/Imagination

The study found that it is also important and feasible (ref to underlined highlighting) to increase usage of figurative language and symbols as strong tools for conversion of tacit into explicit knowledge (Articulation). Accordingly, companies should follow the described Japanese science best practices from e-learning that prove successful with regards to the application of imagination-triggering models, analogies and metaphors. Here, visualisation permits access to accomplished knowledge from one individual to

another, working as a conceptual bridge to potentially enhance quality and speed of transfer significantly within virtual project team environments. Thus, focus should be put on supporting the cognitive process for creating and transferring knowledge with the power of visual formats to overcome arising challenges. Examples of challenges include information overload, identification of relevant information or heterogeneous cognitive backgrounds.

5. Governance / Learning Objects

Likewise, companies should apply comprehensive formal and informal governance. This should include a methodical definition, development and usage of standards for tools and structures that stimulate knowledge sharing and knowledge creation processes. As in e-learning, the corresponding strategy has to combine corporate, IT and knowledge governance on macro as well as micro-level to support employees to share, integrate, create and use existing knowledge. As presented in the literature review, companies have to understand that informal governance mechanisms are more useful to develop solutions for connecting complexities of "knowledge-islands". Here the described IT duopoly sets ideal environments for knowledge brokering principles and investments, as it allows common decision making including business and IT, while maintaining focus on precise issues. Applying relatively easily effective e-learning governance best practices, companies can support to ensure performance via (cost-)effective use of e-learning, asset utilisation and ultimately revenue growth and business flexibility. For this, the eight critical governance factors of e-learning could be transferred highly feasibly, namely transparency, active goal-oriented design, infrequent design, education about IT governance, simplicity, exception handling process, governance designed at multiple organizational levels and aligned incentives. Like with e-learning objects, companies should then also ensure that knowledge resources and entities for contents are interoperable, reusable and accessible for comprehensive solutions with optimal productivity and quality while reducing needed resources.

6. Reflection and Progression

As illustrated by the findings of the study, companies should also consider the importance and feasibility of succeeding with evolving conversion into reflective process-progressions to cope with the increased demand for alternatives of traditional learning/knowledge offerings and the availability of learning/knowledge resources. Accordingly innovative

knowledge brokering should apply e-learning lessons learnt to better grasp the potentials of collaboration and successfully manage the increase of dispersed project-members in conjunction with life-long learners and individuals that demand knowledge in the workplace. Here, reflection and progression may also solve increased demand for skills and knowledge from employees and employers while reducing required costs. Furthermore, it allows a company to sustainably remain part of the competitive knowledge society and knowledge based economy.

7. Entities and roles within the execution: Learning Individual = User of Previous Projects' Knowledge

Another important (and feasible) e-learning best practice directs that companies should not downplay the role of users and instead recognize the influential and important role that they play. Just as learners who are constrained by space, distance and time to attend conventional face-to-face sessions, management should understand that this also applies to employees concerned with PKM. As such, managers should look to increase motivation and self-discipline amongst users of previous projects' knowledge by ensuring clear targets, time-management and self-expression. In this regard companies should focus on the importance of this and guarantee perceived demand for training, particular knowledge along with open-mindedness towards innovations and technology. Knowledge brokering efforts should therefore include necessary change and project management to focus on abilities of users and acceptability. This should be managed especially with regards to resistance to change and perception of value adding, as the reviewed e-learning literature proves that the role of the learning individual has high relevance for success of e-learning and consequently, knowledge brokering.

8. Entities and roles within the execution: E-learning Manager = Knowledge Broker

Similarly, the study results indicate that companies should facilitate knowledge sharing and exchange by easing learning processes. This should be done importantly with guidance, mediating and teaching how to learn. As such, like e-learning managers, companies should install the discussed knowledge brokers that become a guide or catalyst, not necessarily an expert. As in e-learning these functions may heavily rely on informal network and also skills such as training experience, ability to observe and persuade as well as technical and contextual knowledge.

9. Information/Data Management and Tools

The study found that another comparatively strong and easily achievable impact for improvement of PKM and brokering in virtual team environments derives from e-learning best practices of information and data management as well as respective tools. As a result, companies should understand and utilize the potentials of the reviewed ERP and data warehousing and respective tools. The tools in question play a fundamental role in supporting objectives like processes standardisation and central hierarchical controlling that should increase discipline and uniformity. Here the best practice occurred in e-learning via a thorough integration of aspects from both areas (e.g. ERP or OLAP with e-learning) and further developments (e.g. E-learning Data Warehouse) that improved e-learning successes. Corresponding best practices teach that ideally, diverse regional versions based on one system catering for tailor-made local conducts is existing and paired with the understanding that the creation of interrelated processes and one centralised database is not simply a technological challenge. Companies should therefore ensure that both system and company processes are customised and harmonized. This, in turn, requires technical and process change skills. Besides that, an understanding of the environment and managerial and project-related capability should be a prerequisite, including the setting and matching of realistic objectives and ensuring optimal resources, communication and (corrective) actions. It is ranked as important that companies apply this best practice and accordingly include combinations from data warehousing and e-learning to conduct also a thorough supervision and assessment of learner's performance by linkage of data warehouse and OLAP technologies with PKM.

The modern integration of data mining with e-learning reveals high potentials as mining software supports identification of valuable pieces, as also from regular data warehousing. Besides Enterprise Intelligence Portals that deal with unstructured data like documents, emails or photos; e-learning theory promotes E-learning Data Warehouses (EDW) consisting of gathered information from various dispersed and unrelated E-learning Information Sources (EIS). As discussed in the literature review this supports consultation and analysis. Here also the resemblance of data warehousing and e-learning practice around subject organisation, integration, archiving of historic data and data transformation, including filtering, analysing etc. is matching with PKM. Thus, practices like data staging, metadata, loading, storing and assessment in multidimensional databases, enables tailor-made visualisation of content and is already successfully applied within e-learning. This

creates proven potentials for virtual knowledge brokering. Finally, end-user types of data warehouses relate to e-learning users and therefore potentially users of project-knowledge, like “tourists”, “explorers” or “farmers”, having different preferences that applications, policies and processes need to respond to in order to be used effectively.

10. State-Of-The-Art Information Systems

The Delphi experts also emphasised the importance of companies to understand the necessity of successful state-of-the-art IS. Like in e-learning it is ranked also as feasible to provide ubiquitous and personalised environments to support knowledge review and new content development in various forms from text to multi-media formats. Companies should therefore apply state-of-the-art IS solutions for reducing costs, achieving targets and successes deriving from relevant information, system quality, usage, output, input and process orientation in combination with feedback and suitable measurement tools. Like in e-learning, virtual PKM companies should then be able to release the full potential by considering technology, environment, resources and the digital divide.

11. Ownership of Learner

Although not ranked as highly feasible, the Delphi study found that ownership of learner is another important e-learning aspect. Companies should enable users to take ownership and have immediate control over knowledge gaining via adoption of multidimensional means of multiplicative communication. Ideally, companies should go beyond customising options for different learning styles or preferences to endowing the knowledge seeking individual with direct control to acquire input at the required pace. To allow the employee to effectively take ownership and control, the solution has to enable rapid absorbing and authoring of information via various sources as well as media types simultaneously, as done so in e-learning. In this respect, this relatively difficult to apply best practice should cater for preference on-demand, widely accessible input along with constant communication with close and global peers, that are expecting immediate responses.

12. New Trainings: Integration of Pedagogy and Technology

As another significant e-learning best practice that is not transferred comparatively easily, companies should consider developing training programs. Here, companies should adapt and redesign conventional PKM practices of both employees and managers. By enhancing training, both managers and employees are likely to be left in good stead as far as their new facilitating role in virtual project-environments are concerned. These enhancements

should cover development of ICT skills to improve usage in terms of administrating, (social) interacting, motivating and time needed after gaining comfort and confidence around ICTs. The technology use should be focused by trainings to overcome general concerns regarding increased transmission of data via technology as well as personal concerns around changing and increasing work patterns, loss of personal face-to-face relationships or simply conservatism and opposing against change. Here, e-learning advancements stimulate that underlying pedagogy should be integrated, as in state-of-the-art twofold e-learning trainings, where it is understood that neither pure technology nor new pedagogy approaches themselves succeed.

13. Knowledge Marketing

Finally, knowledge marketing is resulted as an area that the study has indicated as having a relatively strong and easily achievable impact for improvement of virtual PKM. E-learning theory exemplifies that companies should not only focus on knowledge communities, chains or supplies but contemplate the problem in analogy of a knowledge market. This consideration should include mechanisms like transparency, liquidity and knowledge marketing processes to avoid wasting resources, potentially resulting from redundancies, emerging business related problems and poor decision-making. In this regard, companies ought to identify stagnation and causes as soon as possible and solve it with effective measures. The usage of e-learning's planning centre best practice aiming at standardisation and coordination should be one element of this important initiative. To fully leverage the potential of this relatively highly important and feasible practice, it is necessary to understand how internal knowledge markets can be impacted and that management can substantially increase value perception of it and reduce the transaction-costs for searching. For achieving ultimate goals of effective knowledge markets, companies require appropriate processes, measurements and underlying infrastructure that continuously improve on both corporate as well as personal level.

6.6.2 Feasibility of Best Practices

Those best practices that are already discussed in the previous importance section will not be discussed again in this feasibility section. Therefore, those same items (like "Ease of Use/Usefulness" are left in the following section only for reference but without a repetition of the description.

1. Ease of Use/Usefulness

2. Team-Cooperation

3. Procurement of IT Tools

In analogy with the most critically ranked two elements (Ease of Use/Usefulness and Team-Cooperation) for both importance and feasibility, the study established that it is of top feasibility when companies also adapt e-learning best practices from general procurement strategies of IT tools. Although not being ranked as highly important, companies should consider the extremely high feasibility of applying collaborative and creativity-enabling open source solutions developed in the e-learning area, by becoming ideally even early-adapting companies. Furthermore, the study has found that companies have to prioritise this field due to the relatively extremely easy application and transfer of related e-learning best practices. These include the robust software stacks that are already developed and matured in the e-learning sector and that are supported by single capable suppliers.

4. Entities and roles within the execution: Learning Individual = User of Previous Projects' Knowledge

5. EP / Web 2.0

Despite being ranked with relatively low impact, EP/Web 2.0 was found to be another relatively easily transferred best practice. E-learning 2.0 does utilize potentials of applications like blogs, social networks, podcasts, wikis, RSS feeds and most recently data mash-ups. These may potentially advance project team members' performances by providing collective intelligence through active participation from the using individual via four key pillars (sharing, participating, cooperating and communicating) in multimedia formats beyond text-exchange. The online network should result in boosted knowledge aptitudes of virtual project teams that establish interconnections. By putting emphasis on the knowledgeable individuals, this "social evolution" with its "knowledge seeking individual"-centric model should focus on the personal knowledge environment. This should use social software to encourage employees to create and share content as well as interact not only with immediate virtual project members but with all worldwide employees from whom learning can be retrieved.

Modern e-learning provides an indication into, how communities of practice (shared interest-domains) enable members to learn together by interacting and developing a shared resource-repertoire, enabled by active ICT-based collaboration and communication-processes. As discussed, this is ironic as this e-learning best practice brings back the state

of learning prior to modern schooling; when learning was supported by the community instead of removing students from it into artificial environments where content is learned unconnected from context. E-learning literature and the Delphi study results indicate that PKM-improvement initiatives should potentially be able to relatively easily internalise accordingly this related shift from delivering pre-defined content towards connected tools.

These tools should then be applied for creating usable knowledge nodes with content authoring activities from users, all combined in a single corporate application system. This should become a personal knowledge centre that includes re-used and re-mixed content-collections of interoperating application environments with syndicated contents and personal spaces. These spaces in turn would allow staff to create and showcase own e-portfolios of potential knowledge, which can subsequently be shared with peers. In line with recommendations from the discussed literature, companies should seek for ubiquitous computing with workflow learning while integrating deeply corporate web-based 2.0 applications into combined process solutions. These process solutions should be for real-time task support by contextual collaboration with people and systems catering for design and modification achieved by modelling and simulation.

6. Cloud (e-learning)

Likewise, with the above, cloud e-learning is another area that should be relatively easily transferable but is yet not rated as very important for improving knowledge brokering in virtual teams. If done correctly, companies should apply all benefits of cloud architecture including services, platform and infrastructure, thus eliminating issues such as hard-disk loss, crash recovery or “downtimes”. As stated also in the literature review, cloud-integration provides proven feasibility, improvements of efficiencies and management resulting from simplified collaboration and group creation. Increased productivity of individuals, analytics and application improvement could be achieved via virtualised IS resources and data on-demand, that is instantly accessible every time and everywhere with different devices. This makes these existing solutions in e-learning easy to use, scalable, affordable and provides high levels of data privacy, availability as well as security. Further potential should be easily retrievable from integration with other areas like outsourcing, mobile learning and the availability of desired functionalities from e-learning like e-mail accounts, forums, individual web pages or chats. As done in e-learning, interactive cloud computing based solutions should then be able to build virtual and personalised knowledge environments for supporting content-creation, management, idea explorations, and

integration of different pedagogical approaches. As presented in the literature review and the study-results, companies could relatively easily be able to provide enhanced experience compared with traditional KMS by well-known environments where goals are more easily achieved by flexible architecture and mash-ups of heterogeneous services that support different activities, like production, distribution, reflection and discussion of knowledge that can be triggered even event-driven.

7. Reflection and Progression

8. Knowledge Marketing

9. Entities and roles within the execution: E-learning Manager = Knowledge Broker

10. Information/Data Management and Tools

11. State-Of-The-Art Information Systems

12. Governance / Learning Objects

13. Visualisation/Imagination

As most high ranked elements for feasibility are similar (underlined headlines) and already described in the above importance section, these are not discussed again. Companies should focus on these matching and twice highly-ranked elements. However, they should also thoroughly evaluate the factors that affect ease of application (higher vs. lower feasibility) and how these compare with the different importance levels (impact). Coupled with this, a few precise elements from above for improvement initiatives of PKM and virtual team set-ups should be selected, considering an economic environment that is normally constrained by limited resources. The conceptual framework and the Delphi results, including those most important and feasible factors that are derived from various areas, illustrate the literature's call for a more balanced approach to PKM, and in particular the key factors which can facilitate this goal. As this research has shown, the goal is to do so in a way as to limit impediments to spontaneity through prescriptive and bureaucratic practices, whilst still providing sufficient control as to prevention the formation of knowledge 'jungles' (Leseure and Brookes 2004).

The feedback from the heterogonous Delphi experts serves to further substantiate the view that there is vast potential for leveraging new organisational practices created within the context of virtual projects, via the found prospective best practise-based advancements for virtual PKM. As different expert groups may judge opportunities and issues differently,

these discrepancies did not only cross-fertilise the results of the survey but may also have relevant implications for the future adoption of the stated recommendations. Furthermore, it has to be re-emphasised that PKM literature continues to evolve as more recently its scope has expanded to include focus on high ranked "best" practices such as reflection and progression, rather than simply on PM tools and techniques. Related PKM literature highlights the importance of enhancing reflective practices and critical attentiveness, rather than (only) the application of special techniques (Williams 2008).

The study has presented a significant advancement to the current situation. According to Kuhn (1971) the development or modification of a scientific paradigm occurs when the prevailing paradigm shows signs of stagnating. This stagnation occurs when new contexts and technologies are not acknowledged or heeded in any way. Now it is up to the companies' management and future scientist to further take on these findings by considering thorough change management, when testing and implementing these new results and recommendations. This should be done under consideration of applying business process re-engineering, where it is vital to identify and select those processes that are most likely to deliver the discussed improvements to facilitate knowledge brokering for developing, transferring and applying knowledge of practicalities, communication and science across boundaries via linkages (Edwards and Peppard 1997).

6.7 Validity and Reliability

6.7.1 Internal Validity

Whilst the findings have been discussed in greater detail as well as within the context of the literature, additional consideration also has to be given to factors such as the validity, reliability and limitations of these findings. Internal validity tends to be conventionally affected by flaws within a study itself. These can be for example a data collection problem resulted from research instrument issues or a design problem resulted from non-control of one or more main variables. As discussed, this was carefully considered and prevented by complying with Delphi study literature, to proactively manage affecting dynamics like given time, sample size, attrition and subject variability. This was also supported by its relevance and available best practices, as a wide-ranging list of dissertations exist that have used the Delphi method; also in the KM-field (Skulmoski et al. 2007). Overall this resulted in a sound research concerning the design and methods of the research as both the findings from literature and their verification via the Delphi study truly represent and analysed the

focused phenomenon.

6.7.2 External Validity

Likewise external validity has to be discussed as it relates to the extent to which the results from the Delphi study could be generalised and applied to a to a wider audience or context. Referring back to the issue of bias, dynamics that impact the external validity were carefully considered and observed. As such, these included characteristics of subjects, influence from time, the data collection methodology, the researcher as well as interaction and the environment. Again, the adherence with instructions and recommendations from Delphi literature supported compliance, as also the generic approach fostered by experts from various backgrounds allows for careful adaptation and application of findings into other fields. Since most companies use a combination of KM solutions, the experts from the Delphi study have also indicated various important aspects that should be taken into considerations for other related fields that do not only relate to PKM and virtual team work. Although extensive efforts are invested for many decades in the research of combining individual into consensual rankings, there is no method that is able to deliver consensus without (social) influence by the method itself, which also includes Kendall's W (Kendall and Gibbon 1990). However, the Delphi approach with its iterative process reduces this impact by enabling panellists to re-edit their responses, and is a preferable choice when it is supported like in this study by mean-ranks and Kendall's W, as these ease understanding and application (Schmidt 1997).

6.7.3 Reliability

Likewise reliability is important, as it is the extent to which repeated Delphi studies would produce similar results. Although positivist research may ensure reliability through methods being repeatedly providing same results (Williams 2008), reliability of Inter-pretative research through replication is unlikely to be possible. This is due to the fact that situations under examination are often unique and subject to change, and original condi-tions may not occur again. However it was still proactively managed by the researcher, as with validity aspects, to avoid even minimal errors or bias in the applied Delphi method, in line with reference Delphi literature and as explained in the research design Chapter, for example in regards to the thorough expert selection process.

6.8 Limitations

Finally limitations are discussed. The review of related literature including the vast organi-

sational learning field was conducted in preparation of the outlining of e-learning practices. This pre-review revealed that also for the OL area a similar insufficient situation than with (P)KM persists and a single ideal 'solution' is yet to emerge. In this respect, rather than being a shortcoming of the literature it is a reflection of the problem area itself and a uniform gap in both praxis and theoretical knowledge persists as well. Also, the OL field deals with complexities of limiting barriers such as lack of profound theoretical background of its systems, organisational structure issues around free information-streams and set-ups as well as again a need for a transparency-, teamwork- and learning-promoting culture (Williams 2008). From this standpoint, e-learning has advanced well in terms of effectively overcoming and working around these issues as described in the previous sections. One particular topic that was not part of the review of existing e-learning practices is the cultural aspect, as this is rather intangible and supported by a combination of the outlined practices, such as for example ownership, interactivity, trainings, reflection and progress or management commitments. Here, it is interesting to see how e-learning has taken on the theory of a learning organisation which describes its objective as to improve the learning capabilities of both individuals and the company as a whole via means of human developments, leadership or empowerments (Williams 2008). As such, the comprehensive approach has guaranteed that all three main perspectives in the literature (1. Information-based, 2. Technology-based 3. Culture-based, related to learning and communication) on knowledge have been considered by the study (Alavi and Leidner 1999a).

As outlined in the literature review, learning strategy should ideally consider not only the benefits but also limitations of e-learning technology considering a comprehensive approach covering topics like motivation, culture, productivity enhancements and skill development (McGraw 2001). This thesis has concentrated on potential best practice, however there are certainly also limitations when relating e-learning to knowledge brokering in virtual project set-ups. Besides only those included but low ranked items like virtual worlds where issues of trust and "lurkers" or passive users, intimidation or even bullying arises; there may also be concrete downsides of e-learning, that might have negative effects on PKM. This is certainly a limitation of this study, as the limited scope does not allow including this area. However, this is a great lead for another potential recommendation for future studies, which should also include a proper risk assessment of how the suggested e-learning practice transfer consideration may be influenced by potential problems.

In terms of key research-limitations, especially for the data-collection, it is stated above already how bias was controlled during the research issues and what where the key limitations of the Delphi approach that have been overcome successfully. With regards to potential other generic limitations it is also emphasised that literature focuses on major topics of current and past literature. Future issues that have not been successfully adopted by e-learning like the internet of things could be reviewed in addition in another updated publication a few years after the completion of this study to ensure that findings remain up-to-date with regards to the fast evolving and adapting requirements and solutions of PKM and e-learning. In that sense, it is anticipated by the previously referenced studies like Zhao et al. (2015) that also PKM and knowledge brokering in virtual projects will remain a highly evolving, complex and challenging process due to the natural temporary characteristics of projects. However, as taken up by the approach of the study and also suggested by relevant literature successful knowledge brokering in virtual project teams can only be achieved with multi-dimensional and multi-disciplinary approaches (Bakker et al. 2011), supported by the combined findings from this PhD thesis.

Methodologically the reliance on experts could also be considered as a limitation. However it is referred to the thorough Delphi research execution as described in the previous Chapters that has mitigated this limitation risk. As described, the best practices applied for the expert selection process ensured that effectively also actual stakeholders where included in the form of business experts to safeguard that the applied expertise is in touch with the reality of employees working in virtual project teams.

6.9 Applied Terminology

An additional point of discussion relates to the usage of terminology in sources, like perspectives for knowledge society differ to some degree and should potentially be adapted. As an example, the theory of the network society definitely brings an enrichment-potential to this, as it states that intra- and inter-company networks are existent, where businesses have already transformed from capability (for example HR or Finance) to project orientation (Stalder 2006). This theory has already reviewed that resources are cooperating on a precise project, after which they are dispersed and reallocated to their usual tasks. The capability by any resource to participate in this value added set-up is defined by the degree to which this node or individual is able to contribute to the network objectives, which necessitates highly flexible and experienced staff and managers (Castells 2006). Likewise it could be argued that knowledge brokering is a term that has been

repackaged to describe something KM has continued to do therefore reducing it to a trendy buzzword in literature that will not sustain. However, the author of this thesis as well as those of the related referenced publications highlight the potentials of the special focus on improving the knowledge transfer or brokering activity that is also in focus of this study in order to learn from experiences. While certain literature claims that PKM slowly improves with the overall maturation of PM practices in a company, there is still a need to effectively enhance the knowledge brokering, especially in the virtual context. Given the required urgency and persisting gap of what is done versus what should be done in practice of this critical topic, this relates also to the discussed requirement of enhanced understanding of the project actuality (Williams 2008).

6.10 Discussion of Qualitative Main Results and their Affirmation of the Quantitative Results

One important consideration as far as the discussion of the results are concerned relates to the final section of the Delphi questionnaire where qualitative comments were retrieved, which subsequently confirmed the findings of the quantitative section. Here for example themes like avoidance of complexity (1. Ease of Use/Usefulness), buy-in (2. Required Management Buy-In/Incentives) and promotion of team-communication (3. Team-Cooperation) were emphasised as even much more important than the also highly relevant technology (9. Information/Data Management and Tools and 10. State-Of-The-Art Information Systems). This is again also valid for the people focus over the technology focus as interaction, governance, incentives, and corporate sharing culture outweigh comments on technological importance by far. As overall challenges are also confirmed by the comments pertaining to the difficulties of achieving efficient and effective knowledge brokering for virtual project teams via IT, this supports the general motivation of this study. Again and in line with the quantitative results, it is also confirmed that state-of-the art technology remains important especially in virtual teams and in that sense the use of technology is key to support project knowledge management in virtual teams.

6.11 Chapter Summary

The final section has summarised the extent to which the initially described objectives of this thesis have been achieved. Besides that, it also specifies how this study has advanced the understanding of knowledge brokering in virtual teams and recommends future directions for the research. Given the fact that established internet and IS now theoretically

enable the required connectivity required for PKM in virtual teams, this study has supported the strive towards putting more science behind the observed art of KM and to support project managers and organisations in improving related KM initiatives. Having personally learned a lot from the research project the author outlines how his enhanced ability to conceptualise, design and implement projects, while making informed judgements via innovative ways to tackle problems has enabled the success of this thesis. As the research ideas were both deeply and broadly presented, the author also encourages researchers to use the Delphi-method and continue research in the area to support the continuous improvement of it. Referring to the innovative approach of this study, it is noted that especially in case companies concentrate on innovation as their main competitive advantage, effective (P)KM can succeed with high achievements (Fletcher and Polychronakis 2007).

The target of pragmatic research is results that are plausibly and honestly produced for the particular case being examined. This target was accordingly achieved, as besides creation and interpretation of new knowledge, this thesis extends the discipline via an identification of most relevant and suitably applied best practices from well-advanced e-learning management. The improvement-solution is achieved via the justified application of the methodology of a Delphi study in which experts, from the selected related fields such as KM, PM, virtual teamwork and e-learning are included as panellists. These best practices have the potential to enhance the effectiveness of virtual project knowledge management, as they successfully overcome similar constraints around virtual knowledge brokering within e-learning. Our contribution is achieved through extensive literature review that distils 25 potential e-learning practices. These practices are assessed in the Delphi study. This group communication process is commonly accepted and applied in order to collect information from experts of certain domains to gain consensus of opinions about a certain real-life problem (Hsu and Sandford 2007). In compliance with literature on the Delphi methodology, the process included structured interrogations of well-chosen experts from related areas (PM, KM, e-learning and virtual team management) to achieve consensus on priorities of e-learning practices.

So that lessons learnt are transferred between transient virtual project teams, our analysis suggests that companies should focus on transferring selected e-learning best practices that may have the strongest improvement impact. Ranked with highest importance were *Ease of Use/Usefulness*, *Required Management Buy-In/Incentives*, and *Team-Cooperation*.

Likewise, the Delphi experts also mostly agreed about those best practices of e-learning that are easily transferable: ranked with highest feasibility is, besides *Ease of Use/Usefulness* and *Team-Cooperation*, the easy *Procurement of* (suitable) *IT Tools*. In line with knowledge management theory, our findings support the claim that besides investments in information systems, companies will only succeed in leveraging the learning gained across virtual projects if they focus on the strategic management of related cultural, managerial and organisational elements of project knowledge management and brokering (Alavi and Leidner 1999b).

7 Chapter Seven: Summary

Knowledge plays a fundamental role in facilitating the end goals of a project team. The sharing of this knowledge however, particularly tacit knowledge, can be difficult to institutionalise and share beyond the lifespan of a single project instance (Bakker et al. 2011). Whilst this may be challenging in a conventional project setting, it is made all the more difficult by the characteristics of virtual projects and geographically dispersed project team members. As the literature review has indicated, knowledge dissemination and transfer in this context has thus far been proven to be inadequate (Williams 2008), particularly with regard to the diffusion of best practice from project reviews. The formulisation of other disciplines, particularly those underpinned by information systems, provides an illustration as to how knowledge can be captured. More importantly within the context of this study, how the incorporation of e-learning practices can an effective means through which to facilitate this. ERP and data warehousing systems provide examples of the way in which knowledge sharing within the context of organisational decision-making can be improved through the integration of e-learning practices.

The field of e-learning shows potential best practices that benefit virtual PKM and knowledge brokering. As a result, the potentials of merging features of e-learning with features of KM and PM has been chosen as the area to pursue as far as this study is concerned. Knowledge is accepted as a key asset for competitiveness, interest in KM is increasing in most organisations and organisations are developing more project-oriented business models without the expertise to manage related project-knowledge, so a joint approach in terms of PKM is beneficial (Ajmal et al. 2010). The rationale for extending PM and KM research across the disciplinary divide and into the sphere of e-learning centres on the challenges faced and overcome by e-learning researchers and specialists. The challenge of facilitating learning and knowledge dissemination is at the very core of the e-learning discipline and it is these very factors that the literature highlights as core weaknesses of organisations that employ virtual project teams.

A review of features of the fields of KM, PM, knowledge brokering and e-learning, defined the 25 described e-learning practices. These have in turn been selected to be reviewed further in this research, as they form a link between PM, KM and virtual project-teams and may potentially improve these. The findings from the research suggest that organisations should focus on selected high ranked items regarding both importance and

feasibility. As claimed within the research, there is no single deliverable that enhances lessons learnt and knowledge exchange in virtual project set-ups. These 25 different but inter-linked aspects from e-learning cover a wide scope of enabling current practices for potentially overcoming PKM limitations, including management support, routines, culture and incentives. Organisations should focus on the top and outstandingly ranked best practices (*Ease of Use/Usefulness* and *Team Cooperation* in regards to both importance and feasibility*; Required Management Buy-In/Incentives* in terms of importance and *Procurement of IT Tools* in terms of feasibility) as these resulted from the Delphi study as most critical success factors for overcoming the stated issues in virtual PKM. The study accordingly recommends that technical aspects should be secondary considerations with the emphasis upon key e-learning best practices. Each of these practices consists of humanistic issues which must be addressed if knowledge brokering is to be facilitated appropriately. Issues such as culture, motivation and employee attitudes are the keystone in a technologically driven process such as the one advocated within this thesis.

Limitations and contributions are elements of the contained chapters. In order to allow the reader a better overview and understanding of each of the 25 items, a summary table with the key findings from each aspect is included in the appendix (II). This explanatory glossary also served the experts during the response of the described Delphi study.

On this basis, the research methodology chapter provided the reader with an explanation of the research design by means of which the author addressed the overall aims of the study. The chapter outlined the paradigmatic research assumptions, which underpin the investigation, as well as outline the method of inquiry and the Delphi study at the heart of the research process.

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Appendix I: Definition of Terms

Project: The British Standard Institute (2002) states: "[A project is] a unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources".

Project Management: Turner (1999) defines: "[The management of projects as] an endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives".

Virtual Project-Teams: In contrast to traditional teams which meet physically, virtual project-teams solely rely on communication via IS-tools. Again, as with other topics, an elaborative description is provided in the related literature review chapter ("Virtual Project-Teams").

Data: Data is referred to as isolated and not yet interpreted facts or symbols, that are not linked with other data or do not have a meaning in itself (Meyer 2009).

Information: Information is more sophisticated than data and defined as data that is taken into a meaningful framework, in distinction to knowledge that is referred to as information already legitimated and thought to be accurate (Vance 1997). Arguably, information will become knowledge once being processed by the brain of a person in order to provide answers to questions (Alavi and Leidner 1999a). However, while containing some meaning, for individuals who fail to understand it, the information remains data (Meyer 2009). Some debate exists along dimensions such as context or usefulness, as to a hierarchy from data to information to knowledge or even inverse as knowledge should occur before information can be expressed and data measured to produce information (Tuomi 1999).

Knowledge: It is important to provide a clear distinction between data, information and knowledge, as especially the latter is the most valuable resource in project KM. Knowledge is an abstract and broad term that has coined epistemological discussions in Philosophy since hundreds of years (Alavi and Leidner 2001). In certain literature, knowledge is referred to as information that is made actionable for a value-adding benefit by applied rules or heuristics (Alavi and Leidner 1999a). Knowledge is also seen as subjective and personalised information that is associated with an idea, observation, fact, procedure or judgement (Alavi

and Leidner 1999a). In that view, Huber (1991) describes knowledge as an individual and justified believe which enhances capability of a person to conduct effective action, referring to one or both parts of intellectual activities or physical competencies. Knowledge is also seen as a state of knowing, which is the condition of understanding gained via studies and experiences being the range or sum of items internalised via learning, perception or discovery (Schubert et al. 1998). As a following step in the process, knowledge should transfer to behaviour, since only an informed action or decision brings value to the conversion from data to information and knowledge (Infield 1997). In relation to its value, knowledge is an immaterial resource that enhances organisational skills by its transfer being applicable to multiple assignments without being lost or less applicable at its origin (Gasik 2011). Overall, Krogh and Kleine (1998) as well as Gourlay (2000) summarise the debate around complex definitions of knowledge in a growingly contradictory literature base, by rightly highlighting that this will not enhance the situation and therefore focus should be not on a universally valid definition but on structuring arising theories according to their research-assumptions (Dominant epistemologies: cognitivist, autopoietic and connectionist) and, in line with this thesis, to focus on practical improvements of its management.

Forms of Knowledge (Nonaka 2007 + Siemieniuch and Sinclair 2004)**:**

- ***Tacit:*** Personal, context-sensitive, internalised, undocumented, dynamic it is embedded and related to human experience, behaviour, feelings and perceptions; requiring practice and skills it evolves via human interaction and its articulation is often challenging.
- ***Explicit:*** Public, structured, conscious and externalised with a fixed context that is capture-able and sharable via ICT.
- Technological
- Organisational
- Network

Knowledge Management: There are in general two schools observed for the holistic and disciplined KM, being either life cycle or process-driven. In general, the management of knowledge resources is aimed at facilitating accessibility and reusability, updatability and archive-ability of knowledge (O'Leary 1998). KM is considered as a process of multiple activities. Influenced by the sociology of knowledge and the view of companies as social collectives or knowledge systems, literature presents smaller differences in term of process-step definitions, but rather in rapport of naming and numbers and not the underlying

methodologies (Alavi and Leidner 2001). Four basic but essential steps simplified and improved by KM that can further be subdivided and are embedded in individuals, groups and structures are generally (Grant 1996):

- **Creation:** Development of new or replacement of existing content*.
- **Storage and retrieval:** Support of storing and reapplying workable solutions in form of individual or collective organisational memory, split in semantic and episodic aspects to avoid loss of knowledge.
- **Transfer:** Between individuals and groups or from individuals to explicit sources, to groups and organisations influenced by motivational dispositions, perceived values, absorptive capacity of involved parties and adequacy of formal, informal, personal and impersonal channels in dependence of the knowledge type to be transferred.
- **Application:** The real source of competitive advantage included three primary mechanisms such as directives, organisational routines, and self-contained task teams.

*As referenced also by other sources in the main body of this thesis, also according to Takeuchi and Nonaka (2004) there are four modes of knowledge creation and conversion that are vastly interdependent and important to understand for enhancements of KM:

- **Socialisation**: Creation and sharing of new tacit knowledge by social interaction and shared experience. The definition of new refers to the recipient's point of view.

- **Externalisation**: Using dialogue and reflection in order to articulate tacit knowledge via best practices and lessons learnt for gaining new explicit knowledge.

- **Combination**: Application and systemisation of existing explicit knowledge as well as information for creating new explicit knowledge.

- **Internalisation**: Acquisition and learning of new practical tacit knowledge from explicit knowledge.

In essence, KM primarily aims by a mix of organisational, process, culture and technology means, at the identification and leverage of a company's collective knowledge in order to achieve the objective of supporting companies to survive in competition (Choo 1996).

Knowledge Management Mapping: KMM helps to identify where knowledge resides and what is essential and to identify gaps in the organisation that may require training or recruitment as a solution (Ruminzen 2002).

Knowledge Brokering: Aims at enabling or supporting the knowledge exchange and usage. In this context the management has to understand that there are three relevant infrastructures within which the knowledge process takes place (Culture, Organisation and Technology) and accordingly Snider and Nissen (2003) define three knowledge brokering activities:

- **Knowledge Managers:** Acquisition of knowledge by experience - as everyone in the team could create relevant information it is important to know who has and who needs know-how and how to hand-over the knowledge between these entities.
- **Knowledge Agents:** Development of knowledge caused by actual problem - solutions are created by specialised experts who hand it on to others.
- **Capacity Builders:** Creation of knowledge by social exchange - associates of certain environment share relevant information in order to support social activity.

Database: An organised and centralised data-collection for efficient supply of various applications and avoidance of redundancies (McFadden et al. 2000).

Expert Systems: To capture knowledge this AI means consists of knowledge-intensive applications that feature human expertise in limited knowledge domains (Laudon and Laudon 2000).

Semantic Memory: Knowledge about the general world (ideas or facts) that is accumulated by individuals over the time and linked with culture and experience (Jordan and Jones 1997).

Episodic Memory: Explicit knowledge of events related to autobiography (wh-questions) developed via personal experiences at specific places and time (Alavi and Leidner 2001).

Learning: When knowledge is created and captured, ideally it is integrated into processes and learning takes place: Learning is referred to as the process via which learning individuals achieve their learning-goals by carrying out learning-activities and participating in interactions to reflect their understanding (Sun et al. 2004). Consequently, learning deals with the way people acquire new skills and knowledge and the method in which existing skills and knowledge are modified in order to solve problems (Shuell 1968). Important for this thesis, Barnard (2006) rightly emphasises that learning refers to the active role played by the learner to process information for use and not an abstract transfer of knowledge from one source to another. In connection with this statement, Shuell and Lee (1967) discuss that learning includes a change in the ability to do something that is the outcome of a practice or experience and that remains. This learning process is conducted by various learning styles

such as visual (e.g. demonstrating), auditory (e.g. discussing) or tactile resp. kinaesthetic (e.g. interactive conducting) (Sun et al. 2003).

Learning Theory: Learning theory supports the understanding of knowledge-creation and transfer and the connected social interactions, which works as a link to the researched best practices application from e-learning (Meyer 2009). It deals with the concrete learning-process and what happens inside the learning individual. Three major directions are coexisting and complementing:

- **Behaviourism**: Concentrates on learning via stimuli as well as conditioning and recognises learning as an observable shift in the behaviour of an individual. Accordingly positive and negative reinforcement is used to build up experience and knowledge (Gray 1977).
- **Cognitive theory**: Describes the shift of an individual's understanding that concludes from learning. This is supposed to be a result of a constructive but also active and goal-focused process that relies on mental activities as the cognitive structures process and store the information. In line with this the teacher provides organised information that is received, used, reviewed and embedded in the individual (Good and Brophy 1990).
- **Constructivist approaches**: Focus on collaborative learning during which the individual learner actively creates new thinking based on his already existing skills and knowledge. The target is that the teacher only facilitates the problem tackling and critical review in order to prepare for normal complexities in reality (Fosnot 1996).

Organisational Learning: In link with general learning it is concerned with how change is achieved via developing capabilities tied with production and reproduction of new organisational routines (Feldman and Pentland 2003). OL occurs only in two manners. Either via learning from existing staff or by hiring new staff, but in general what is learned by an individual staff-member is highly dependent on what is already known by other staff or what type of information is available in the environment of the company (Feldman and Pentland 2003). As no comprehensive literature review for organisational learning was feasible for the scope of this thesis, at this stage it is briefly noted that the main debate in literature revolves around locations and nature, territorial debates and approaches on investigation of organisational learning (Easterby-Smith et al. 2000).

Learning Methods: Various learning methods can be distinguished, as all of them deal with different ways of delivering and providing learning material by the teachers:

- Traditional learning deals with the teacher-oriented face-to-face learning that provides teaching to the individuals at one distinct time and place (Shuell and Lee 1967).
- E-learning contrarily applies ICTs for transforming the traditional learning process into a ubiquitous one as it provides both asynchronous and synchronous electronic means (Meredith and Newton 2003). One aspect that is noteworthy in this concept is the fact that learning individuals take ownership of their learning, which is one key element of the in the literature review discussed current practices.
- Blended learning combines both of the above described methods in order to optimize the learning results (Valiathan 2002).
- Mobile learning uses the progressive usage of portable electronic devices in order to further enhance e-learning methods (Wagner 2007).
- Personalised learning deals with a facilitation trough customisation of individuals' learning courses (Graven and Mac Kinnon 2005).

E-Learning: Distance education that uses the internet and/or other information technologies (ICTs) to transform and support teaching and learning processes ubiquitously (Watanabe 2005). Furthermore, it facilitates learning by various electronic means and results in connectivity between individuals and information and creates opportunity for social learning approaches, which links with the potentials for applying its best practices for virtual project teams and related KM (Meredith and Newton 2003). Consequently, e-learning projects are the establishment of links between content and learners through the use of combined communication channels and technologies (Collis 1996). This is also a good example of the referenced "Leavitt Diamond". From another summarising perspective e-learning can also be defined as an innovative method for providing learner-centric, well-designed, collaborative and facilitated learning environments anytime to anyone at any place by employing features and resources of various digital tools alongside with other methods of learning materials suited for open and distributed learning (Khan 2010). Although not synonymous, a close connection exists between distance and distributed learning, which are defined both as instructional models enabling learners, teachers and content to be located in different decentralised places in order to enable learning without restrictions of time or place (Saltzberg and Polyson 1995).

Organisational Culture: Builds the foundation of the holistic, socially constructed and traditionally determined manifestation consisting of shared symbols, norms, values and practices of employees in regards to appropriate behaviour (Sherry and Wilson 1997).

Appendix I: Definition of Terms

Influencing decisions and responsiveness to changes in the environment, four core cultures are distinguished although often mixtures are experienced (Ajmal and Koskinen 2008):

- **Collaboration core:** Targets close connections, unity and synergies to people-driven and informal practicality and tangible realities.
- **Cultivation core**: Meaningfulness and enrichment are targeted via beliefs, inspiration open-mindedness.
- **Control core**: Aims at safeguarding accuracy, certainty and predictability.
- **Competence core**: With unique offerings it aims for distinction, achievements and best-in-class solutions.

Appendix II: Explanatory Glossary

Answer of e-learning / State of the art status: Established practices and current topics for knowledge brokering of global project-teams: *"In order to become successful by fully grasping potentials from established e-learning practices/current e-learning topics; effective Project Knowledge Management and knowledge brokering for global virtual project-teams, has to - in the way of e-learning apply this item, and …"*

1. IS Set-up:

1.1. State-Of-The-Art Information Systems: Understand necessity of successful state-of - art IS: Provide ubiquitous/personalised environments to support knowledge-review + new content development in various forms (text to multi-media). Provide solutions for reducing costs + achieving targets/success deriving from relevant information, system quality, usage, output + input- /process-orientation in combination with feedback/suitable measurement tools. Release full potential by considering technology, environment, resources + digital divide.

1.2. Distinction of IT: Leading to Sustainability/ Competitive Advantage: Sustain competitive advantage + support adaptability of company, by: Establishing proper knowledge brokering set-up for distribution of information, increasing intellectual capital/improving social connections + assessment/utilisation of knowledge from global project teams. Has to be applied to precise projects/not concentrate solely on IT but related management, organisation + development of skills. Supports requirement that company has involved employees knowing how to apply correctly information received. Higher intensification of OL improves distinctive quality of IT infrastructure, IT business coherence + relationship set-ups. Value competitiveness + dynamic competencies with absorptive capability improve knowledge assessment and utilisation: In connection with good learning intensity enable companies to adapt effectively in competitive environments. Knowledge brokering efforts to focus on training management skills as it decreases discrepancies / conflicts + supports accomplishing sustained competitive advantage by supporting implementation of multi-faceted strategies like cost-leadership and differentiation. Especially for tacit invisible benefits/attributes, security aspects + establishing of close connections as diffusion of IT inclined which can be compensated by sustainable e-learning.

1.3. Governance / Learning Objects: Apply comprehensive formal/informal governance

incl. definition, development + usage of standards for tools/structures that stimulate knowledge sharing- + knowledge creation processes. Strategy has to combine corporate-, IT and knowledge governance on macro/micro-level to support employees to share, integrate, create + use existing knowledge. Have to understood that informal governance mechanisms more useful to develop solutions for connecting complexities of "knowledge islands". IT duopoly set ideal environments for knowledge brokering principles + investments, as it allows common decision making incl. business + IT while maintaining focus on precise issues. Effective governance ensures performance: (Cost) effective use e-learning + asset utilisation, revenue growth & business flexibility. Eight critical governance factors of e-learning to be transferred: Transparency, active goal-oriented design, infrequent design, education about IT governance, simplicity, exception-handling process, governance designed at multiple organizational levels + aligned incentives. As e-learning objects, ensure that knowledge resources + entities for contents are interoperable, reusable + accessible for comprehensive solutions with optimal productivity/quality while reducing needed resources.

1.4 Information/ Data Management and Tools: Understand/utilize potentials of ERP + Data Warehousing tools for supporting objectives like processes standardisation + central hierarchical controlling that increase discipline/uniformity. A thorough integration (e.g. ERP or OLAP with e-learning) + further developments (e.g. E-learning Data Warehouse) of aspects from both areas improved e-learning successes. Best practices like diverse regional versions based on 1 system catering for tailor-made local conducts by understanding that creation of interrelated processes + 1 centralised database is not simply a technological challenge. Both system- + company-processes are customised/harmonised + requires technical/process change skills + understanding of environment + managerial/project-related capability (Setting/matching realistic objectives by ensuring optimal resources, communication & (corrective) actions). Apply best practices from Data Warehousing + e-learning to conduct thorough supervision + assessment of learner's performance by linkage of data warehouse/ OLAP technologies with PKM. Integration of data mining with e-learning reveals also high potentials (like regular data warehousing) as mining software supports identification of valuable pieces. Besides Enterprise Intelligence Portals (dealing with unstructured data like documents, emails or photos) e-learning theory promotes E-learning Data Warehouses (EDW) consisting of gathered information from various dispersed + unrelated E-learning Information Sources (EIS): Supports consultation + analysis. Resemblance of data warehousing/e-learning practice around subject organisation,

integration, archiving of historic data + data transformation (incl. filtering, analysing etc.) is matching with PKM. Practices like data staging, metadata, loading, storing + assessment in multidimensional databases, enables tailor-made visualisation of content + also successfully applied: potentials for virtual knowledge brokering. Also, end-user types of data warehouses relate to e-learning users, like ”tourists”, “explorers” or “farmers”, having different preferences that applications, policies + processes need to respond to in order to be used effectively.

1.5. Procurement of IT Tools: Adapt best practices from general procurement strategies of IT tools + early adapting companies. E-learning developing collaborative + creativity-enabling open source solutions + comprehensive software stacks developed + supported by single capable suppliers.

1.6. Outsourcing: Consider strategic outsourcing of intellectually-based services by cooperating with experienced strategic partner with proven products to accelerate progress + improve outcome quality in a more economical way together with less operational risk (vs. in-house) and to increase cross-divisional, integrated, updated, innovative and value-added features. In the way e-learning learnt from e-business, internalize that outsourcing includes holistic approaches beyond brokering of core-processes + that focus during outsourcing should be on service instead of technology + outcome/strategy instead of activity/tactics. Strategic outsourcing ideal solution providing focus, simplicity, limited overhead, innovation, flexibility + quality for PM, technology, design, infrastructure, administration, as well as knowledge + business models.

2. IS-related Trends and Potentials:

2.1. EP / Web 2.0: (E-learning 2.0:) Utilize potentials of applications (e.g. blogs, social networks, podcasts, wikis, RSS feeds + most recently data mash-ups), that advance project team members performances by providing collective intelligence through active participation from using individual via 4 key pillars (sharing, participating, cooperating + communicating) in multimedia formats beyond text exchange. Online network should result in boosted knowledge aptitudes of virtual project teams that establish interconnections. By putting emphasis on the knowledgeable individuals, this “social evolution” with its “knowledge-seeking-individual”-centric model should focus on personal knowledge environment which uses social software to encourage employees to create + share content + interact not only with immediate virtual project-members but with all worldwide employees from whom

learnings can be retrieved. Communities of practice (shared interest domains) should enable members to learn together by interacting + developing shared resource-repertoire enabled by active ICT-based collaboration + communication processes (Ironic: e-learning best practices bring back state of learning prior to modern schooling, when learning was supported by community instead of removing students from it into artificial environments where content is learned unconnected from context). PKM should internalise related shift from delivering pre-defined content towards connected tools for creating usable knowledge nodes with content authoring activities from users via single corporate application system becoming a personal knowledge centre (incl. re-used/re-mixed content-collections of interoperating application environments with syndicated contents + personal spaces for staff to create/showcase own e-portfolios of potential knowledge for others). Seek for ubiquitous computing with workflow learning integrating deeply corporate web-based 2.0 applications into combined process-solutions for real-time task support by contextual collaboration with people + systems catering for design + modification achieved by modelling/simulation.

2.2. Cloud: Cloud e-learning: Apply all benefits of cloud architecture (services, platform + infrastructure) by letting problems like hard-disk loss, crash recovery or down-times disappear. Cloud-integration provides proven feasibility, improvements of efficiencies + management resulting from simplified collaboration + group creation. Increased productivity of individuals, analytics + application improvement via virtualised IS resources + data on-demand accessible, instantly accessible every time + everywhere with different devices, make these solutions easy to use, scalable, affordable + provides high levels of data privacy, availability + security. Further potential from integration with other areas like outsourcing + mobile learning + the availability of desired functionalities from e-learning like e-mail accounts, forums, individual web pages or chats. Interactive cloud computing based solutions build virtual + personalised learning environments for supporting content creation/management, idea explorations + integration of different pedagogical approaches to learning/teaching: provide enhanced experience compared with traditional LMS by well-known environments where goals are more easily achieved by flexible architecture + mash-ups of heterogeneous services that support different activities (production, distribution, reflection, and discussion of learnings that can be triggered even event-driven).

2.3. Consumerisation: Embrace reality of employees bringing own IT solutions into work-processes: Benefit from existing best practices for solutions for learners' demand for simple/chunked answers in any format linked to content rather than courses. Besides again

connecting it with other areas like mobile-learning, existing knowledge processes have to be adapted resulting in "smart workers" with improved productivity in terms of finding/applying content + creating/sharing information on social web + joining/building communities. PKM of virtual project-teams can benefit by re-working learning + development strategies + embracing new c*onsumerisation of (e-)learning* bringing innovation opportunities by allowing personal, easy, effective and satisfactory state-of-the-art solutions + recognising that this trend is inevitable, companies' frontiers are blurry, security has to be managed + (cultural) differences have to be proactively addressed.

2.4. Custom Software Development / Customisation: Develop/use highly customisable + flexible open applications useable as modular solutions to avoid that IS changes natural patterns of work. PKM solutions to be accordingly conceptualised with internal structure serving a customisable shell. Due to complexities of global virtual project-works, again governance should be ensured to ensure user satisfactions in pedagogically sound way, application of proven solutions for effective re-use + customisation. Custom software development will become successful if specialists from all areas included + thorough process is followed. Success criteria from e-learning: manageable project size, accurate requirements definition, executive sponsorship, simplicity, communication, feedback, courage + whole-team approach facilitated by structured meetings.

2.5. Virtual Worlds / Edutainment: Increase multi-user interaction/stimulation by promoting virtual worlds + edutainment: In link with Web 2.0: Support individuals' learning development + thinking by also creating social features. Multi-user online computer gaming environments (like mature Second Life unstructured 3-D spaces) to provide platforms for virtual project-teams by the immersive, technical + social potential. Particular potential: advanced e-learning solutions apply Virtual Reality + multimedia connected with communication tools for enhancing collaboration among learners. Potential for global projects emphasized as virtual worlds provide shared quasi-realistic visual spaces for individuals to meet + interact by hearing + seeing another via avatars, creating a sound environment for group presence + interactions. Also "edutainment" (emerging from game authoring technologies) further supports knowledge exchange + build-up of social groups by blend of knowledge-exchange + entertainment for providing educational experience. Lesson learnt from e-learning: important for success is understanding that children learn from gaming skills for strengthening understanding to take charge of their learning + have to

apply meaning to words by relating it to experience which is opposing to common teaching.

3. IS-related Risks:

3.1. Big Data: Embrace potentials of another highly inter-connected discipline for providing performance support with solutions + instructors preventing filter failure + information overload. Big data analytics provide interactive + tailor-made learnings as result of better tracked + monitored user-experience according to individual skills/progress. Core challenge to be addressed by new fast + scalable integrated PKM solutions as by e-learning: Users generating big data in various channels + a lot of unstructured data emerges = very complex to manage, store + process. Understanding what + how knowledge is brokered in virtual project-teams extremely valuable for better-informed decisions, identification of mistakes + scenario-forecasting + taking preventive action, as individual's performances, failures + strengths could be predicted for future projects + accordingly trends + upfront situations improvements possible. PKM to embrace this game-changing innovation by revolutionising + optimising solutions + its results as it supports development + execution of personalised + adaptive programs + accordingly questions past knowledge-brokering design principles/beliefs for processes, systems + design. Using employee's digital footprints for tracking will provide immense opportunities for improving effectiveness, adaptability + extending possibilities of present tracking standards.

3.2. Escalations of Implementations: Apply clear strategy + structured approach + understand/manage change + marketing incl. observance of environment + all stakeholders for successful project-implementations + avoidance of escalations (e.g. due to underestimated time-lines or budgets). Thorough upfront analysis targeting clear understanding of actual problems/causes by asking precise questions + developing solution + implementation plan based on findings will support implementation. Successes (e.g. long-term cost-reductions, improvement of individual/company performance, maintenance of core-competences + adaptability to markets/competitors) may result when global virtual PKM strategy built on previously defined overall learning and KM strategy + considers benefits/limitations of technology + aim beyond content + delivery at comprehensive approach covering wide-range topics such as motivation, culture, productivity-enhancements + skill development. Strategy should be result of identification/cataloguing of existing learning contents, gap-analysis, assessment of sizes, resources + costs, determination of existing learning levels + suitability of current methods. To continuously improve + sustain

long-term successes + avoid negative project status: Avoidance of information-asymmetry + clearly defined communication-plans, -deliverables and –principles + focus on considerations of essential pedagogic aspects + avoidance of obstacles for learners + constant monitoring of successes/deviations. Structured approach ideally consists of systematic end-to-end process covering planning, design, development, evaluation + implementation. 8-dimensional frame-work for holistic approaches for e-learning projects supports implementations: Institutional, Management, Technological, Pedagogical, Ethical, Interface Design, Resource Support + Evaluation.

4. Management theory, models, and management of social aspects

4.1. Knowledge Marketing: Not only focus on knowledge communities, chains or supplies but consider problem in analogy of a knowledge market (incl. transparency, liquidity + knowledge marketing processes) for avoidance of resource-wasting: Redundancies, emerging business-related problems + poor decision making. Identify stagnation + causes as soon as possible + solve it with effective measures. Use planning centre best practice aiming at standardisation + coordination. Necessary to understand how internal knowledge markets can be impacted + that management can substantially increase value perception + reduce the transaction-costs for searching. For achieving ultimate goals of effective knowledge markets, companies require appropriate processes, measurements + underlying infrastructure that continuously improve on both corporate as well as personal level.

4.2. Ownership of Learner: Enable users to take-over ownership + have immediate control over knowledge gaining via adoption of multidimensional means of multiplicative communication. Go beyond customising options for different learning styles or preferences to endowing knowledge seeking individual with direct control to acquire input at required pace. To allow employee to effectively take ownership + control, solution has to enable rapid absorbing + authoring of information via various sources + media types simultaneously. Has to cater for preference on-demand + widely accessible input as well as constant communication with close + global peers expecting immediate responses.

4.3. Interactivity / Integration: Provide fully integrated + interactive solutions that develop frame-works embracing trends like cloud + web 2.0 + promote interactivity between individuals with self-motivational tools + communities. Building on naturally multi-device blended e-learning, support interactivity + communication not only between instructors + learning individuals but also between learners themselves. PKM to be improved besides

collecting facts + making meaning: By building connections between knowledgeable communities + social community reproductions + by allowing participation + feedback from users while being applicable to real business problems.

4.4. Ease of Use/Usefulness: Focus on ease of use + usefulness, by providing users confidence in solution + increase intent of actual usage by quality of information systems + related sufficiency for tasks aimed to be performed. To be assured by structured + standardised data (formats), metadata and managed content, referring to information, communication + learning material incl. areas for interaction + exchange. E-learning best practices accordingly rivet on formative design of platforms, training contents + training agents.

4.5. Team-Cooperation: Understand + leverage importance of team-cooperation, as modern e-learning solutions widely recognised as support tools for cooperation within organisations + teams. For virtual project-teams that rarely meet, state-of-the art e-learning solutions like e-learning 2.0 or virtual worlds for example with digital human avatars to increase team cooperation + in turn knowledge brokering accordingly.

4.6. Entities and roles within the execution: E-learning Manager = Knowledge Broker: Manage to facilitate knowledge sharing + exchange by easing learning processes with guidance, mediating + teaching how to learn. Become a guide or catalyst, not necessarily an expert. Functions heavily rely on informal network + also skills such as training experience, ability to observe + persuade + technical/contextual knowledge.

4.7. Entities and roles within the execution: Learning Individual = User of Previous Projects' Knowledge: Focus on role of user to become more influential + important. Management has to, like with learning individuals deprived of space/time to attend conventional face-to-face sessions, increase motivation + self-discipline amongst users of previous projects' knowledge by ensuring clear targets, time management + self-expression. Perceived demand for training + particular knowledge + open-mindedness towards innovations + technology has to be guaranteed. Knowledge brokering efforts incl. necessary change + project management to focus on abilities of users + acceptability, especially with regards to resistance to change + perception of value adding as role of learning individual has high relevance for success of e-learning + consequently knowledge brokering.

4.8. Reflection and Progression: Succeed with evolving conversion into reflective process progressions to cope with increased demand for alternatives of traditional learning offerings

+ availability of learning resources. Accordingly innovative knowledge brokering to apply e-learning lessons learnt to better grasp the potentials of collaboration + manage successfully increase of dispersed project members in conjunction with life-long learners + individuals that demand knowledge in workplace. Reflection and progression may also solve increased demand for skills + knowledge from employees + employers while reducing required costs + ensuring to sustainably remain part of competitive knowledge society + knowledge based economy.

4.9. New Trainings: Integration of Pedagogy and Technology: Adapt + redesign conventional PKM practices of both employees and managers that have to be trained properly in order to be able to assume their new facilitating role in virtual project environments effectively. These enhancements should cover development of ICT skills to improve usage in terms of administrating, (social) interacting, motivating + time needed after gaining comfort + confidence around ICTs. Technology use to be focused by training to overcome general concerns regarding increased transmission of data via technology + personal concerns around changing/increasing work patterns, loss of personal face-to-face relationships or simply conservatism/opposing against change. Underlying pedagogy needs to be integrated, as in two-fold e-learning training (neither pure technology nor new pedagogy approaches themselves succeed).

4.10. Required Management Buy-In and Incentives: Ensure comprehensive buy-in from senior management to push for initial change, operational implementation + long-term sustainability of new approach by top-down adaption of related processes in organisation. Like knowledge brokering set-ups, e-learning employments are serious endeavours involving important aspects like necessary change of processes from areas of strategy, organisation, economy, culture + didactic that considers all effected stakeholders + can only be achieved by top-down management commitment: Holistic approach /support is another success factor. Utilisation of knowledge to be intensively encouraged by senior management incl. raise of a related corporate culture with thorough evaluation of utilisation/results. Besides extrinsic/intrinsic motivation + in link with the central leadership buy-in also appropriate incentive measures contribute to forming supportive behaviour/culture + contribute to success. A multi-faceted approach of KMS to incl. besides technology also important organisational and cultural aspects, like shift from traditional award of staff for individual performance/know-how towards incentivising for sharing and contributing.

4.11. Visualisation/Imagination: Increase usage of figurative language + symbols as strongest tools for conversion of tacit into explicit knowledge (Articulation). Following Japanese science, best practices from e-learning prove success with regards to the application of imagination-triggering models, analogies and metaphors. Visualisation permits access to accomplished knowledge from one individual to another + works as a conceptual bridge to enhance quality/speed of transfer. Focus on supporting cognitive process for creating/transferring knowledge with the power of visual formats to overcome challenges arising (e.g. information overload, identification of relevant information or heterogeneous cognitive backgrounds).

4.12. Incorporation of Society's Paradigm Shift for Knowledge Society: Effectively incorporate macro-economic paradigm shift towards information + knowledge society: strive to succeed not only adaption of society's paradigm shift away from traditional more into electronic + personalised training/knowledge needs; also support companies to remain part of competitive knowledge society + knowledge based economy. Go ideally even beyond this as not only working + learning but living + learning will eventually merge and provide solutions on how to use learning to create something in addition, referring also to communication.

Appendix III: Correspondences with Participants

Delphi Study: Round I - Project Knowledge Management and Brokering in Virtual Team-Environments: Application of Best Practices from Modern e-Learning Management

Dear Mr./Mrs. …,

Thank you for the initial exchange and your interest to support the empirical research in the above mentioned field. Please follow this link for your participation in the first Delphi-round, which may be followed by one or two additional rounds over the next weeks: https://www.esurveycreator.com/s/delphi

This Delphi study is an essential part of my exploratory PhD study that reviews the problem that no or limited transfer of knowledge and lessons learnt between different projects occur; especially in virtual project teams. These deal with the problem that the team-members mostly never meet, which is a strong supportive aspect for knowledge management in traditional environments. The study targets an improvement of the related problematic knowledge brokering situation by identifying selected established practices and current topics from e-learning. This is because e-Learning also deals with distance and IS-supported knowledge exchange of individuals who often also never meet. The Delphi study method is chosen, as it is perfectly suited for this case of incomplete knowledge about the problem. Also it supports the goal to improve our understanding of the related opportunities and solutions from e-learning in order to develop recommendations and forecasts or expertise-based speculations. As e-learning shows advanced aspects as listed in the survey, you are kindly asked to assess the feasibility and importance for transferring these mentioned practices from e-learning to improve the project knowledge management and brokering in virtual team-environments. All e-learning practices are gathered via thorough literature review and prior expert consultations and briefly explained within the attached explanatory glossary for ensuring a similar level of understanding for all participating experts (You may want to print this sheet for reference during your Delphi-response and/or skip an explanation, if you are familiar with a topic to reduce participation-time). As mentioned, potentially one or two additional Delphi-rounds are targeted. These aim for consensus from you and other experts on priorities and feasibilities from identified e-learning practices and to develop solutions and recommendations on how to enhance knowledge brokering in virtual project teams.

PS: Please find attached also an information sheet for additional background-info, if

required. Moreover you will find attached a consent form. Please do not hesitate to contact me any time, in case you have questions or need support.

I would highly appreciate a response on the survey from you before Saturday, XYth of XYZ. Please also feel free to nominate additional experts.

Thank you for your valuable time! Best regards, Nils Finger

Appendix IV: Information Sheet, Consent Form, Ethical Approval

Full title of Project:

Project Knowledge Management and Brokering in Virtual Team-Environments: Application of Best Practices from Modern e-Learning Management

Name and Contact Address of Researcher:

Nils Finger, Benrather Str. 56, 40721 Hilden, Germany

N.Finger@edu.salford.ac.uk / +49 151 46 131391

I would like to invite you to take part in a research study, which is part of my PhD thesis, undertaken through the University of Salford. Before you decide to take part you need to understand why the research is being done and what it will involve for you. Please take time to read the following information carefully. Please ask questions if anything you read is not clear or you would like more information. Please take time to decide whether or not to take part.

What is the purpose of the study?

There is limited transfer of knowledge and lessons learnt between different projects within organisations, especially when project-teams are virtual. In general, this is because project-teams disband at the end of a project and their knowledge disperses with the team members. E-learning deals with knowledge exchange at a distance and between individuals who often never meet. Furthermore, e-learning theory shows that how learning content is used and distributed by learners is more important than how it is designed. Therefore, this project examines how knowledge transfer practices in e-learning can be used for knowledge management in organisations where project teams are commonly virtual and temporary.

The anticipated result is to reach consensus from experts on priorities of most important e-learning practices for improvement of knowledge management for virtual teams and determine what might be most feasibly transferred from identified e-learning effective practices. Ideally it will also develop a framework with aspects identified as most important that will enable improved knowledge brokering in virtual project environments. Overall it seeks to provide solutions and recommendations on how to enhance knowledge brokering in virtual project teams, by suggesting to apply selected practices from e-learning.

Contribution to business: Recommendations and solutions will enable companies to improve competitive advantage as they will become more efficient and ideally avoid re-development and loss of transferable knowledge from virtual project work.

Contribution to science: Enhancement of underdeveloped theory in this niche. Identify potential areas for future research. Also, promote re-usage of Delphi method and identify areas that require further research.

Why have I been invited?

You have been invited due to your high level of expertise in min. one of the four core fields relevant for the research: Project Management, Knowledge Management, Virtual Teamwork, Organisational/e-Learning. Besides you, seven other experts have been recruited to ensure two inputs per core field.

Do I have to take part?

It is up to you to decide. This information sheet will inform you about the study and its purposes to support your decision. By reverting with the filled in consent from and responding to the study we assume your agreement to the details. You are free to withdraw at any time, without giving a reason.

What will happen to me if I take part?

The form of research is a thoroughly chosen Delphi study that seeks consensus from experts for the object of research (More information and justification of this choice e.g.: http://www.wilderdom.com/delphi.html). You will be involved for the course of approximately three questionnaire-rounds. The entire research process may take a few weeks, whereas each round will only require you to fill out a provided questionnaire for approx. 15 minutes. This will be done electronically and there is no need for shipping or travelling.

Expenses and payments?

There are no expenses foreseen, that will require reimbursement.

What will I have to do?

You will be asked to fill in an online questionnaire, providing feedback on your opinion for the feasibility and importance of each e-learning practice. Also, there is a comment-field where you are encouraged to fill in free-text information. As the Delphi study is planned to

have two to three cycles, you are accordingly asked to fill in the questionnaire two to three times. After the first round, the questionnaires will be prefilled with the feedback from the other panellists including medians from all ratings, in order to present consensus to support in subsequent rounds.

What are the possible disadvantages and risks of taking part?

No risks; discomfort or inconveniences are foreseen for participants. The participation should only require a limited amount of your time. Your feedback may be quoted and consequently be associated with your expertise, but will be anonymous in presented findings, as outlined below. Kindly let me know if you do not want this to be done.

What are the possible benefits of taking part?

We cannot promise the study will help you but the information we get from the study will help to increase the understanding of the problematic situation of Project Knowledge Management and Brokering in Virtual Team-Environments and support improvements in practice.

What if there is a problem?

If you have a concern about any aspect of this study, you are free to speak to the researcher who will do his best to answer your questions (N.Finger@edu.salford.ac.uk / +49 151 46 131391).

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of the research will be kept confidential. For any quote based on your input from the free-text comment fields your name will be removed. In line with general practice of reporting research, quotes will be included, but your name will be replaced by a pseudonym (e.g. Respondent 1), so that you cannot be recognised.

What will happen if I don't carry on with the study?

You can withdraw from the study at any cycle. However, this will certainly influence the quality of the consensus that might be reached after the accomplishment of multiple rounds. Therefore you are highly encouraged to remain involved throughout all cycles. Information collected prior to a withdrawal may still be used.

What will happen to the results of the research study?

They will be published in the final PhD thesis and potentially future publications. You will be given access to them via free copies.

Who is organising or sponsoring the research?

The research is organised by the student without financial support by any institution that influences the research.

Further information:

If you require further information, please do not hesitate to contact the researcher via the contact details stated above.

CONSENT FORM

Full Title of Project:

Project Knowledge Management and Brokering in Virtual Team-Environments:

Application of Best Practices from Modern e-Learning Management

Name and Contact Address of Researcher:

Nils Finger, Benrather Str. 56, 40721 Hilden, Germany

N.Finger@edu.salford.ac.uk / +49 151 46 131391

Please Initial Bo

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐
3. I agree to take part in the above study. ☐
4. I agree to the use of quotes in publications with the usage of pseudonyms, as described in the information sheet. ☐

Electronic submission of this document without signature is sufficient

Name of Participant	Date	Signature
Nils Finger		
Name of Researcher	Date	Signature

ETHICAL APPROVAL

College of Arts & Social Sciences
Room 633 Maxwell Building
The Crescent
Salford, M5 4WT
Tel: 0161 295 5876

08 June 2015
Nils Finger
University of Salford

Dear Nils

Re: Ethical Approval Application – 140042

I am pleased to inform you that based on the information provided, the Research Ethics Panel have no objections on ethical grounds to your project.

Yours sincerely

Deborah Woodman

On Behalf of CASS Research Ethics Panel

Appendix V: Raw Data

QUANTITATIVE RESULTS RAW-DATA ROUND I

Respondent:		1	2	3	4	5	6	7	8	9	10	11	12	13	14
In which of the following fields do you have profound expertise?															
Project Management				1		1	1		1	1	1	1		1	1
Knowledge Management					1	1				1	1	1		1	
Virtual Teamwork			1		1	1		1				1		1	
E-Learning Management		1				1					1		1	1	
1.1. State-Of-The-Art IS	Importance	7	7	8	8	10	6	5	1	9	5	6	8	10	9
1.1. State-Of-The-Art IS	Feasibility	4	6	9	7	9	6	7	5	7	4	8	7	3	5
1.2. Distinction of IT	Importance	5	8	5	7	7	5	5	1	6	8	7	7	8	5
1.2. Distinction of IT	Feasibility	5	6	5	7	8	6	7	1	4	5	7	6	3	1
1.3. Governance/Learning Objects	Importance	6	8	7	6	9	8	8	7	9	5	10	8	10	9
1.3. Governance/Learning Objects	Feasibility	7	7	5	5	7	7	10	7	7	5	6	6	7	5
1.4. Information/Data Mgt./Tools	Importance	8	5	8	7	7	8	7	5	10	9	8	8	8	5
1.4. Information/Data Mgt./Tools	Feasibility	4	7	9	7	8	7	7	5	8	9	7	8	1	5
1.5. Procurement of IT Tools	Importance	7	8	6	7	10	6	7	2	5	7	7	6	5	5
1.5. Procurement of IT Tools	Feasibility	4	8	5	7	8	4	7	2	5	5	6	6	7	9
1.6. Outsourcing	Importance	2	8	3	8	6	7	5	1	3	2	6	4	4	9
1.6. Outsourcing	Feasibility	2	8	4	8	9	8	10	1	5	1	4	6	3	5
2.1. EP / Web 2.0	Importance	8	8	5	7	10	8	5	8	7	9	6	6	8	5
2.1. EP / Web 2.0	Feasibility	4	7	5	6	9	8	5	8	9	9	3	7	6	8
2.2. Cloud (e-learning)	Importance	8	10	8	6	10	6	8	9	6	0	6	7	10	5
2.2. Cloud (e-learning)	Feasibility	8	10	9	5	9	6	10	9	10	0	6	6	7	8
2.3. Consumerisation	Importance	5	7	4	7	7	7	8	1	8	5	2	7	7	7
2.3. Consumerisation	Feasibility	5	9	4	7	4	6	8	1	9	8	2	7	4	5
2.4. Custom Softw-Dev./Customisat.	Importance	7	5	8	8	7	8	7	1	2	8	7	8	7	5
2.4. Custom Softw-Dev./Customisat.	Feasibility	6	5	9	7	5	6	8	1	5	5	6	7	3	5
2.5. Virtual Worlds / Edut.	Importance	8	6	4	7	4	6	5	7	1	5	2	4	4	6
2.5. Virtual Worlds / Edut.	Feasibility	4	5	6	5	2	5	5	5	3	3	2	4	2	6
3.1. Big Data	Importance	6	9	7	8	3	6	5	1	6	2	8	8	10	9
3.1. Big Data	Feasibility	4	7	6	7	3	5	4	1	7	2	8	7	4	1
3.2. Escalations of Implement.	Importance	8	7	8	7	8	6	7	9	3	8	8	9	8	9
3.2. Escalations of Implement.	Feasibility	8	7	5	7	6	8	6	9	5	6	6	8	8	2
4.1. Knowledge Marketing	Importance	3	8	9	8	3	8	7	8	8	9	6	8	8	5
4.1. Knowledge Marketing	Feasibility	7	6	8	7	5	6	7	6	10	9	5	8	7	5
4.2. Ownership of Learner	Importance	8	7	8	5	4	7	9	5	7	5	7	9	10	5
4.2. Ownership of Learner	Feasibility	8	8	6	5	7	5	10	6	9	5	7	8	8	5
4.3. Interactivity/Integration	Importance	8	8	9	6	10	5	9	8	10	9	7	7	8	5
4.3. Interactivity/Integration	Feasibility	8	8	6	6	8	5	8	6	10	5	6	6	5	5
4.4. Ease of Use/Usefulness	Importance	8	9	9	9	10	8	10	10	10	10	10	10	10	10
4.4. Ease of Use/Usefulness	Feasibility	8	7	7	7	9	5	10	5	10	6	10	9	7	10
4.5. Team-Cooperation	Importance	8	9	7	8	10	8	8	10	10	8	10	9	10	10
4.5. Team-Cooperation	Feasibility	6	6	8	6	8	5	9	5	10	5	9	8	8	5
4.6. E-learn Mgr.=Knowl. Broker	Importance	8	9	7	7	3	8	8	8	10	3	7	8	8	10
4.6. E-learn Mgr.=Knowl. Broker	Feasibility	8	9	6	6	1	7	8	6	8	3	7	7	8	3

4.7. Learn. Indiv.=Use Project K.	Importance	8	8	7	8	8	7	6	9	10	8	9	9	8	10
4.7. Learn. Indiv.=User Project K.	Feasibility	8	7	4	7	5	7	8	5	7	8	9	8	8	3
4.8. Reflection and Progression	Importance	8	9	8	7	8	8	9	10	10	9	8	5	10	9
4.8. Reflection and Progression	Feasibility	8	9	8	7	8	8	9	7	6	5	6	6	9	5
4.9. Trainings: Integ. Pedag./Tech.	Importance	8	9	9	9	9	8	6	8	7	8	5	6	9	10
4.9. Trainings: Integ. Pedag./Tech.	Feasibility	6	6	9	7	4	4	8	5	5	9	5	7	8	8
4.10. Mgt. Buy-In/Incentives	Importance	8	8	6	9	7	9	9	10	10	5	10	10	10	10
4.10. Mgt. Buy-In/Incentives	Feasibility	5	7	7	6	9	8	8	6	7	5	7	9	6	5
4.11. Visualisation/Imagination	Importance	8	7	8	5	10	8	8	5	7	9	8	4	9	5
4.11. Visualisation/Imagination	Feasibility	8	5	7	5	9	4	8	3	6	8	5	6	8	5
4.12. Incorp. Shift Knowl. Society	Importance	5	10	4	8	5	9	6	8	6	3	7	4	8	5
4.12. Incorp. Shift Knowl. Society	Feasibility	5	6	8	5	3	6	6	4	9	3	4	5	5	5

Appendix V: Raw Data

QUANTITATIVE RESULT RAW-DATA ROUND II

Respondent:		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.1. State-Of-The-Art IS	Importance	3	8	4	7	5	8	8	8	6	9	6	5	7	6
1.1. State-Of-The-Art IS	Feasibility	6	8	8	7	5	8	7	8	8	8	7	5	9	9
1.2. Distinction of IT	Importance	7	6	6	6	7	6	5	4	6	7	6	6	5	7
1.2. Distinction of IT	Feasibility	8	7	9	6	3	7	6	5	6	5	6	6	7	7
1.3. Governance/Learning Objects	Importance	7	8	6	7	9	6	7	4	6	6	7	8	5	4
1.3. Governance/Learning Objects	Feasibility	10	9	7	8	9	9	9	6	7	4	7	8	9	9
1.4. Information/Data Mgt. and Tools	Importance	7	8	6	7	6	8	7	7	7	7	6	7	5	4
1.4. Information/Data Mgt. and Tools	Feasibility	9	9	7	8	5	8	8	8	8	8	7	6	5	8
1.5. Procurement of IT Tools	Importance	6	7	5	7	9	9	6	7	7	8	5	8	8	9
1.5. Procurement of IT Tools	Feasibility	6	7	5	6	4	9	4	8	7	7	6	4	7	8
1.6. Outsourcing	Importance	3	7	6	6	5	8	5	3	7	6	5	7	8	7
1.6. Outsourcing	Feasibility	2	8	4	4	5	7	3	4	5	3	4	3	3	4
2.1. EP / Web 2.0	Importance	4	7	3	7	5	7	8	9	7	9	7	8	8	9
2.1. EP / Web 2.0	Feasibility	6	7	7	7	5	7	7	7	7	7	7	7	3	7
2.2. Cloud (e-learning)	Importance	8	9	4	7	5	9	7	3	7	9	7	7	8	7
2.2. Cloud (e-learning)	Feasibility	8	9	8	7	9	9	5	2	7	8	7	5	6	8
2.3. Consumerisation	Importance	5	7	3	5	5	7	6	3	5	5	5	8	7	4
2.3. Consumerisation	Feasibility	5	7	6	5	5	7	7	2	4	5	6	7	9	4
2.4. Custom Softw-Dev./Customisat.	Importance	6	7	5	4	5	5	6	7	8	8	5	8	3	2
2.4. Custom Softw-Dev./Customisat.	Feasibility	8	8	8	8	3	6	6	8	7	7	6	4	3	6
2.5. Virtual Worlds / Edutainment	Importance	6	5	3	5	5	3	5	8	2	6	4	9	5	4
2.5. Virtual Worlds / Edutainment	Feasibility	6	5	7	5	5	4	5	7	2	8	5	3	5	8
3.1. Big Data:	Importance	8	5	8	6	5	6	4	6	7	7	4	2	3	5
3.1. Big Data:	Feasibility	8	5	8	7	5	6	5	7	8	5	6	8	3	10
3.2. Escalations of Implementations	Importance	6	5	3	6	5	8	7	9	6	6	7	5	8	6
3.2. Escalations of Implementations	Feasibility	9	5	6	6	6	8	5	8	8	7	8	5	9	6
4.1. Knowledge Marketing	Importance	4	6	9	7	6	4	8	8	7	7	7	7	9	6
4.1. Knowledge Marketing	Feasibility	8	7	3	7	9	6	10	7	7	5	8	7	9	7
4.2. Ownership of Learner	Importance	6	7	6	6	5	6	7	6	8	7	7	5	4	9
4.2. Ownership of Learner	Feasibility	6	9	10	7	8	4	8	5	8	9	7	5	8	8
4.3. Interactivity/Integration	Importance	6	7	4	7	5	6	7	8	9	6	7	7	1	3
4.3. Interactivity/Integration	Feasibility	7	9	7	6	9	8	6	9	9	9	7	4	2	6
4.4. Ease of Use/Usefulness	Importance	9	8	7	8	5	9	8	9	7	7	8	8	5	7
4.4. Ease of Use/Usefulness	Feasibility	10	9	8	9	9	10	7	9	9	9	10	5	9	10
4.5. Team-Cooperation	Importance	7	8	8	8	5	8	8	7	9	6	7	9	6	8
4.5. Team-Cooperation	Feasibility	10	9	9	8	9	9	9	8	10	8	9	3	8	8
4.6. E-learn Mgr.=Knowledge Broker	Importance	8	7	9	5	5	7	6	5	8	5	6	5	9	9
4.6. E-learn Mgr.=Knowledge Broker	Feasibility	8	7	8	6	5	9	7	7	8	7	7	9	9	8
4.7. Learn. Indiv.=User Project-Knowl.	Importance	8	7	7	7	5	8	7	9	8	6	6	6	8	8
4.7. Learn. Indiv.=User Project-Knowl.	Feasibility	8	7	7	8	5	8	9	9	9	8	8	7	9	7
4.8. Reflection and Progression	Importance	6	7	9	7	5	8	8	4	8	5	7	7	8	8
4.8. Reflection and Progression	Feasibility	7	9	9	8	9	8	8	8	9	9	8	3	8	8
4.9. Trainings: Integ. Pedagogy/Tech.	Importance	6	7	6	6	5	6	5	9	8	7	6	7	3	7
4.9. Trainings: Integ. Pedagogy/Tech.	Feasibility	8	7	8	7	8	6	6	9	8	9	8	5	4	8
4.10. Requir. Mgt. Buy-In/Incentives	Importance	7	7	5	6	5	6	8	7	6	4	7	8	3	7
4.10. Requir. Mgt. Buy-In/Incentives	Feasibility	10	9	9	10	9	10	10	9	8	7	9	8	4	10

4.11. Visualisation/Imagination	Importance	8	7	8	6	5	8	6	8	8	5	6	2	5	8
4.11. Visualisation/Imagination	Feasibility	10	8	6	8	8	8	6	9	8	8	7	10	9	8
4.12. Incorp. Shift Knowledge Society	Importance	6	6	4	4	5	7	6	4	6	6	5	7	3	3
4.12. Incorp. Shift Knowledge Society	Feasibility	6	7	8	6	9	7	6	5	6	6	6	5	3	6

Appendix VI: Results e-Learning Practices' Importance and Feasibility for Each Panellist

Table A VI.1 Results e-learning practices' importance and feasibility from panellist 1 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	7	6	4	3
1.2. Distinction of IT	5	8	5	7
1.3. Governance / Learning Objects	6	10	7	7
1.4. Information / Data Management and	8	9	4	7
1.5. Procurement of IT Tools	7	6	4	6
1.6. Outsourcing	2	2	2	3
2.1. EP / Web 2.0 (E-learning 2.0)	8	6	4	4
2.2. Cloud (e-learning)	8	8	8	8
2.3. Consumerisation	5	5	5	5
2.4. Custom Software Dev. / Customisation	7	8	6	6
2.5. Virtual Worlds / Edutainment	8	6	4	6
3.1. Big Data	6	8	4	8
3.2. Escalations of Implementations	8	9	8	6
4.1. Knowledge Marketing	3	8	7	4
4.2. Ownership of Learner	8	6	8	6
4.3. Interactivity / Integration	8	7	8	6
4.4. Ease of Use / Usefulness	8	10	8	9
4.5. Team-Cooperation	8	10	6	7
4.6. E-learning Mgr=Knowledge Broker	8	8	8	8
4.7. Learning-Individual=User Project Knowl.	8	8	8	8
4.8. Reflection and Progression	8	7	8	6
4.9. New Trainings: Integ. Pedagogy / Techn.	8	8	6	6
4.10. Required Mgt. Buy-In / Incentives	8	10	5	7
4.11. Visualisation / Imagination	8	10	8	8
4.12. Paradigm Shift for Knowledge Society	5	6	5	6
Means	6.92	7.56	6.00	6.28
Grand Mean	6.69			
W	0.60			
X^2	58.05*			

*$p < 0.001$

Table A VI.2 Results e-learning practices' importance and feasibility from panellist 2 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	7	8	6	8
1.2. Distinction of IT	8	7	6	6
1.3. Governance / Learning Objects	8	9	7	8
1.4. Information / Data Management and	5	9	7	8
1.5. Procurement of IT Tools	8	7	8	7
1.6. Outsourcing	8	8	8	7
2.1. EP / Web 2.0 (E-learning 2.0)	8	7	7	7
2.2. Cloud (e-learning)	10	9	10	9
2.3. Consumerisation	7	7	9	7
2.4. Custom Software Dev. / Customisation	5	8	5	7
2.5. Virtual Worlds / Edutainment	6	5	5	5
3.1. Big Data	9	5	7	5
3.2. Escalations of Implementations	7	5	7	5
4.1. Knowledge Marketing	8	7	6	6
4.2. Ownership of Learner	7	9	8	7
4.3. Interactivity / Integration	8	9	8	7
4.4. Ease of Use / Usefulness	9	9	7	8
4.5. Team-Cooperation	9	9	6	8
4.6. E-learning Mgr=Knowledge Broker	9	7	9	7
4.7. Learning-Individual=User Project Knowl.	8	7	7	7
4.8. Reflection and Progression	9	9	9	7
4.9. New Trainings: Integ. Pedagogy / Techn.	9	7	6	7
4.10. Required Mgt. Buy-In / Incentives	8	9	7	7
4.11. Visualisation / Imagination	7	8	5	7
4.12. Paradigm Shift for Knowledge Society	10	7	6	6
Means	7.88	7.64	7.04	6.92
Grand Mean	7.37			
W	0.47			
X^2	45.05*			

*p = 0.057

Table A VI.3 Results e-learning practices' importance and feasibility from panellist 3 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	8	8	9	4
1.2. Distinction of IT	5	9	5	6
1.3. Governance / Learning Objects	7	7	5	6
1.4. Information / Data Management and	8	7	9	6
1.5. Procurement of IT Tools	6	5	5	5
1.6. Outsourcing	3	4	4	6
2.1. EP / Web 2.0 (E-learning 2.0)	5	7	5	3
2.2. Cloud (e-learning)	8	8	9	4
2.3. Consumerisation	4	6	4	3
2.4. Custom Software Dev. / Customisation	8	8	9	5
2.5. Virtual Worlds / Edutainment	4	7	6	3
3.1. Big Data	7	8	6	8
3.2. Escalations of Implementations	8	6	5	3
4.1. Knowledge Marketing	9	3	8	9
4.2. Ownership of Learner	8	10	6	6
4.3. Interactivity / Integration	9	7	6	4
4.4. Ease of Use / Usefulness	9	8	7	7
4.5. Team-Cooperation	7	9	8	8
4.6. E-learning Mgr=Knowledge Broker	7	8	6	9
4.7. Learning-Individual=User Project Knowl.	7	7	4	7
4.8. Reflection and Progression	8	9	8	9
4.9. New Trainings: Integ. Pedagogy / Techn.	9	8	9	6
4.10. Required Mgt. Buy-In / Incentives	6	9	7	5
4.11. Visualisation / Imagination	8	6	7	8
4.12. Paradigm Shift for Knowledge Society	4	8	8	4
Means	6.88	7.28	6.60	5.76
Grand Mean	6.63			
W	0.47			
X^2	44.81*			

*p = 0.0061

Table A VI.4 Results e-learning practices' importance and feasibility from panellist 4 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	8	7	7	7
1.2. Distinction of IT	7	6	7	6
1.3. Governance / Learning Objects	6	8	5	7
1.4. Information / Data Management and	7	8	7	7
1.5. Procurement of IT Tools	7	6	7	7
1.6. Outsourcing	8	4	8	6
2.1. EP / Web 2.0 (E-learning 2.0)	7	7	6	7
2.2. Cloud (e-learning)	6	7	5	7
2.3. Consumerisation	7	5	7	5
2.4. Custom Software Dev. / Customisation	8	8	7	4
2.5. Virtual Worlds / Edutainment	7	5	5	5
3.1. Big Data	8	7	7	6
3.2. Escalations of Implementations	7	6	7	6
4.1. Knowledge Marketing	8	7	7	7
4.2. Ownership of Learner	5	7	5	6
4.3. Interactivity / Integration	6	6	6	7
4.4. Ease of Use / Usefulness	9	9	7	8
4.5. Team-Cooperation	8	8	6	8
4.6. E-learning Mgr=Knowledge Broker	7	6	6	5
4.7. Learning-Individual=User Project Knowl.	8	8	7	7
4.8. Reflection and Progression	7	8	7	7
4.9. New Trainings: Integ. Pedagogy / Techn.	9	7	7	6
4.10. Required Mgt. Buy-In / Incentives	9	10	6	6
4.11. Visualisation / Imagination	5	8	5	6
4.12. Paradigm Shift for Knowledge Society	8	6	5	4
Means	7.28	6.96	6.36	6.28
Grand Mean	6.72			
W	0.41			
X^2	38.89*			

*p = 0.028

Table A VI.5 Results e-learning practices' importance and feasibility from panellist 5 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	10	5	9	5
1.2. Distinction of IT	7	3	8	7
1.3. Governance / Learning Objects	9	9	7	9
1.4. Information / Data Management and	7	5	8	6
1.5. Procurement of IT Tools	10	4	8	9
1.6. Outsourcing	6	5	9	5
2.1. EP / Web 2.0 (E-learning 2.0)	10	5	9	5
2.2. Cloud (e-learning)	10	9	9	5
2.3. Consumerisation	7	5	4	5
2.4. Custom Software Dev. / Customisation	7	3	5	5
2.5. Virtual Worlds / Edutainment	4	5	2	5
3.1. Big Data	3	5	3	5
3.2. Escalations of Implementations	8	6	6	5
4.1. Knowledge Marketing	3	9	5	6
4.2. Ownership of Learner	4	8	7	5
4.3. Interactivity / Integration	10	9	8	5
4.4. Ease of Use / Usefulness	10	9	9	5
4.5. Team-Cooperation	10	9	8	5
4.6. E-learning Mgr=Knowledge Broker	3	5	1	5
4.7. Learning-Individual=User Project Knowl.	8	5	5	5
4.8. Reflection and Progression	8	9	8	5
4.9. New Trainings: Integ. Pedagogy / Techn.	9	8	4	5
4.10. Required Mgt. Buy-In / Incentives	7	9	9	5
4.11. Visualisation / Imagination	10	8	9	5
4.12. Paradigm Shift for Knowledge Society	5	9	3	5
Means	7.40	6.64	6.52	5.48
Grand Mean	6.51			
W	0.38			
X^2	36.86*			

*p = 0.0452

Table A VI.6 Results e-learning practices' importance and feasibility from panellist 6 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	6	8	6	8
1.2. Distinction of IT	5	7	6	6
1.3. Governance / Learning Objects	8	9	7	6
1.4. Information / Data Management and	8	8	7	8
1.5. Procurement of IT Tools	6	9	4	9
1.6. Outsourcing	7	7	8	8
2.1. EP / Web 2.0 (E-learning 2.0)	8	7	8	7
2.2. Cloud (e-learning)	6	9	6	9
2.3. Consumerisation	7	7	6	7
2.4. Custom Software Dev. / Customisation	8	6	6	5
2.5. Virtual Worlds / Edutainment	6	4	5	3
3.1. Big Data	6	6	5	6
3.2. Escalations of Implementations	6	8	8	8
4.1. Knowledge Marketing	8	6	6	4
4.2. Ownership of Learner	7	4	5	6
4.3. Interactivity / Integration	5	8	5	6
4.4. Ease of Use / Usefulness	8	10	5	9
4.5. Team-Cooperation	8	9	5	8
4.6. E-learning Mgr=Knowledge Broker	8	9	7	7
4.7. Learning-Individual=User Project Knowl.	7	8	7	8
4.8. Reflection and Progression	8	8	8	8
4.9. New Trainings: Integ. Pedagogy / Techn.	8	6	4	6
4.10. Required Mgt. Buy-In / Incentives	9	10	8	6
4.11. Visualisation / Imagination	8	8	4	8
4.12. Paradigm Shift for Knowledge Society	9	7	6	7
Means	7.20	7.52	6.08	6.92
Grand Mean	6.93			
W	0.41			
X^2	39.10*			

*p = 0.0267

Table A VI.7 Results e-learning practices' importance and feasibility from panellist 7 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	5	7	7	8
1.2. Distinction of IT	5	6	7	5
1.3. Governance / Learning Objects	8	9	10	7
1.4. Information / Data Management and	7	8	7	7
1.5. Procurement of IT Tools	7	4	7	6
1.6. Outsourcing	5	3	10	5
2.1. EP / Web 2.0 (E-learning 2.0)	5	7	5	8
2.2. Cloud (e-learning)	8	5	10	7
2.3. Consumerisation	8	7	8	6
2.4. Custom Software Dev. / Customisation	7	6	8	6
2.5. Virtual Worlds / Edutainment	5	5	5	5
3.1. Big Data	5	5	4	4
3.2. Escalations of Implementations	7	5	6	7
4.1. Knowledge Marketing	7	10	7	8
4.2. Ownership of Learner	9	8	10	7
4.3. Interactivity / Integration	9	6	8	7
4.4. Ease of Use / Usefulness	10	7	10	8
4.5. Team-Cooperation	8	9	9	8
4.6. E-learning Mgr=Knowledge Broker	8	7	8	6
4.7. Learning-Individual=User Project Knowl.	6	9	8	7
4.8. Reflection and Progression	9	8	9	8
4.9. New Trainings: Integ. Pedagogy / Techn.	6	6	8	5
4.10. Required Mgt. Buy-In / Incentives	9	10	8	8
4.11. Visualisation / Imagination	8	6	8	6
4.12. Paradigm Shift for Knowledge Society	6	6	6	6
Means	7.08	6.76	7.72	6.60
Grand Mean	7.04			
W	0.59			
X^2	56.75*			

*$p < 0.001$

Table A VI.8 Results e-learning practices' importance and feasibility from panellist 8 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	1	8	5	8
1.2. Distinction of IT	1	5	1	4
1.3. Governance / Learning Objects	7	6	7	4
1.4. Information / Data Management and	5	8	5	7
1.5. Procurement of IT Tools	2	8	2	7
1.6. Outsourcing	1	4	1	3
2.1. EP / Web 2.0 (E-learning 2.0)	8	7	8	9
2.2. Cloud (e-learning)	9	2	9	3
2.3. Consumerisation	1	2	1	3
2.4. Custom Software Dev. / Customisation	1	8	1	7
2.5. Virtual Worlds / Edutainment	7	7	5	8
3.1. Big Data	1	7	1	6
3.2. Escalations of Implementations	9	8	9	9
4.1. Knowledge Marketing	8	7	6	8
4.2. Ownership of Learner	5	5	6	6
4.3. Interactivity / Integration	8	9	6	8
4.4. Ease of Use / Usefulness	10	9	5	9
4.5. Team-Cooperation	10	8	5	7
4.6. E-learning Mgr=Knowledge Broker	8	7	6	5
4.7. Learning-Individual=User Project Knowl.	9	9	5	9
4.8. Reflection and Progression	10	8	7	4
4.9. New Trainings: Integ. Pedagogy / Techn.	8	9	5	9
4.10. Required Mgt. Buy-In / Incentives	10	9	6	7
4.11. Visualisation / Imagination	5	9	3	8
4.12. Paradigm Shift for Knowledge Society	8	5	4	4
Means	6.08	6.96	4.76	6.48
Grand Mean	6.07			
W	0.55			
X^2	53.03*			

*$p < 0.001$

Table A VI.9 Results e-learning practices' importance and feasibility from panellist 9 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	9	8	7	6
1.2. Distinction of IT	6	6	4	6
1.3. Governance / Learning Objects	9	7	7	6
1.4. Information / Data Management and	10	8	8	7
1.5. Procurement of IT Tools	5	7	5	7
1.6. Outsourcing	3	5	5	7
2.1. EP / Web 2.0 (E-learning 2.0)	7	7	9	7
2.2. Cloud (e-learning)	6	7	10	7
2.3. Consumerisation	8	4	9	5
2.4. Custom Software Dev. / Customisation	2	7	5	8
2.5. Virtual Worlds / Edutainment	1	2	3	2
3.1. Big Data	6	8	7	7
3.2. Escalations of Implementations	3	8	5	6
4.1. Knowledge Marketing	8	7	10	7
4.2. Ownership of Learner	7	8	9	8
4.3. Interactivity / Integration	10	9	10	9
4.4. Ease of Use / Usefulness	10	9	10	7
4.5. Team-Cooperation	10	10	10	9
4.6. E-learning Mgr=Knowledge Broker	10	8	8	8
4.7. Learning-Individual=User Project Knowl.	10	9	7	8
4.8. Reflection and Progression	10	9	6	8
4.9. New Trainings: Integ. Pedagogy / Techn.	7	8	5	8
4.10. Required Mgt. Buy-In / Incentives	10	8	7	6
4.11. Visualisation / Imagination	7	8	6	8
4.12. Paradigm Shift for Knowledge Society	6	6	9	6
Means	7.20	7.32	7.24	6.92
Grand Mean	7.17			
W	0.60			
X^2	57.81*			

*$p < 0.001$

Table A VI.10 Results e-learning practices' importance and feasibility from panellist 10 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	5	8	4	9
1.2. Distinction of IT	8	5	5	7
1.3. Governance / Learning Objects	5	4	5	6
1.4. Information / Data Management and	9	8	9	7
1.5. Procurement of IT Tools	7	7	5	8
1.6. Outsourcing	2	3	1	6
2.1. EP / Web 2.0 (E-learning 2.0)	9	7	9	9
2.2. Cloud (e-learning)	0	8	0	9
2.3. Consumerisation	5	5	8	5
2.4. Custom Software Dev. / Customisation	8	7	5	8
2.5. Virtual Worlds / Edutainment	5	8	3	6
3.1. Big Data	2	5	2	7
3.2. Escalations of Implementations	8	7	6	6
4.1. Knowledge Marketing	9	5	9	7
4.2. Ownership of Learner	5	9	5	7
4.3. Interactivity / Integration	9	9	5	6
4.4. Ease of Use / Usefulness	10	9	6	7
4.5. Team-Cooperation	8	8	5	6
4.6. E-learning Mgr=Knowledge Broker	3	7	3	5
4.7. Learning-Individual=User Project Knowl.	8	8	8	6
4.8. Reflection and Progression	9	9	5	5
4.9. New Trainings: Integ. Pedagogy / Techn.	8	9	9	7
4.10. Required Mgt. Buy-In / Incentives	5	7	5	4
4.11. Visualisation / Imagination	9	8	8	5
4.12. Paradigm Shift for Knowledge Society	3	6	3	6
Means	6.36	7.04	5.32	6.56
Grand Mean	6.32			
W	0.44			
X^2	42.48*			

*p = 0.0114

Table A VI.11 Results e-learning practices' importance and feasibility from panellist 11 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	6	7	8	6
1.2. Distinction of IT	7	6	7	6
1.3. Governance / Learning Objects	10	7	6	7
1.4. Information / Data Management and	8	7	7	6
1.5. Procurement of IT Tools	7	6	6	5
1.6. Outsourcing	6	4	4	5
2.1. EP / Web 2.0 (E-learning 2.0)	6	7	3	7
2.2. Cloud (e-learning)	6	7	6	7
2.3. Consumerisation	2	6	2	5
2.4. Custom Software Dev. / Customisation	7	6	6	5
2.5. Virtual Worlds / Edutainment	2	5	2	4
3.1. Big Data	8	6	8	4
3.2. Escalations of Implementations	8	8	6	7
4.1. Knowledge Marketing	6	8	5	7
4.2. Ownership of Learner	7	7	7	7
4.3. Interactivity / Integration	7	7	6	7
4.4. Ease of Use / Usefulness	10	10	10	8
4.5. Team-Cooperation	10	9	9	7
4.6. E-learning Mgr=Knowledge Broker	7	7	7	6
4.7. Learning-Individual=User Project Knowl.	9	8	9	6
4.8. Reflection and Progression	8	8	6	7
4.9. New Trainings: Integ. Pedagogy / Techn.	5	8	5	6
4.10. Required Mgt. Buy-In / Incentives	10	9	7	7
4.11. Visualisation / Imagination	8	7	5	6
4.12. Paradigm Shift for Knowledge Society	7	6	4	5
Means	7.08	7.04	6.04	6.12
Grand Mean	6.57			
W	0.65			
X^2	61.95*			

*$p < 0.001$

Table A VI. 12 Results e-learning practices' importance and feasibility from panellist 12 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	8	5	7	5
1.2. Distinction of IT	7	6	6	6
1.3. Governance / Learning Objects	8	8	6	8
1.4. Information / Data Management and	8	6	8	7
1.5. Procurement of IT Tools	6	4	6	8
1.6. Outsourcing	4	3	6	7
2.1. EP / Web 2.0 (E-learning 2.0)	6	7	7	8
2.2. Cloud (e-learning)	7	5	6	7
2.3. Consumerisation	7	7	7	8
2.4. Custom Software Dev. / Customisation	8	4	7	8
2.5. Virtual Worlds / Edutainment	4	3	4	9
3.1. Big Data	8	8	7	2
3.2. Escalations of Implementations	9	5	8	5
4.1. Knowledge Marketing	8	7	8	7
4.2. Ownership of Learner	9	5	8	5
4.3. Interactivity / Integration	7	4	6	7
4.4. Ease of Use / Usefulness	10	5	9	8
4.5. Team-Cooperation	9	3	8	9
4.6. E-learning Mgr=Knowledge Broker	8	9	7	5
4.7. Learning-Individual=User Project Knowl.	9	7	8	6
4.8. Reflection and Progression	5	3	6	7
4.9. New Trainings: Integ. Pedagogy / Techn.	6	5	7	7
4.10. Required Mgt. Buy-In / Incentives	10	8	9	8
4.11. Visualisation / Imagination	4	10	6	2
4.12. Paradigm Shift for Knowledge Society	4	5	5	7
Means	7.16	5.68	6.88	6.64
Grand Mean	6.59			
W	0.37			
X^2	35.16*			

*p = 0.066

Table A VI.13 Results e-learning practices' importance and feasibility from panellist 13 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	10	9	3	7
1.2. Distinction of IT	8	7	3	5
1.3. Governance / Learning Objects	10	9	7	5
1.4. Information / Data Management and	8	5	1	5
1.5. Procurement of IT Tools	5	7	7	8
1.6. Outsourcing	4	3	3	8
2.1. EP / Web 2.0 (E-learning 2.0)	8	3	6	8
2.2. Cloud (e-learning)	10	6	7	8
2.3. Consumerisation	7	9	4	7
2.4. Custom Software Dev. / Customisation	7	3	3	3
2.5. Virtual Worlds / Edutainment	4	5	2	5
3.1. Big Data	10	3	4	3
3.2. Escalations of Implementations	8	9	8	8
4.1. Knowledge Marketing	8	9	7	9
4.2. Ownership of Learner	10	8	8	4
4.3. Interactivity / Integration	8	2	5	1
4.4. Ease of Use / Usefulness	10	9	7	5
4.5. Team-Cooperation	10	8	8	6
4.6. E-learning Mgr=Knowledge Broker	8	9	8	9
4.7. Learning-Individual=User Project Knowl.	8	9	8	8
4.8. Reflection and Progression	10	8	9	8
4.9. New Trainings: Integ. Pedagogy / Techn.	9	4	8	3
4.10. Required Mgt. Buy-In / Incentives	10	4	6	3
4.11. Visualisation / Imagination	9	9	8	5
4.12. Paradigm Shift for Knowledge Society	8	3	5	3
Means	8.28	6.40	5.80	5.76
Grand Mean	6.56			
W	0.47			
X^2	45.17*			

*p = 0.0056

Table A VI.14 Results e-learning practices' importance and feasibility from panellist 14 out of 14

	Importance		Feasibility	
Topic Number / Name	Round I	Round II	Round I	Round II
1.1. State-Of-The-Art Information Systems	9	9	5	6
1.2. Distinction of IT	5	7	1	7
1.3. Governance / Learning Objects	9	9	5	4
1.4. Information / Data Management and	5	8	5	4
1.5. Procurement of IT Tools	5	8	9	9
1.6. Outsourcing	9	4	5	7
2.1. EP / Web 2.0 (E-learning 2.0)	5	7	8	9
2.2. Cloud (e-learning)	5	8	8	7
2.3. Consumerisation	7	4	5	4
2.4. Custom Software Dev. / Customisation	5	6	5	2
2.5. Virtual Worlds / Edutainment	6	8	6	4
3.1. Big Data	9	10	1	5
3.2. Escalations of Implementations	9	6	2	6
4.1. Knowledge Marketing	5	7	5	6
4.2. Ownership of Learner	5	8	5	9
4.3. Interactivity / Integration	5	6	5	3
4.4. Ease of Use / Usefulness	10	10	10	7
4.5. Team-Cooperation	10	8	5	8
4.6. E-learning Mgr=Knowledge Broker	10	8	3	9
4.7. Learning-Individual=User Project Knowl.	10	7	3	8
4.8. Reflection and Progression	9	8	5	8
4.9. New Trainings: Integ. Pedagogy / Techn.	10	8	8	7
4.10. Required Mgt. Buy-In / Incentives	10	10	5	7
4.11. Visualisation / Imagination	5	8	5	8
4.12. Paradigm Shift for Knowledge Society	5	6	5	3
Means	7.28	7.52	5.16	6.28
Grand Mean	6.56			
W	0.38			
X^2	36.29*			

*p = 0.0514

Appendix VII: List of Abbreviations, Figures & Tables

List of Abbreviations

EL	E-Learning
ERP	Enterprise Resource System
ICT	Information and Communication Technology
IS	Information System(s)
KM	Knowledge Management
KMS	Knowledge Management System
OL	Organisational Learning
PKM	Project Knowledge Management
PM	Project Management

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