THE IMPLICATIONS FOR INDUSTRY OF INTERNATIONALLY RECOGNISED ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) STANDARDS

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I would like to dedicate this thesis to all those researching and working within the field of environmental management. I hope this study will provide many of you with valuable findings and ideas on which to base your own investigations.

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GLOSSARY

Accreditation:	Approval by UKAS of bodies seeking to certify organisations to BS 7750 or ISO 14001, or verify organisations to EMAS.
AO:	Auto-oxidation Process
BATNEEC:	Best Available Techniques not Entailing Excessive Cost
BPEO:	Best Practicable Environmental Option
BPM:	Best Practicable Means
BSI:	British Standards Institution
Capa:	Caprolactone
C.E.N:	European Standards Body
Certification:	Conformity of EMS to BS 7750 or ISO 14001
C.O.D:	Chemical Oxygen Demand
CIA:	Chemical Industries' Association
DIS:	Draft International Standard
EAC:	European Accreditation of Certification
EMS:	Environmental Management System
EMAS:	Eco-management and Audit Scheme
EN:	European Norm
EPA:	Environmental Protection Act
EVABAT:	Economically Viable Application of Best Available Technology
HMIP:	Her Majesty's Inspectorate of Pollution
HSE:	Health, Safety and Environment
ISRS:	International Safety Rating System
IPC:	Integrated Pollution Control
LAAPC:	Local Authority Air Pollution Control
LPC:	Loss Prevention Council
NACCB:	National Accreditation Council for Certification Bodies
PAA:	Peracetic Acid
PSM:	Process Safety Management
RCLP:	Responsible Care & Loss Prevention
SMEs:	Small & Medium Sized Enterprises
SOP:	Standard Operating Procedure
SIC:	Standard Industrial Classification

TCS: Teaching Company Scheme

UKAS: United Kingdom Accreditation Service

VOCs: Volatile Organic Compounds

Validation: External validation of the environmental statement required to meet EMAS.

Verification: Certification of management system and validation of statement under EMAS

ABSTRACT

The first industry standard for environmental management systems, BS 7750, was published in the UK in September 1994. Since then we have seen the EC Eco-management and Audit Scheme come into force in April 1995 and an international environmental management system standard, ISO 14001, published in September 1996.

The EMS standards allow organisations to have their environmental management systems externally assessed and approved. The first companies became registered to BS 7750 in April 1995, with approximately 70 organisations gaining certification during its first year of operation. Since then uptake of the standards has been steady but slow with many companies delaying their decision until the implications of adopting such a recognised approach have been clarified.

This research reviews the experiences of organisations adopting the standards during their early years of operation. Key lessons are learnt from a three year Teaching Company Scheme project designing and implementing an EMS for a large chemical manufacturer. The author also draws on evidence obtained through a survey of organisations gaining BS 7750 certification during its first year of operation and a number of detailed case-studies.

The aim of the research is to identify and assess the implications for industry of the EMS standards. Their impacts on business performance in terms of operational efficiency, competitive advantage, legislative compliance, public image and staff morale are assessed and their variability between organisations explained. The resource commitments required to achieve certification are identified including management time, capital expenditure, consultancy fees and certification charges. Accounting mechanisms for comparing the costs and income associated with environmental activities are reviewed and their applicability to monitoring the performance of an EMS evaluated. The research concludes with the identification of decision making criteria to assist companies in determining their environmental strategy.

CHAPTER 1

1.0. INTRODUCTION

Since the publication of the first standard on environmental management systems in the early 1990s there has been extensive speculation regarding their potential implications for industry. The slow uptake of the standards reflects industrial perceptions of unnecessary bureaucracy and high resource requirements. This has led to criticism of environmental management systems as documentation exercises not focused on achieving real environmental benefit. Conversely their supporters have promoted their potential to lead to increased legislative compliance, cost savings and competitive advantage. Certification may also improve public image through the demonstration of environmental commitment to stakeholders including the general public, customers, shareholders, banks and insurers. The issue of importance to industry today is whether an environmental management system is a drain on already stretched resources or a commercial advantage. This has resulted in the majority of companies delaying their decision regarding certification until the benefits and resource requirements are more clearly understood. The objective of this research is to disprove the hypothesis that industrial environmental management systems fail to assist companies enhance their business and environmental performance.

1.1. THE HISTORY OF ENVIRONMENTAL MANAGEMENT

1.1.1 Early Controls and Best Practicable Means (BPM)

In the UK the introduction of the first pollution control measures resulted from the Industrial Revolution of the late 18th and 19th centuries. These early controls were based on the concept of Best Practicable Means, first introduced in 1842 for the prevention or abatement of smoke nuisance. The concept was later applied to discharges of noxious or offensive gases arising from alkali works through the enactment of the *Alkali Act 1863*. In the 20th century processes listed in the *Health & Safety (Emissions into the Atmosphere) Regulations 1983* were required to demonstrate to the pollution inspectorate that their works were provided with the Best

Practicable Means for preventing the release of noxious or offensive substances, and for rendering such emissions harmless and inoffensive. The concept was extended to noise control by the *Control of Pollution Act 1974*, which states that it is a defence to prove Best Practicable Means has been used to mitigate noise from a factory. More recently the *Environmental Protection Act 1990* also allows a defence of Best Practicable Means in respect of nuisance from industrial, trade or business premises.

1.1.2 Polluter Pays Principle (PPP)

The polluter pays principle was introduced at the proceedings of the UN Conference on the Human Environment, Stockholm 1972. In the European Community the principle was first mentioned in the *First Action Programme on the Environment* (1973-77). As a signatory of the Treaty of Rome the UK accepted the principle that the cost of preventing pollution or of minimising environmental damage due to pollution should be borne by those responsible. This remains a key principle of European environmental policy.

1.1.3 Best Practicable Environmental Option (BPEO)

Best Practicable Environmental Option (BPEO) was first proposed by the Royal Commission on Environmental Pollution in its 5th Report in 1976. It is based on the principle of adoption of technology which is best for the environment as a whole and requires consideration of total impact on water, land and air pathways together. This concept formed the basis of Integrated Pollution Control (IPC), the system introduced for regulating more polluting industries under the *Environmental Protection Act 1990*.

1.1.4 Developments in UK Legislation

The rise of the Green Party in West Germany in the 1980s was a significant catalyst for change in governmental attitudes towards the environment (Jones, 1997). However, the UK Conservative government, committed to free market business expansion, was slow to respond. Throughout most of the 1980s the environment did not feature very highly on the agenda of any of the main political parties. It was not until 1988 that the government demonstrated its commitment through Mrs Thatcher's speech to the Royal Society of Chemistry in which she argued the case for environmental protection while still encouraging industrial growth.

In the late 1980s and early 1990s a number of key pieces of legislation were introduced (Table 1.1). In particular, the *Environmental Protection Act 1990* provided for the introduction of Integrated Pollution Control (IPC), Local Authority Air Pollution Control (LAAPC) and Duty of Care for waste management (Table 1.2).

Table 1. 1: Major UK environmental legislation (Little, et al., 1992)

Name of Act / Regulation	*Date*
Alkali & Coal Works Regulations Act	1900s
Public Health Acts	1930s
Clean Air Acts	1950/1960s
Health & Safety at Works Act	1970s
Control of Pollution Act	1970s
Water Act	1980s
Environmental Protection Act	1990s
Environment Act	1995

Table 1. 2: Key provisions of the Environmental Protection Act 1990

• Integrated Pollution Control (IPC)
• Local Authority Air Pollution Control (LAAPC)
• The "Polluter Pays" Principle
• Duty of Care Responsibility for Waste Management
• Public Registers of Environmental Legislation
• Provisions for the Remediation of Contaminated Land

Integrated Pollution Control (IPC), introduced by Part I of the *Environmental Protection Act*, regulates emissions to air, land and water from processes with the greatest polluting potential, known as Part A processes. It was originally regulated by Her Majesty's Inspectorate of Pollution (HMIP), which became part of the Environment Agency in 1996. In implementing IPC, HMIP was required to set conditions which were commensurate with the BPEO (best practicable environmental option). Less polluting Part B processes are regulated in the UK by the local authorities under Local Authority Air Pollution Control (LAAPC). In comparison to IPC this only covers releases to air and does not include impacts on land and water.

All prescribed companies, whether Part A or Part B, must "render harmless" all releases from their processes by the application of Best Available Techniques not Entailing Excessive Cost (BATNEEC). This provoked much debate regarding what constituted BATNEEC for specific industrial sectors. In 1991 guidance notes were published for both HMIP and the local authority controlled processes offering advice on BATNEEC for specific industrial processes.

Part II of the *Environmental Protection Act 1990* introduced the duty of care provision for waste disposal. Companies are required to take all reasonable steps to look after their waste and prevent its illegal, unauthorised disposal. Part III of the Act deals with noise, dust, odours and other public nuisances. Other parts cover more specialised topics, including genetically modified organisms and radioactive wastes.

The *Environment Act 1995* consolidated previous legislation and established the Environment Agency for England and Wales and the Scottish Environmental Protection Agency. It expanded upon the *Environmental Protection Act 1990* to cover important new provisions for the identification and remediation of contaminated land and abandoned mines. It also makes many minor amendments to the *Control of Pollution Act 1974*, the *Clean Air Act 1993*, the *Radioactive Substances Act 1993*, the *Water Resources Act 1991* and the *Water Industries Act 1991*.

1.1.5 Developments in European Legislation

European legislation dates back to the 1970s with the publication of Directives on waste disposal, the first being the 1975 Directive on waste oil. This was soon followed by a General Directive on waste and a series of specific Directives to control toxic and dangerous waste, PCBs and titanium dioxide. Directives covering the pollution of water and air followed during the late 1970s and early 1980s.

The *Single European Act 1986* and the signing of the Maastricht Treaty in 1992 resulted in a multitude of environmental legislation (Figure 1.1). Those of particular relevance covered environmental impact assessment, eco-management and auditing, eco-labelling, polluter pays principle and packaging waste (Table 1.3). The Directive on packaging and packaging waste requires all EU member states to recycle, compost or recover the energy from 50-65% of the weight of the packaging and to recycle 25-45% by the year 2000. Its implementation in the UK, through the *Producer Responsibility Obligations (Packaging Waste) Regulations 1997,* had a substantial impact on industry by requiring those handling packaging to recycle and recover a percentage.

1.1.6 Sustainable Development

Sustainable development has become the key principle of EC and international environmental policy and legislation. The concept was first introduced in the World Commission on Environment and Development's 1987 report, *Our Common Future* (the Brundtland Report) (World Commission on Environment and Development, 1987). This defined sustainable development as meeting the needs of the current generations without compromising the ability of future generations to meet their own needs.

A major land mark in the history of environmental management was the United Nations Conference on Environment and Development held at Rio de Janeiro, Brazil, in the late spring of 1992. The conference was held to reaffirm the Declaration of the U.N. Conference on the Human Environment, adopted at Stockholm in 1972. The Rio Declaration, also known as Agenda 21, is the most important international agreement designed to protect the environment (Table 1.4). The Rio Declaration encourages international action to address the needs and interests of all countries through sustainable development.

Figure 1.1: Environmental laws adopted by the European Union (from Brady, 1996)

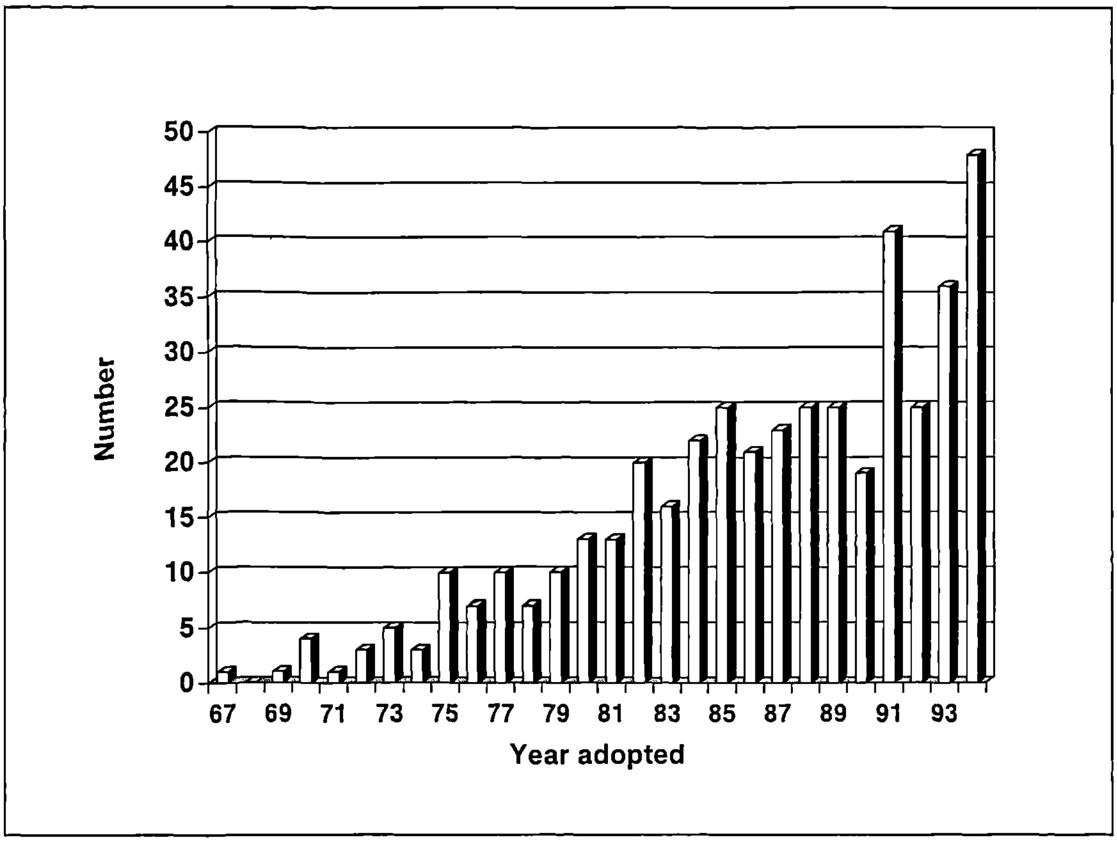


Table 1. 3: Major EC environmental legislation

Directive	***Subject***
EC Directive 85/337/EEC	Environmental impact assessment
Council Regulation (EEC) 1836/93	The Eco-management and Audit Regulation.
Council Regulation (EEC) 880/92	Ecolabelling Regulation
EC Directive 90/313/EC	Freedom of access to environmental information
Community Waste Strategy SEC (89) (934)	Legal expression of the polluter pays principle
EC Directive 94/62/EC	Packaging and Packaging Waste

Table 1. 4: Principles of the U.N Rio Declaration (Cited in Sayre, 1996)

* **Sovereign Rights to Sustainable Development**
* **Sustainable Development for the Present and Future**
* **Eradicate Poverty for Sustainable Development**
* **Global Partnership for Sustainable Development**
* **Eliminate Unsustainable Patterns**
* **Participation of All**
* **Equitable Environmental Legislation**
* **International Economic Co-operation**
* **Liability and Compensation**
* **Co-operation for the Environment and Human Health**
* **Precautionary Approach**
* **Internal Environmental Impact Assessment**
* **Immediate Notification and International Response**
* **Full Participation by Women**
* **Global Youth Partnership**
* **Role of the Indigenous and Protection of the Oppressed**
* **Peace, Sustainable Development, and Environmental Protection**
* **Peaceful Resolution, Good Faith and Partnership**

In 1992 the International Chamber of Commerce published their *Business Charter for Sustainable Development* which translated the commitments contained in the Rio Declaration into a series of guiding principles for business (Table 1.5) (International Chamber of Commerce, 1992). Many of these principles were later incorporated into the environmental management system standards (Chapter 2). In particular both require policies, programmes, employee training, an assessment of environmental impacts, emergency preparedness and continuous improvement.

Table 1. 5: International Chamber of Commerce Business Charter for Sustainable Development (International Chamber of Commerce, 1992)

1. Corporate Priority	To recognise environmental management as among the highest corporate priorities and as a key determinant to sustainable development. To establish policies, programmes and practices for conducting operations in an environmentally sound manner.
2. Integrated Management	To integrate these policies, programs and practices fully into each business as an essential element of management in all its functions.
3. Process of Improvement	To continue to improve policies, programs and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as the starting point, and to apply the same environmental criteria internationally.
4. Employee Education	To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.
5. Prior Assessment	To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.
6. Products and Services	To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused or disposed of safely.
7. Customer Advice	To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided, and to apply similar considerations to provisions of services.
8. Facilities and Operations	To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimisation of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

In 1993 the EC's ongoing commitment to sustainability was enforced through the publication of its *Fifth Action Programme on the Environment: Towards Sustainability* (European Commission, 1993b). This runs from 1993 - 2000 and emphasises the need for governments, industry and communities to become involved in and take responsibility for the protection of their environment.

In 1994 the UK Government published *Sustainable Development - the UK Strategy* (Department of the Environment, 1994). It reviews UK policies, sets out the agenda for achieving sustainable development, and is regularly updated. It was followed in 1996 by *Indicators of Sustainable Development for the United Kingdom* (Department of the Environment, 1996a). This contains 120 indicators, covering issues such as transport, climate change, air quality and energy, for monitoring progress towards achieving the objectives set out in the UK Strategy.

1.1.7 Developments in Environmental Auditing

The concept of environmental auditing can be dated back to 1971 when Sir Frederick Warner, speaking in the Centenary Lecture at the University of Newcastle, suggested auditing would be necessary to ensure improved environmental control (Shillito, 1994). However, until the 1980s environmental management focused on avoiding major disasters and prosecution. Its approach was largely reactive, fending off environmental costs that could limit an organisation's competitive advantage (McKenna, et al., 1996).

It was not until the late 1980s and early 1990s, that major developments in the concept of environmental management occurred (Barwise, 1994). The practice of environmental auditing was imported from the USA during the 1980s, in a similar way to environmental impact assessment in the 1970s. The growing numbers of corporate organisations undertaking regular environmental audits reflected the increased pressure on industry. Tighter legislation, growing public awareness, increased customer demands and reduced insurance availability contributed towards the drive towards cleaner industry. Campaigns from pressure groups such as Friends of the Earth and Greenpeace also had a significant impact in shaping public attitudes. These focused on the detrimental impacts of increasing population, industrial pollution, global climate change, unsustainable resource consumption and the wastefulness of consumer societies. Such arguments shaped green politics throughout the world and increased pressure for improved environmental management within industry.

The emergence of environmental monitoring and targeting soon followed environmental auditing. Amongst the most ambitious targets were those set by ICI in

1990 which included a promise to cut all releases by 50% by 1995 (ENDS Report 206, 1992). Environmental reporting also became more popular within corporate companies and BP Chemicals and ICI both released their first environmental reports in 1992.

1.2. THE EVOLUTION OF ENVIRONMENTAL MANAGEMENT SYSTEMS

In the early 1990s it became increasingly apparent that the usefulness of auditing, targeting and reporting as separate techniques, was limited. Audits cannot by themselves provide an organisation with the necessary assurance that performance will continue to meet the relevant legislative and other policy requirements (McKenna, et al., 1996). To ensure continual environmental improvement, they need to be conducted within a structured management system, integrated with overall management activity and addressing significant environmental effects. This realisation lead to the British Standards Institution (BSI) publishing the first standard on environmental management systems (EMSs). *BS 7750: a specification for an environmental management system* was published in draft in 1992 (British Standards Institution, 1994a). It aims to provide a framework to assist companies manage the environment in a pro-active, structured and effective way. The Government intended the standard to act as a market based mechanism to encourage voluntary improvement in environmental performance.

BS 7750 was subsequently adopted by the standard setting bodies in Finland, the Netherlands and Sweden. Despite the publicity and high profile of BS 7750 it was only one model for an environmental management system. A number of other countries developed national standards including Canada, South Africa, France, Spain and Ireland (Leinster, 1996). The *EC Eco-management and auditing scheme* (EMAS) came into force in April 1995 (European Commission, 1993a) and an international version, *BS EN ISO 14001: Environmental management systems, specification with guidance for use*, was published in September 1996 (British Standards Institution, 1996a) (Chapter 2). In addition the Chemical Industries Association published guidelines for their *Responsible Care Management Systems for Health, Safety and Environment* in 1995 (Chemical Industries Association, 1995).

Whilst the individual standards vary in their prescriptive detail they share a similar approach and framework, based on a cycle of activities incorporating planning, implementing, checking and reviewing. They are designed to achieve continual improvement in environmental performance. Each requires an environmental policy; an analysis of environmental impacts; environmental objectives and targets; an improvement programme; a system of auditing and a regular management review of the system (Chapters 2 & 4).

1.3. RESEARCH BACKGROUND

Companies are adopting environmental management systems as mechanisms to improve legislative compliance, operational efficiency, public image and competitive advantage. Regulators have acknowledged the existence of an EMS may result in a reduction in inspection visits and subsistence fees. Insurers are currently investigating the standards usefulness in assessing risk and determining premium levels. Increasingly customers are requiring their suppliers to adopt an environmental standard and investors are becoming concerned over environmental liabilities. In addition, as their environmental awareness increases, employees, the general public and pressure groups are exerting increased pressure on industry to improve its environmental performance.

Despite this increasing pressure uptake of standards has been slow with approximately 60 organisations worldwide achieving certification to BS 7750 during its first year of operation. After this uptake fell and only 13 companies were certified between April and July 1996 (ENDS Report 258a, 1996). EMAS uptake in the UK has been slower with only 20 companies registering during the first eighteen months after its launch (Environment Business, 1996d). By October 1996 fewer than 10% of companies, over 35 mostly industrialised countries, were proactively working towards certification to one of the standards (Environment Business, 1996e) (Chapter 2).

The slow uptake of the standards reflects negative industrial perceptions towards environmental management. Companies are rarely sufficiently motivated by the potential benefits to adopt a positive environmental strategy. Time constraints, fear of bureaucracy and a lack of financial resources are all commonly cited as reasons for not taking action (Hill, 1994) (Environment Business, 1996b) (ETBPP, 1996a) (ENDS Report 231, 1994) (ENDS Report 216a, 1993). These attitudes may have arisen, in part, from industry's experience with quality management systems, such as BS 5750 and later ISO 9000, in the 1980s. Whilst it was expected that improving quality would have business benefits there was little hard evidence to support this. The growth of quality consultants was enormous and companies generally complained of the cost of ISO 9000 certification. Few attempted to measure the impact of their quality initiatives on business performance and as a result have yet to understand the benefits (Parker, 1995).

To enable industry to make an informed decision on whether to adopt a recognised EMS standard empirical data on the business implications is required. It is essential that information regarding the costs and benefits is collated from companies with experience. This will enable comparisons to be made between various industrial sectors and company sizes. Assessments of the consequences of environmental action have recently become a central issue for both industry and policy makers. This is reflected by the new requirement placed on the Environment Agency by the Environment Act 1995, to take into account the likely costs and benefits for certain of its activities (Hill, et al., 1995).

1.4. AIMS & OBJECTIVES OF THE RESEARCH

1.4.1 Aim

To identify and assess the implications of adopting a recognised environmental management system (EMS) standard on environmental performance and business operations.

1.4.2 Objectives

The objectives of the research are to:

1. To undertake a detailed analysis of the requirements of the EMS standards, BS 7750, ISO 14001 and the EC Eco-management and Audit Scheme.

2. To determine the mechanisms by which UK industry is translating the theoretical requirements of the standards into practice and investigate their ease of implementation.

3. To design and implement an EMS meeting recognised standards, compatible with existing business management systems, at a large chemical manufacturer.

4. To identify the implications of the EMS standards on management practices and company culture and determine how they affect the nature and focus of industrial environmental management.

5. To identify the business benefits and implied resource requirements of achieving EMS certification and explore the variance between organisations.

6. To investigate mechanisms for measuring the value of an EMS and develop guidelines to assist companies deciding whether to adopt a recognised approach.

1.5. OUTLINE OF THE THESIS

The next chapter describes the history of the EMS standards. An overview of their requirements, a description of certification arrangements and their uptake within industry is also included. The research methodology and design, including techniques employed for data collection and analysis, is explained in chapter three. This includes the development of a theoretical framework for the research identifying factors requiring consideration during the data collection and analysis. This leads to the establishment of hypotheses to be proved or disproved by the research. Chapter four contains a detailed analysis of the requirements of the standards including the similarities and differences between BS 7750, ISO 14001 and EMAS. In chapter five the practicalities of adopting a recognised EMS are investigated through five case-studies from certified companies. The methodologies adopted and their approach towards system design and implementation are reviewed. Chapter six contains a detailed case-study describing how an EMS was designed and implemented by the author for a large chemical manufacturer in Cheshire. The problems encountered and their solutions are investigated and explained. Chapter seven explores the changes in management practices and culture resulting from the adoption of such a formal system. Chapter eight identifies and analyses the business benefits of an EMS by drawing on evidence from companies adopting BS 7750, ISO 14001 and EMAS during their early years of operation. Chapter nine investigates the internal and external resource implications in terms of human resources, capital expenditure and other associated costs. Finally chapter ten investigates current best practice in environmental accounting and examines methodologies for measuring the value of environmental activity. The final part of the chapter identifies decision making criteria to assist companies in determining their environmental strategy and evaluate the value of adopting a recognised approach. Chapter eleven summarises the research findings and conclusions. Chapter twelve details the further research required to substantiate the results and broaden understanding of the subject area.

1.6. SUMMARY

The concept of environmental management can be dated back to the industrial revolution of the 18th and 19th centuries and the concept of Best Practicable Means. It was not until the 1970s, however, that substantial activity was seen in the field of environmental legislation. The introduction of the polluter pays principle and Best Practicable Environmental Option both substantially strengthened the regulatory framework governing industry. This was further substantiated during the late 1980s and early 1990s by the enactment of a number of key pieces of UK legislation, including the Environmental Protection Act 1990 and the Water Resources Act 1991. Since 1992 an added pressure on industry has been the multitude of environmental legislation originating from Europe.

Until the 1980s industrial environmental management was largely reactive and focused on preventing major pollution accidents. It was not until the late 1980s, with the introduction of environmental auditing from the United States, that companies began to proactively manage their environmental impact. They soon realised that as an isolated technique auditing was limited in its effectiveness. To achieve ongoing environmental improvement a system of activities was required, similar to those adopted for quality management since the late 1970s. The led to the publication of a new British Standard on environmental management systems, BS 7750, the first in the world of its kind. The long awaited Eco-management and Auditing Regulation came into force in April 1995 and an international standard, ISO 14001, soon followed in September 1996.

Since the publication of the EMS standards uptake has been slow with approximately 60 organisations becoming certified to BS 7750 during its first year of its operation. The standards have caused substantial controversy regarding the applicability of formal systems to environmental management. The important question to industry today is whether it is advantageous to implement an EMS meeting the requirements of an externally recognised standard.

CHAPTER 2

2.0. HISTORY & BACKGROUND TO THE EMS STANDARDS

2.1. INTRODUCTION

All industrial organisations operate elements of an environmental management system (EMS). At the very least this is likely to include procedures, formal or informal, for ensuring legislative compliance and handling emergency situations. Some will have incorporated more sophisticated techniques including an environmental policy, documented procedures, performance measurement and record keeping. An EMS is a generic description for these types of environmental management activities. The British Standards Institution define it as the organisational structure, responsibilities, practices, procedures, processes and resources for implementing environmental management (British Standards Institution, 1994a). EMS specifications, such as BS 7750, EMAS and ISO 14001, translate this broad definition into a set of clearly defined requirements. They aim to provide a model for any size and type of organisation to establish their own system, review its performance and have it assessed by an independent body (Sheldon, 1995a). Unlike legislation, which specifies emission limits, they do not dictate accepted performance levels. They do not certify companies as being "green" but are purely concerned with the effective operation of their management systems. Their philosophy is to harness market forces to encourage industry to voluntarily improve its performance beyond legal requirements.

2.2. THE HISTORY OF THE STANDARDS

"*Whist the 1980s saw the drive to introduce quality management systems into companies through the standards BS 5750 and ISO 9000, the 1990s is becoming the decade of environmental management standards*" (Mayhook-Walker, 1995).

The development of the systems approach to environmental management has been likened to the development of quality assurance systems throughout the 1980s (Mayhook-Walker, 1995) (Sheldon, 1995a) (Shillito, 1995a). The British Standards

Institution's experience in the use of quality systems originated the initial thinking behind BS 7750. Prior to its publication they received enquiries regarding whether the quality standard BS 5750, now BS EN ISO 9000, could be applied to environmental management (ENDS Report 207, 1992). Their decision was negative due to concern that management decisions on quality could conflict with environmental objectives. Whilst quality and environmental management share many common activities, the consensus was that BS 5750 was not suitable for environmental management.

There was a demand for an environmental standard which was compatible with BS EN ISO 9000. This would harness the skills and resources already present within an organisation (Williams, 1993). ISO 9000 had shown that a well-designed management system could ensure that aims and objectives are met in a measurable way (Sheldon, 1995a). The British Standards Institution (BSI) believed that if it was possible to write a specification for a concept as diverse as quality assurance it would be possible to develop a standard for environmental management.

The development of BS 7750 was launched within BSI in 1989 by the formation of the technical committee EPC/50, now known as ESS/1. The original brief was that the standard must be compatible with ISO 9000 but able to stand alone; be applicable to all types of organisation; be able to embrace the whole of an organisation's activities and the whole life cycle of its products; and be capable of certification (Tothill, 1993). An additional priority was that it was not too onerous for business, yet would add value and credibility to a certified organisation (Smith, 1995).

The draft version of BS 7750, launched in April 1992, took 18 months to develop including 6 months of research (Table 2.1). An extensive pilot scheme followed, involving 450 organisations across 38 industrial sectors. The standard was amended before being published in its final version in January 1994. It did not become fully operational until March 1995 after arrangements for accreditation of certification bodies had been established by the Government.

Table 2. 1: The history of the EMS standards (from Sheldon, 1995b and Institute of Environmental Management, 1997).

Date		***Event***
Dec	1990	Draft EC Directive on compulsory environmental auditing
Sept	1992	Publication of the draft BS 7750:1992
July	1993	EMAS approved for entry into force
Jan	1994	Publication of the final version of BS 7750:1994
Oct	1994	Publication of draft version of ISO 14001:1994
April	1995	EMAS comes into force and open for participation
March	1995	First certificates to BS 7750 issued
Dec	1995	NACCB publish guidelines to allow BS 7750 *certified companies* to become certified to draft DS ISO 14001
Feb	1996	BS 7750 formally recognised by EC regulatory committee as meeting the EMS requirements of EMAS
June	1996	EAC publish guidelines for accreditation of certification bodies
Oct	1996	CEN adopt ISO 14001 as a European Standard and 14001 published
March	1997	BS 7750 withdrawn
April	1997	EC regulatory committee formally recognise ISO 14001 as meeting the EMS requirements of EMAS
Aug	1997	CEN publish bridging document between ISO 14001 and EMAS
May	1998	Competent Body for EMAS transferred from DoE to Institute of Environmental Assessment.
July	1998	Final date for Council review of EMAS

In December 1990 the European Commission produced a draft directive for environmental auditing which, had it been implemented, would have made annual environmental auditing compulsory for an estimated 12,000 sites based on 58 defined types of activity (Jones, 1997). This was strongly opposed by industry, in particular the chemical industry who had particular concerns over disclosing liabilities (Klaver, et al., 1998). Discussions between the twelve member states on the proposed directive produced eight different drafts of the scheme. By February 1991 the draft directive had been transformed into a draft regulation establishing a voluntary auditing scheme. It was finally published as a Commission proposal in the EC's Official Journal on March 27, 1992. The scheme developed over the next few years and the EC Eco-management and Audit Regulation entered into force in all 12 Member States on the 13th July 1993. This was followed by a 21 month implementation period to allow Member States to prepare the administration necessary for the scheme's operation. Each member state was required to set up an accreditation system for environmental verifiers and a Competent Body to administer the scheme. In the UK the United Kingdom Accreditation Service (UKAS), formally the National Accreditation Council for Certification Bodies (NACCB), managed the accreditation system and the Department of the Environment became the Competent Body. The Eco-Management and Audit Scheme (EMAS) was officially launched in the UK on 10 April 1995 after a small pilot trial of 17 organisations (Hillary, 1996). In May 1998 the Institute of Environmental Assessment took over as the Competent Body for England, Wales and Northern Ireland with responsibility to register sites and promote good environmental management (Institute of Environmental Assessment, 1998).

The international standard, ISO 14001, was published in draft in October 1994 by the International Organisation for Standardisation (ISO). ISO, whose headquarters are in Geneva, Switzerland, has over 100 member countries (Sayre, 1996). Its role is to develop and promote standards world wide through the work of hundreds of Technical Committees (TCs). ISO 14001 resulted from the work of the Strategic Advisory Group for the Environment (SAGE), formed by the UNCED Conference at Rio. The group's remit was to identify those areas where standards would help with controlling the impact of man on the environment. The areas identified by SAGE were developed by Technical Committee ISO / TC 207, set up in June 1993 (Environment Business, 1996c). TC 207 subsequently created six subcommittees (SCs) and one working group (WG) and allocated each an area of work. The resulting standards were allocated numbers in the range 14000 to 14099 and are now referred to as the ISO 14000 series. They cover environmental management systems (ISO 1400x), environmental auditing (ISO 1401x), environmental labelling (ISO 1402x), evaluation of environmental performance (ISO 1403x), life cycle assessment (ISO 1404x) and terms and definitions (ISO 1405x) (Table 2.2). Their aim is to create a standardised global model for environmental management. ISO 14001, the specification for an environmental management system, and its guidance ISO 14004, are key standards in the series. Others of particular relevance to EMS are the auditing standards ISO 14010, ISO 14011 and ISO 14012.

Table 2. 2: Key documents in the ISO 14001 series (from Institute of Environmental Management, 1997)

Published Standards	
ISO 14001	Environmental management systems - specification with guidance for use.
ISO 14004	Environmental management systems - guidelines on principles, systems and supporting techniques.
ISO 14010	Guidelines for environmental auditing - general principles.
ISO 14011	Guidelines for environmental auditing - auditing environmental management systems.
ISO 14012	Guidelines for environmental auditing - qualification criteria for environmental auditors.
ISO 14020	Environmental labels and declarations - general principles.
ISO 14040	Environmental management - life cycle assessment - principles and framework.
ISO 14041	Life cycle assessment - life cycle inventory analysis.
ISO 14050	Environmental management - terms and definitions
ISO Guide 64	Inclusion of environmental aspects in product standards
Other standards:	
ISO 14002	Environmental management systems - guidelines on special considerations affecting small and medium sized enterprises (work cancelled in June 1998).
ISO 14015	Environmental assessment of site and entities (under preparation)
ISO 14021	Environmental labels and declarations - environmental labelling TYPE 11 - self-declaration environmental claims - terms and definitions*.
ISO 14022	Environmental labels and declarations - self-declaration environmental claims - symbols*.
ISO 14023	Environmental labelling - self-declaration environmental claims - testing and verification methodologies*.
ISO 14024	Environmental labels and declarations - environmental labelling TYPE 1 - guiding principles and procedures*.
ISO 14025	Environmental labels and declarations - environmental labelling TYPE III - guiding principles and procedures*.
ISO 14031	Environmental performance evaluation - guidelines*.
ISO 14032	Technical report type 3 - environmental management - environmental performance evaluation - case studies illustrating the use of ISO 14031*.
ISO 14049	Technical report type 3 - environmental management - life cycle assessment - examples for the application of ISO 14041*.
ISO 14042	Life cycle assessment - impact assessment*.
ISO 14043	Life cycle assessment - interpretation*.
ISO 14048	Life cycle inventory data format *.
ISO 14061	Technical report Type 3 - guidance to assist forestry organisations in the use of ISO 14001 and ISO 14004 (awaiting publication).

* Publication expected by end of 1999

The final draft of ISO 14001, the only specification standard, was approved at a meeting in Oslo in June 1995 (McKenna, et al., 1996). This elevated both ISO 14001 and ISO 14004 to draft international standard (DIS) status. The ISO Secretariat distributed the draft standards to all ISO member bodies for a six month consultation period. The revised versions were circulated for a ballot process lasting two months. To be accepted the standard had to win the approval of two-thirds of the members of TC 207, with no more than a quarter of the full ISO membership voting against. This was achieved and the final version launched in October 1996.

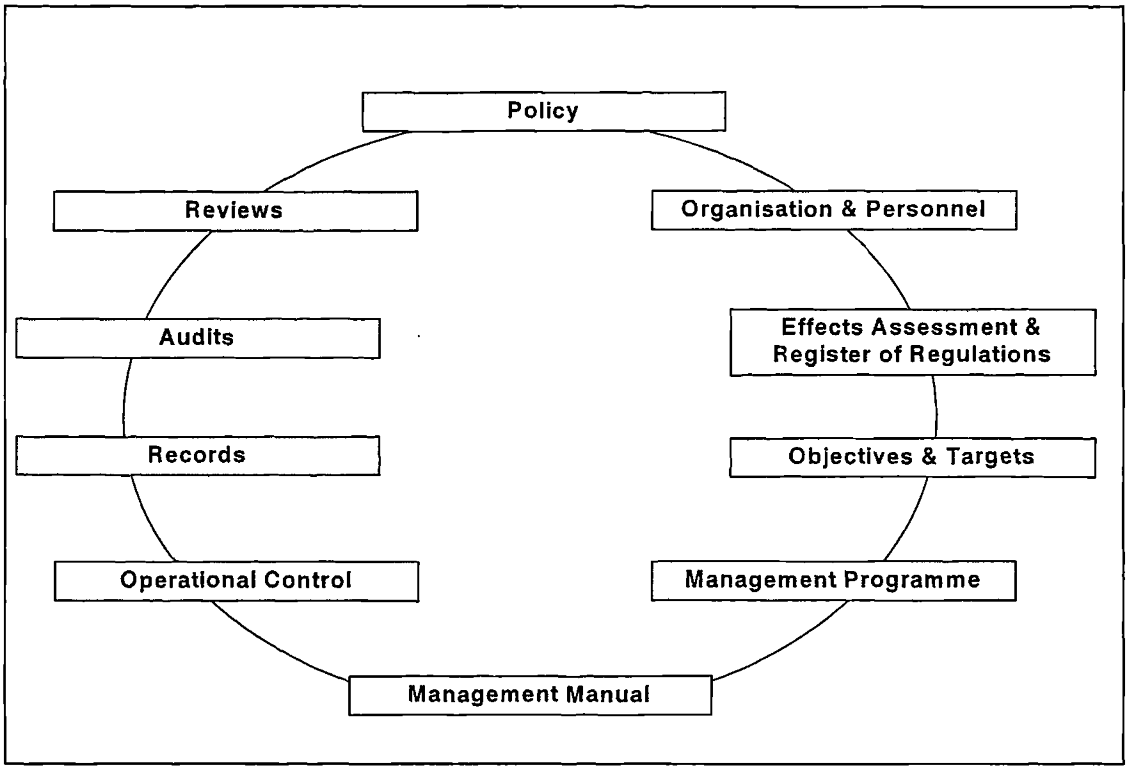
2.3. AN OVERVIEW OF THE EMS STANDARDS

The three EMS standards are similar in their approach although their detailed requirements vary. EMAS is the most stringent as, unlike BS 7750 and ISO 14001, it requires an externally validated environmental statement containing details of the site's environmental performance. ISO 14001 is the least stringent regarding public availability of information, requiring only the policy to be available. This resulted from fierce lobbying from business interests in the USA driven by fear of opening up avenues for litigation (ENDS Report 240b, 1995). Other differences between the standards are minor and tend to be in spirit rather than content.

2.3.1 British Standard BS 7750

The clauses of BS 7750 are based on a cycle of activities designed to achieve continual environmental improvement (Figure 2.1). The first requirement is for a policy summarising the organisation's environmental intent. Responsibilities must be recorded and a representative assigned to ensure compliance with the requirements of the standard. Employees must be adequately trained and contractors activities controlled. Systems are required for handling internal and external environmental communications and a register of relevant regulations must be established.

Figure 2. 1: The requirements of BS 7750 (from British Standards Institution, 1994a)



The environmental effects assessment is a key requirement of BS 7750. Significant direct and indirect effects must be identified and compiled into a register. Improvements in environmental performance are achieved through objectives, targets and programmes to address these significant effects.

BS 7750 emphasises the need for written procedures, manuals and documentation. The management manual describes the system and provides direction to more detailed procedures and records. All documents must be carefully controlled to ensure only the most recent versions are in use.

Activities with the potential to affect the environment need to be controlled. This requires standard operating procedures and the monitoring of process characteristics. Any incidents, accidents and other non-conformities with the management system need to be investigated and corrected. Internal audits are required to determine whether environmental activities comply with the management system and whether the system is effective in fulfilling the company's policy. Finally management reviews of the system are required to ensure its continuing effectiveness and suitability.

2.3.2 The EC Eco-management and Audit Scheme (EMAS)

EMAS aims to encourage continuous environmental improvement within participating sites through the establishment and implementation of policies, programmes and management systems (Leinster, 1996). Organisations must periodically audit their environmental performance and provide information to the public. The management system requirements draw heavily on BS 7750 involving a policy, programme, documented procedures, records, audits and objectives (Hillary, 1993) (Figure 2.2). The most significant difference is the requirement for an externally verified publicly available environmental statement detailing performance against objectives and targets. This was included as an incentive for companies to improve their performance (Tothill, 1993). It was also seen as a mechanism to enhance the credibility of corporate environmental reports (Warris, et al., 1995). EMAS is designed to appeal to companies who operate throughout Europe and recognise the growing importance of structured environmental reporting (Mayhook-Walker, 1995).

EMAS has a narrower field of application than BS 7750 (Table 2.3). The scheme only applies to EC companies (Table 2.4) performing industrial activities. To participate, sites must be involved in manufacturing; electricity, gas, steam or hot water production; or the recycling, treatment, destruction or disposal of solid or liquid waste. Non-industrial sectors are not covered by the scheme but Member States may apply the elements of EMAS to other sectors on an experimental basis. This is the case in the UK where a pilot study has been undertaken to investigate its applicability to local authorities. Sites operating outside of the EC are not able to register but could use parts of the scheme as improvement tools and acknowledge their adherence to it in the statement of participation (Hillary, 1996).

In contrast to BS 7750 where certification can cover several sites registration to EMAS is site based. The Commission believed this would help promote greater uptake of the Scheme and ensure action at the local level (Department of the Environment, 1996b).

Figure 2. 2: Implementation stages of the Eco-management and audit scheme (from Hillary, 1994).

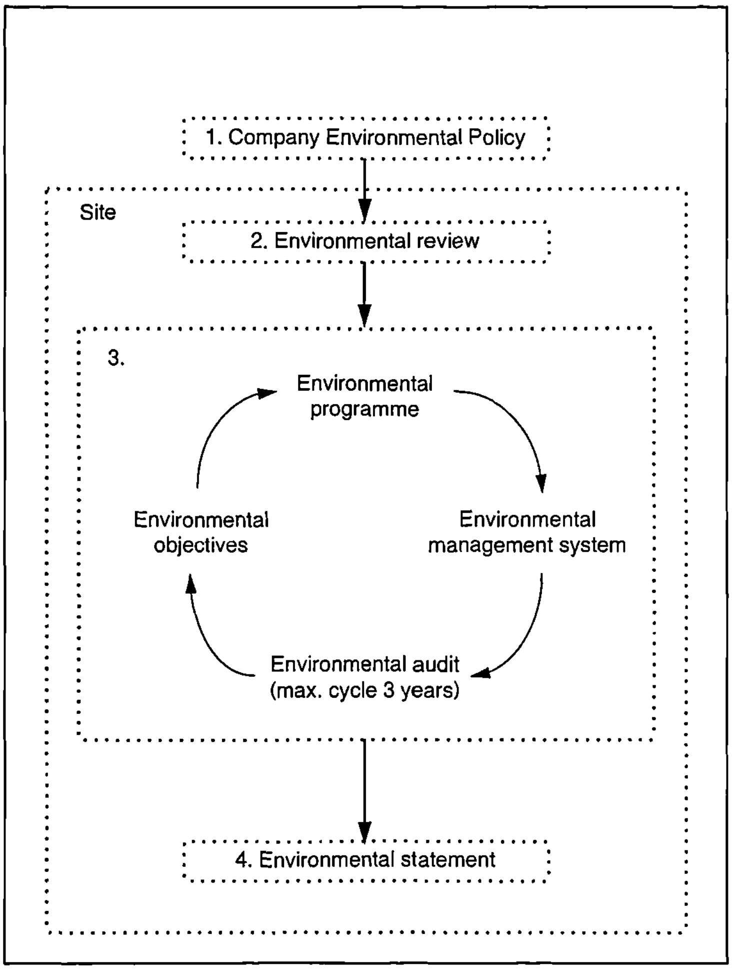


Table 2. 3: Differences in the scope of EMAS and BS 7750

EMAS	*BS 7750*
Applies across the whole of the EC	Applies in the UK
Only sites can participate	Organisations or sites can participate
Open to certain industrial sectors only	Open to organisations across all sectors
Non-industrial activities can only be included on an experimental basis	Open to non-industrial activities eg transport, services, offices, LAs.

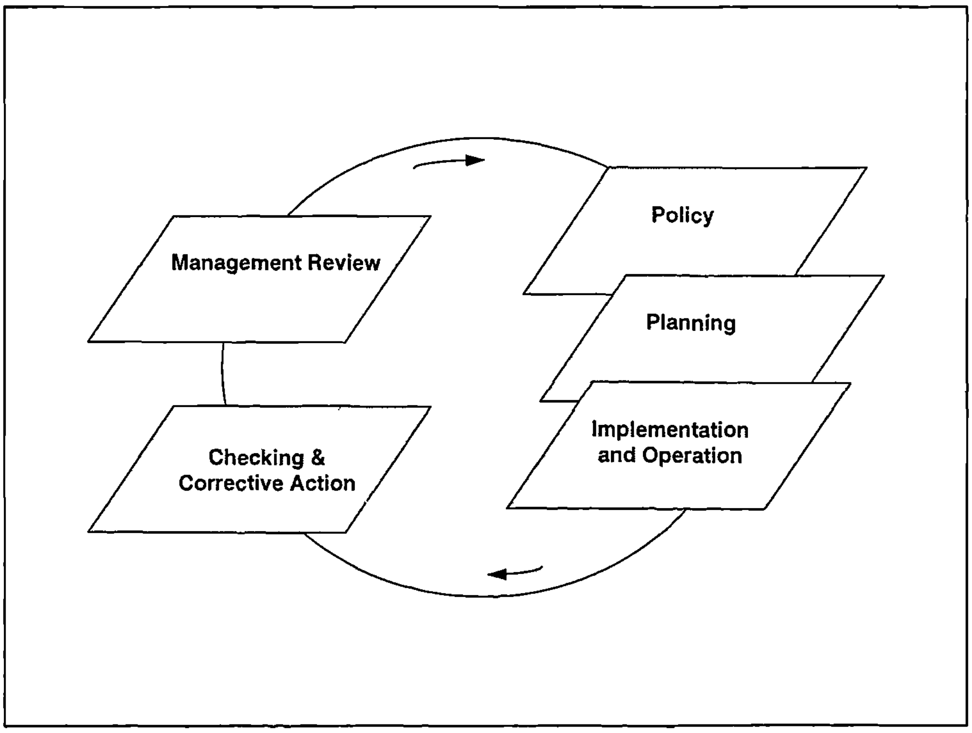
Table 2. 4: Countries covered by EMAS (from Hillary, 1994)

• Belgium	• Greece	• Portugal
• Denmark	• Ireland	• Spain
• France	• Italy	• The Netherlands
• Germany	• Luxembourg	• UK

2.3.3 The International Standard ISO 14001

The individual requirements of ISO 14001 are extremely similar to those of BS 7750 although its format differs. The requirements are categorised into policy, planning, implementation, checking and management review (Figure 2.3).

Figure 2. 3: The format of ISO 14001 (from British Standards Institution, 1996a)



The international standard places far less importance on the need for careful documentation (ENDS Report 240a, 1995) (Institute of Environmental Management, 1995b). In particular there is no explicit requirement for a register of environmental effects, register of legislation or management manual. These, however, are implied in the standard and it would be difficult to demonstrate that the environmental effects and legislation had been identified without a documented register (Chapter 4).

2.4. HARMONISATION OF THE STANDARDS

Article 12 of EMAS provides for organisations already certified to another standard to be considered as meeting the corresponding requirements of the EC Scheme. European organisations certified to BS 7750, whose business falls within the scope of the regulations, have been able to use BS 7750 to meet the environmental management system requirements of EMAS since February 1996 (Environment Business, 1996d). BS 7750 certified companies seeking EMAS registration were required only to produce an environmental statement and have it validated by the official EMAS verification bodies.

Conversion from BS 7750 to ISO 14001 was also straightforward. In December 1995, UKAS issued guidelines to allow certification of BS 7750 companies to the draft ISO 14001 (Brockway, 1995). These identified a series of 18 points of difference between the standards which needed to be addressed before the certification could be transferred (Chapter 4). Most of the points covered are minor and should result in minimal, if any, additional expenditure. Several certification bodies, including the British Standards Institution, accepted an initial statement of compliance from their clients as sufficient for transition to ISO 14001. Evidence was checked at the next routine surveillance visit (Environment Business, 1996c).

The European Standards Body (CEN) was under a mandate from the European Commission to produce or adopt, by October 1996, a European Standard to be used as an alternative means of achieving EMAS registration (ENDS Report 237, 1994). Such a standard had to be acceptable to the USA, who refused to accept any changes to the text of ISO 14001 after months of argument over its content (ENDS Report

252c, 1996). CEN adopted ISO 14001 as a European Standard (EN) in October 1996 and as a result all other conflicting national standards were withdrawn (McKenna, et al., 1996). BS 7750 was withdrawn on 31 March 1997 and certificates remained valid only until this date (British Standards Institution, 1996e).

In two Decisions published in the Official Journal on 22nd April 1997 the European Commission's regulatory committee formally approved ISO 14001 as compatible with EMAS (ENDS Report 267a, 1997). In August 1997 CEN published a bridging document to address the differences between the standards. This is a guidance document whose application is limited to the EU. The document acknowledges the overall similarities between ISO 14001 and EMAS and covers the few areas where the EMAS specification is not covered by the international standard (Chapter 4). The relationship between ISO 14001 and EMAS will be strengthened, and the need for the bridging document removed, with the publication of the revised EMAS Regulation in the year 2000 (Institute of Environmental Management, 1998a). Until the foreseeable future manufacturing companies operating within the EU will have the choice of whether to gain registration to EMAS, certification to ISO 14001, or both.

2.5. LINKS WITH OTHER MANAGEMENT SYSTEM STANDARDS

BS 7750 is one of four management system specifications published by the British Standards Institution (Table 2.5) (British Standards Institution, 1992, 1994, 1994a, 1996f). All four standards are based on the Demming principles of plan, act, do and check. Their similar numbering system emphasises their common requirements for written procedures and auditing systems (Jones, 1997).

Table 2. 5: British standards for management systems

Number	*Discipline*
BS 5750	Quality Management Systems
BS 7750	Environmental Management Systems
BS 7850	Total Quality Management Systems
BS 8750 (now BS 8800)	Health and Safety Management Systems

The first management system specification, BS 5750, was introduced in 1979. The revised version, published in 1989, was dual numbered for international acceptance as ISO 9000. It was later adopted by the European Community and is now known as BS EN ISO 9000 (British Standards Institution, 1994). During the late 1980s and early 1990s there was a strong uptake of the quality standard with 18,577 UK companies certified by January 1993 rising to 44,107 by March 1995 (Environment Business, 1996e).

There are many similarities between the requirements of BS 5750 and BS 7750 (Table 2.6). Both standards require top management commitment, adequate resources, trained competent personnel, a documented management system and an audit and review system. In organisations with quality systems it is often possible to build on the strengths of existing systems by expanding their remit to cover environmental management (Barwise, 1996) (Fishwick, 1996) (Hocking, 1994) (Bedford, 1991).

There are some general areas of difference between the quality and environmental standards (Table 2.6). As minimum levels of environmental performance, unlike quality performance, are clearly governed by legislation, compliance forms a key part of an EMS. In addition the focus on continual improvement is more evident in BS 7750 by the inclusion of the effects assessment, objectives and targets and management programme. The policy must contain a commitment to continual improvement and, unlike BS 5750, be made available to the general public.

Due to the similar techniques required in management systems the Technical Management Board of ISO intend to achieve greater compatibility between the two standards and to align their revision dates (Institute of Environmental Management, 1998a) (Barthel, 1996) (Environment Business, 1996c) (Williams, 1993). In 1998 the ISO Technical Committee TC 207 voted in favour of an integrated audit standard both for environmental management and quality. Barthel (1996) suggests we could ultimately see standards providing organisations with a systems framework for all their management functions, including financial, personnel and data management. It appears that this would be particularly useful to industry in the light that many organisations are already integrating or considering integrating their EMS with other business management systems.

Table 2. 6: Similarities and differences between BS 5750 and BS 7750

Similarities	*Differences*
• policy statement	• commitment to continual improvement
• documentation of responsibilities	• effects assessment
• training	• register of regulations
• management manual	• objectives and targets
• written procedures	• management programme
• operational control	• system must cover the entire site
• auditing system	• policy and objectives to be made public
• non-conformances system	• broader scope
• record keeping	
• management review	

2.6. THE CERTIFICATION PROCESS

In October 1993, the UK Government appointed the National Accreditation Council for Certification Bodies (NACCB), now the United Kingdom Accreditation Service (UKAS), to set up an accreditation system for bodies certifying compliance with BS 7750 and environmental verifiers under EMAS (Brockway, 1995) (Counsell, et al., 1995) (Environmental Information Bulletin, 1993). In 1994 the NACCB published environmental accreditation criteria defining the competencies required of BS 7750 certification bodies (NACCB, 1994a, 1994b and 1995). In March 1995, eight organisations were given the first BS 7750 accredited certificates (Figure 2.4). By June 1998 the number had increased to nineteen with ten also being accredited environmental verifiers for EMAS (UKAS, 1998).

Figure 2. 4: The first BS 7750 certification bodies (from NACCB, 1995)

Aspects Certification Services Limited
British Standards Institution
Bureau Veritas Quality Assurance Limited
Det Norske Vertas Quality Assurance Limited
Lloyd's Register Quality Assurance Limited
Professional Environmental & Caring Services Ltd
SGS Yarsley International Certification Services Ltd
Trada Certification Ltd

To harmonise the national accreditation systems of seventeen European countries the European Accreditation of Certification (EAC) published guidelines for ISO 14001 certification in July 1996 (ENDS Report 258b, 1996) (European Accreditation of Certification, 1996). These were based on the *European Standard EN 45012: General Criteria for Certification Bodies Operating Quality System Certification* and specify criteria to be met before certification can be awarded. In particular the EMS must have been operational for a minimum of three months; the internal audit system must be fully operational and shown to be effective; and one management review must have been conducted. Certifiers must notify the organisation's management of any discovered non-compliances with legislation and ensure regulatory bodies are informed if this is required by a licence or permit.

Certification to BS 7750 and ISO 14001 involves several stages (Excel Partnership, 1996b). An application form must be completed to enable the certification body to develop a proposal. They calculate a fee which varies according to the size of the company and its environmental complexity. Should the organisation decide to go ahead with the certification the next stage involves a desk top review of key documentation, such as the policy statement and management manual, and an initial site visit. This identifies non-conformities in the EMS and enables the external auditor to estimate a realistic time scale and programme for the main assessment. This is followed by a detailed on-site assessment, lasting up to several days, by an audit team. Upon their satisfaction that all requirements have been met a report is submitted to the Governing Body recommending certification. This is followed by six monthly surveillance visits to ensure the ongoing effectiveness of the system.

To become registered to EMAS an organisation's environmental management system, audit cycle and environmental statement must be validated by accredited environmental verifiers. They check all the elements of the scheme are in place and functioning effectively. The arrangements for accrediting verifiers and their functions are outlined in Annex III of the Regulation (European Commission, 1993a). The requirements are similar to those contained in European Accreditation of Certification (EAC) Guidelines for BS 7750 / ISO 14001 certification. In reality most certification bodies for BS 7750 and ISO 14001 are also accredited as EMAS verifiers. This means that the registration process is similar to that outlined above with the additional step of the verification and validation of the environmental statement. Verification relates to the establishment of the correctness of data by examining internal data gathering systems. Validation involves establishing the accuracy of textual statements incorporated in the environmental statement (Warris, et al., 1995).

Site registration to EMAS is controlled by the Competent Body. Registration only occurs once they have received the necessary information and are satisfied the site meets all the requirements (Figure 2.5). They have the power to de-register sites no longer complying with the Regulation. This includes the failure to submit a validated environmental statement and registration fee within three months of the deadline specified in the previous statement. De-registration can also occur if an enforcement authority, such as the Environment Agency, informs them of breaches with legislation. This must be lifted if the regulator gives satisfactory assurances that the breach has been rectified and arrangements are in place to prevent reoccurrence (ENDS Report 216b, 1993)

2.7. RESPONSE TO THE PUBLICATION OF EMS SPECIFICATIONS

The publication of the EMS standards has caused extensive debate over their adequacy and potential impact on industry. Environmental pressure groups have welcomed them, hoping they'll encourage voluntary environmental improvement beyond legislation (Hill, 1994). They believe this may encourage improvements in those areas outside regulatory control such as the use of resources and transport policy. The standards have also been welcomed for their potential to encourage release of information to the public. This is certainly true in the case of EMAS due to the requirement for the publicly available externally verified environmental statement.

Figure 2. 5: Information to be submitted to the EMAS Competent Body prior to registration (from Hillary, 1996).

- **The site's validated environmental statement**
- **A registration fee**
- **Information on the company and site:**
  - **i) name of company**
  - **ii) name and location of site**
  - **iii) brief description of activities**
  - **iv) name and address of accredited environmental verifier**
  - **v) deadline for submission of next validated statement**
  - **vi) brief description of management system**
  - **vii) description of auditing programme**

The standards have attracted criticism from environmentalists as they do not dictate a minimum level of environmental performance above that required by current legislation (ENDS Report 260, 1996). Germany is particularly concerned about the absence of performance criteria (ENDS Report 231, 1994). Organisations with severe environmental impacts will be able to continue to operate and achieve certification as long as they comply with the law. Richard Tapier, Head of Industry Policy at the World Wide Fund for Nature, is cynical over the worth of the standards. He claims an EMS alone is of little comfort where levels remain high or catastrophic leaks occur (ENDS Report 231, 1994).

A key issue is the extent the standards will lead to improved environmental performance (Howlett, 1994). They ask for continual improvement but provide little guidance on the levels considered acceptable, apart from to state that effects should be reduced to those not exceeding economically viable application of best available techniques (EVABAT) (Chapter 4). The lack of performance criteria was intentional as the standards were designed to be applicable to all types of organisations. This flexibility enables companies to proceed at a pace which suits their natural capacities (McKenna, et al., 1996) but makes comparisons impossible. This does little for global standard setting (Gleckman, 1997). Certification doesn't imply similar environmental performance, but this is unrealistic, particularly between countries with varying legal requirements. This is misleading to the general public who expect certification to be an assurance that the company is "green". There is also potential for confusion with eco-labels. These specify the environmental performance levels to be met during the production of products (ENDS Report 260, 1996). The standards have also been criticised for not incorporating the recommendations in the Rio Declaration (Agenda 21) that companies report annually on routine emissions of toxic chemicals and establish policies on sustainable development (Benchmark Environmental Consulting, 1996).

Industry is concerned over the potential implications of corporate organisations demanding their suppliers to gain EMS certification. This may result in small and medium sized enterprises (SMEs) losing business due to a lack of resources to meet their customers' demands. Geoff Smith (Department of Trade and Industry) addresses this by urging that large companies are sensitive to their needs (ENDS Report 231, 1994). A further concern is that companies forced to adopt a standard to meet customer's requirements will achieve little benefit. They will not be motivated by the desire to improve their environmental performance and fail to focus on the needs of the business. Parallels can be made with the adoption of quality standards in the 1980s. The publication of BS 5750, and later ISO 9000, led to the perception that a certificate to ISO 9000 was synonymous with a quality company. As customers wanted to buy products from quality suppliers certification became a requirement to supply. Many companies implemented the standard to please their customers and achieved minimal lasting benefit (Davies, 1993).

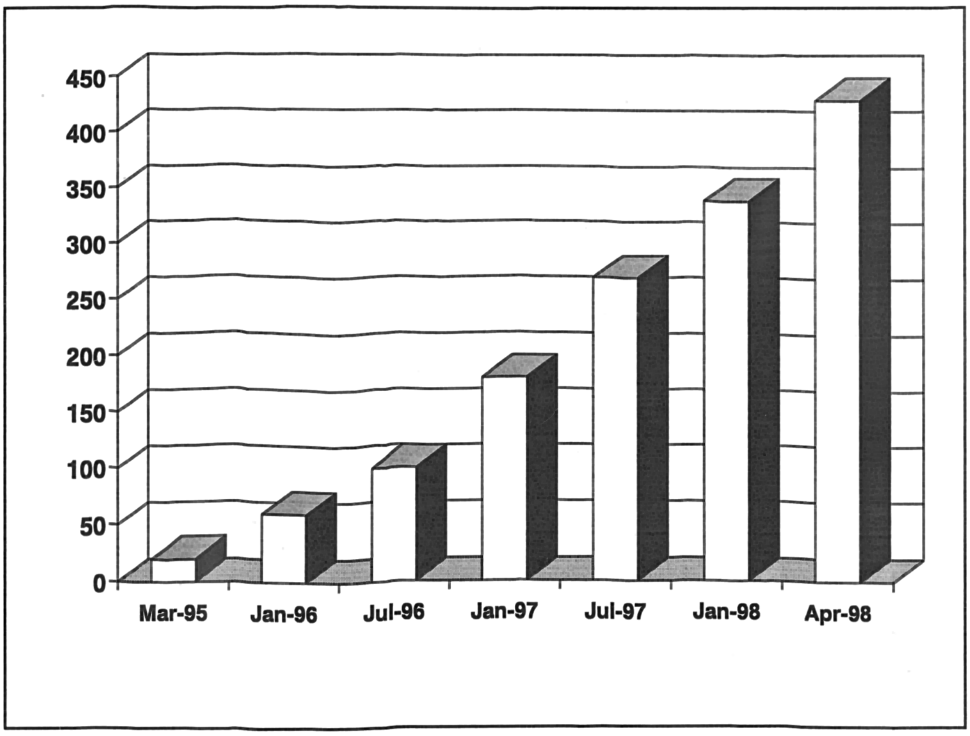
2.8. UPTAKE OF ENVIRONMENTAL MANAGEMENT SYSTEMS

The first 15 BS 7750 certificates were awarded in March 1995 (Table 2.7) (ENDS Report 252a, 1996). Since then the number of UK companies certified to either BS 7750 or ISO 14001 has continued to steadily grow (Figure 2.6) and by July 1996 had risen to 100 (ENDS Report 258a, 1996). The reduced uptake in the final quarter of 1996, when only 13 new companies gained certification, can be attributed to confusion surrounding the transition to the international standard (ENDS Report 261, 1996). The first companies gaining certification to the draft ISO 14001 included Nortel, Specialised Adhesives, Spectral Colours, Tioxide Europe, Aerospace Composite Technologies and Ford Motors (ENDS Report 258b, 1996). Draft certificates were recognised in full once the final standard was launched in October 1996.

Table 2. 7: First companies certified to BS 7750 in March 1995 (from NACCB, 1995)

• **Anaplast Ltd**	• **Field Packaging**
• **Applied Chemicals Ltd**	• **Layezee Beds**
• **BOC Gasses**	• **Lindsey Oil Refinery Ltd**
• **Brico Engineering Ltd**	• **Loudwater Litho**
• **Carson Office Furniture**	• **Nor Systems**
• **Cego Ltd**	• **Northumbrian Water Limited**
• **Ciba-Clayton**	• **Personnel Hygiene Services Ltd**
• **Crosby Sarek Ltd**	• **Shields Special Metals Ltd**
• **Design to Distribution Ltd**	• **Thomas Swan & Co Ltd**
• **Dunlop**	• **Triton plc**

Figure 2. 6: Number of UK companies holding at least one certificate to BS 7750 / ISO 14001 (from ENDS Reports 1995 - 1998)



During the last quarter of 1996 60 firms gained certification to either BS 7750 or ISO 14001 making a total of 180 certificates (ENDS Report 264, 1997). By the end of 1997 this had increased to 340, with 70 companies being certified during the final quarter of the year (ENDS Report 275, 1997). The first quarter of 1998 saw 100 new certificates, bringing the total to 650 across 430 companies (ENDS Report 278, 1998) (ENDS Report 280, 1998) (Figure 2.6). By the end of November 1998 another 80 certificates were issued amounting to 730 in total (ENDS Report 286, 1998).

A significant number of corporate organisations demonstrated their commitment to the environment through certification to ISO 14001 (Table 2.8). All the major power generators including PowerGen, Nuclear Electric and Scottish Power had adopted ISO 14001 or EMAS at one or more sites by December 1997. Four of the major car manufacturing companies, Ford, Vauxhall, Toyota and Rover are also certified.

Several companies hold more than one certificate. Blue Circle Cement have nine certificates whilst National Power, Nuclear Electric, UK Waste and Biffa Waste all hold at least six certificates (ENDS Report 267a, 1997). British Aerospace has committed itself to certifying all its 24 sites in the UK over a five year period between 1997 and 2002. Powergen aim to have all sites world-wide certified to ISO 14001 by the year 2000 (ENDS Report 275, 1997).

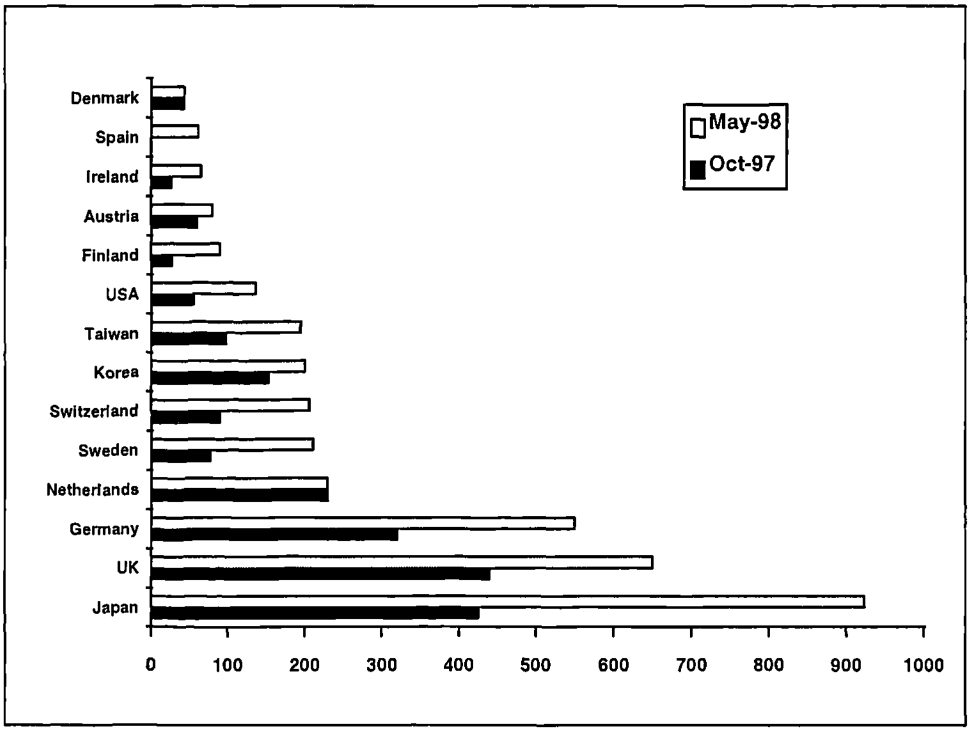
Table 2. 8: Major companies certified to ISO 14001 in the UK by the end of 1997

Scottish Power	UK Waste
PowerGen	Biffa
British Nuclear Fuels Ltd	Chelwood Brick
Manweb	Blue Circle Cement
National Power	Rugby Cement
Nuclear Electric	Pilkington Glass Technologies
Brunner Mond (UK)	Dunlop
Courtaulds Chemicals	Phillips Components
Lever Brothers	Lucas
Bristol-Myers Squibb	Toshiba
DuPont	Mitsubishi Electric
Monsanto	GPT
ICI Katalco	Ericsson
Alcan Smelting & Power	Siemens GEC Communications
Mobil	Brother Industries
Vauxhall Motors	Hygena
Rover Group	Leeds City Council
Ford Motors	Nottingham City Council
Toyota Motor Manufacturing	Business Link London City
UK Nirex	Department of the Environment

By October 1997 the UK had the largest number of ISO 14001 registered sites world wide (ENDS Report 273, 1997) (Figure 2.7). This can be attributed to the two year start gained by BS 7750 over ISO 14001. Before the launch of ISO 14001 approximately 200 firms had already been certified to BS 7750 and could easily convert to ISO 14001.

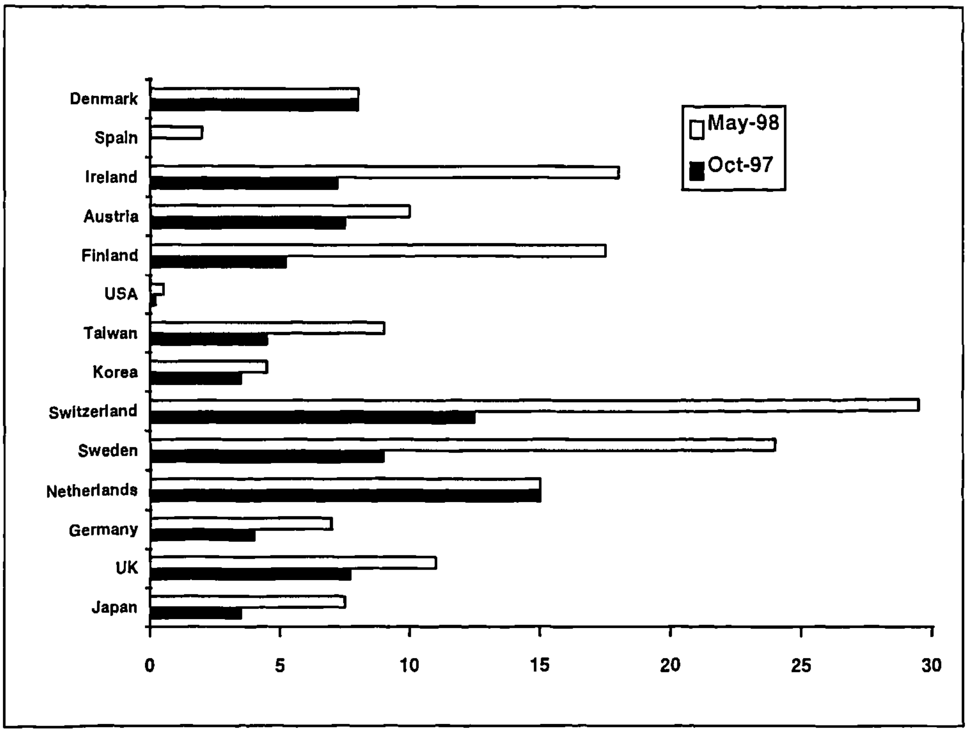
Uptake of ISO 14001 has been strong in Japan, Korea and Taiwan (Figure 2.7). The first draft certificate in Taiwan was awarded to Kind Management Consulting in September 1996 by DNV Quality Assurance (Tarling, 1996). A number of Japanese companies including Fuji, Hitachi, Mitsubishi, NEC, Sharp, Sony and Toshiba were among the first to become certified to BS 7750 (ENDS Report 258a 1996). Japan's Audit and Certification Organisation for the Environment was accredited by UKAS during summer 1996. By October 1997 they held 425 certificates, compared to 440 in the UK (Figure 2.7). A key driving force in the Far East is a fear that certification will become a barrier to the European market (Environment Business, 1996d). Certification is also prized by Asian companies as it demonstrates their environmental responsibility.

Figure 2. 7: Number of ISO 14001 certified sites world wide (ENDS Report 273, 1997 and 280, 1998)



Uptake in the USA has been slow, with only 55 sites being certified by October 1997. This is surprising considering how strongly they fought for ISO 14001 to be less demanding than BS 7750 and EMAS. US firms are reported to be unclear about the benefits to gained from certification (Joe Casico, leader of the US negotiating team of ISO 14001) (ENDS Report 273, 1997). They do not regard lack of certification as a threat to trade and have been given no clear guidance that certification will result in less regulation.

Figure 2. 8: Number of ISO 14001 certified sites world wide per million population (ENDS Report 273, 1997 and 280, 1998)



The number of world wide sites certified to ISO 14001 doubled, from 2,300 to over 4,000, between October 1997 and April 1998 (ENDS Report 280, 1998). Japan overtook the UK with over 900 certificates compared to 650 in the UK. The number of US certificates increased from 55 to 136, the lowest number per million of population world-wide (Figure 2.8). The rate of uptake of the international standard is increasing with 76 sites per month becoming registered in 1998 compared to 65 in 1997 (EAG Environ, 1998). By September 1998 worldwide certified sites had risen to 5,637 with the number of US certificates increasing to 200 (Institute of Environmental Management, 1998a).

In the UK uptake of ISO 14001 has been largest in electronics industry. By April 1997 electrical equipment suppliers held 12.4%, with chemicals, power generation and the paper and printing sectors each with approximately 10%. This trend is also seen worldwide with the electronics sector holding 36%, chemical manufacturing 11% and machinery and equipment manufacturing 9% by Autumn 1998 (EAG Environ, 1998). The greatest uptake in the electronics sector has been in Japan, with 52% of certificates compared to 16% in the UK. In comparison the UK held 43% of chemical certificates, compared to 10% in Japan, 85% of power producers and 56% of sites involved in recycling. The first half of 1998 saw a marked increase in the number of office based activities seeking certification, with 72% of these being located in the UK (EAG Environ, 1998).

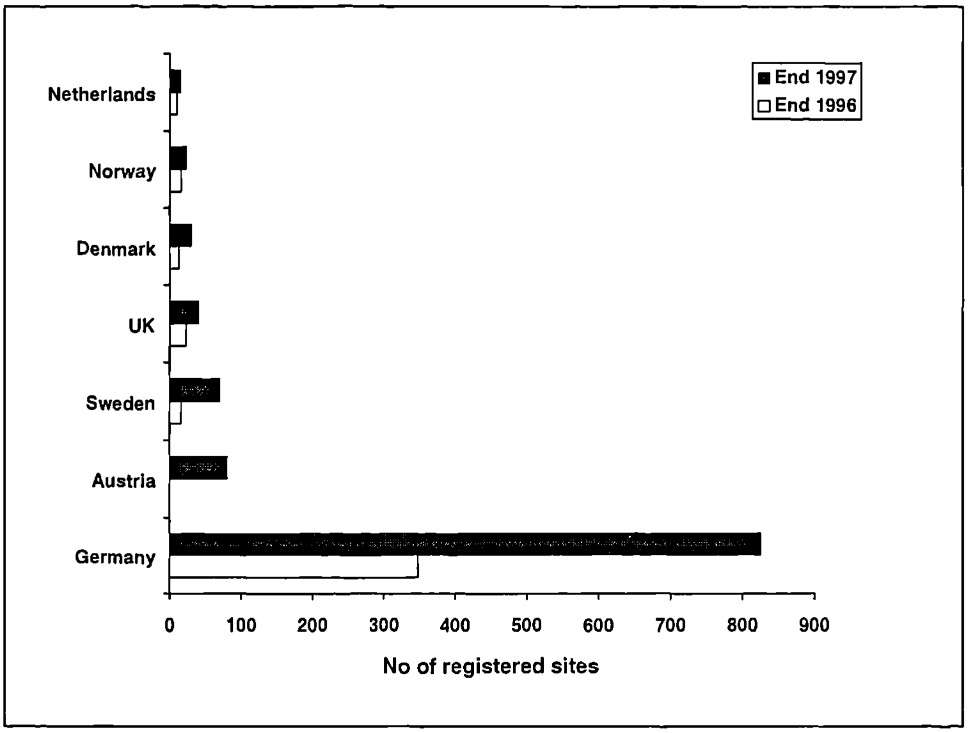
The first five companies registered to EMAS, during the summer of 1995, were UK based (Table 2.9) (Chemistry in Britain, 1995). By the end of 1996, 421 sites were registered throughout Europe with 348 based in Germany, compared to only 23 in the UK (ENDS Report 264a, 1997) (Figure 2.9). This trend was sustained during 1997 with the number of UK sites increasing by only 18 to 41 compared to over 800 in Germany (ENDS Report 272, 1997). A further 21 sites in the UK became registered during 1998, bringing the total to just 61, with only 4 sites achieving registration between July and December (ENDS Report 286, 1998).

Table 2. 9: First UK site's registered to EMAS in August 1995 (from Department of the Environment, 1996b)

Akzo Nobel Chemicals	**National Power at Drax**
Ciba Clayton	**NOR Systems**
Design to Distribution	

The greater uptake of EMAS in Europe can be explained by increased supply chain pressure. An example being Volvo's decision to call 850 suppliers to Sweden to encourage them to adopt a certified system. It is also believed that Germany's lead in EMAS is a reflection of official suggestions that registered sites may be less tightly regulated (ENDS Report 261, 1996).

Figure 2. 9: Number of EMAS registered sites by country (from ENDS Report 272, 1997)



Throughout the EC EMAS uptake was largest in the chemical industry, followed by the food processing and metal working sectors (Table 2.10). In the UK the chemical industry led the way, followed by the printing and automotive industries (Department of the Environment, 1996b).

Table 2. 10: Total number of EMAS registered European sites by sector by September 1997 (from ENDS Report 272, 1997)

Chemical	116	Paper and board	34
Food processing	96	Communications equipment	30
Metal working	81	Non-metallic minerals	27
Rubber and plastics	64	Medical equipment	25
Machinery and equipment	65	Metallurgy	25
Printing	55	Wood	23
Automobiles	49	Textile	20
Electrical equipment	48	Other	116
Recycling	48		

Uptake in small and medium sized enterprises remains low despite the introduction of a government grant scheme, the Small Company Environmental and Energy Management Assistance Scheme (SCEEMAS). By March 1998 the Department of the Environment had only received 250 applications for funding under the scheme, which provides up to 50% of consultancy fees. This led to only 13 EMAS registrations across the UK (Pers. comm. Thomas, 1998).

The comparative low uptake of EMAS in the UK can be explained by the low level of awareness prior to its adoption. Only one in five companies had heard of the scheme four months before its launch (Environment Business, 1996d). As it can take 1-2 years to implement it is not surprising that so few companies gained registration in the first eighteen months. The profile of the EMAS may rise as more major companies become registered. Many UK leaders, including ICI, ICL, BP Chemicals and Blue Circle Cement have now made a commitment to the scheme (Environment Business, 1996d). BP Chemicals and Blue Circle Cement both plan to register all their UK sites (ENDS Report 275, 1997) (ENDS Report 278, 1998).

2.9. PREVIOUS RESEARCH ON INDUSTRIAL ENVIRONMENTAL ATTITUDES

The majority of previous research in the subject area has focused on industrial environmental attitudes and their response to the environmental challenge. This generally indicates low industrial environmental awareness, in particular in small and medium sized enterprises. In 1993 the Co-operative Bank's Manchester Business Survey, *Profiting from Environmental Protection*, surveyed 1,100 Manchester businesses (Hooper, et al., 1995). They found 33% believed they could not improve their environmental performance. Only 10% believed they have a negative environmental impact and 66% were not aware of BS 7750.

Over 99.8% of UK business consists of small and medium sized companies (SMEs) (Groundwork Trust, 1995). Environmental awareness in such organisations tends to be low with time and cost representing particularly significant barriers to improved performance (KPMG, 1997) (Vogt, 1996) (Groundwork Trust, 1995) (Hutchinson, 1995) (ACBE, 1993) (Whitaker, 1993). Their attitudes were investigated in a Gallop survey of 300 SMEs commissioned by the Groundwork Trust in 1995. This revealed that 24% could see no reasons for addressing the environment, 79% did not believe cost savings could result from improved environmental performance and only 16% were aware of the Duty of Care Regulations (Groundwork Trust, 1995).

An important barrier to environmental management remains to be senior managers' lack of understanding of the benefits of improved performance (Institute of Environmental Management, 1995). In 1995 the Environmental Technology Best Practice Programme, a Department of Trade and Industry initiative, surveyed environmental attitudes in a number of industrial sectors (ETBPP, 1996a). Over 50% felt financial constraints restricted them from improving their environmental performance (Figure 2.10). Perceptions varied between sectors, with over 50% of those in the printing industry seeing no significant cost benefits compared to only 18% in the speciality chemical sector (Figure 2.11). Almost 30% of chemical companies believed environmental issues affected profitability (Figure 2.12).

Figure 2. 10: Companies feeling financial constraints restrict them doing more to improve their environmental performance (ETBPP, 1996)

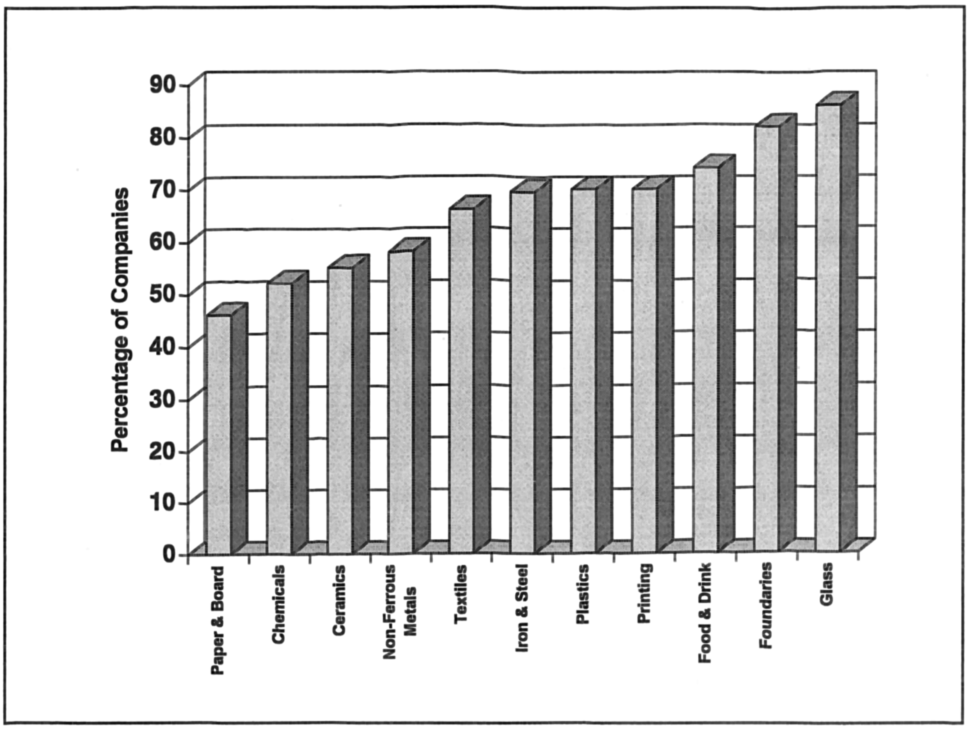


Figure 2. 11: Companies seeing no significant cost benefits in improving environmental performance (from ETBPP, 1996a)

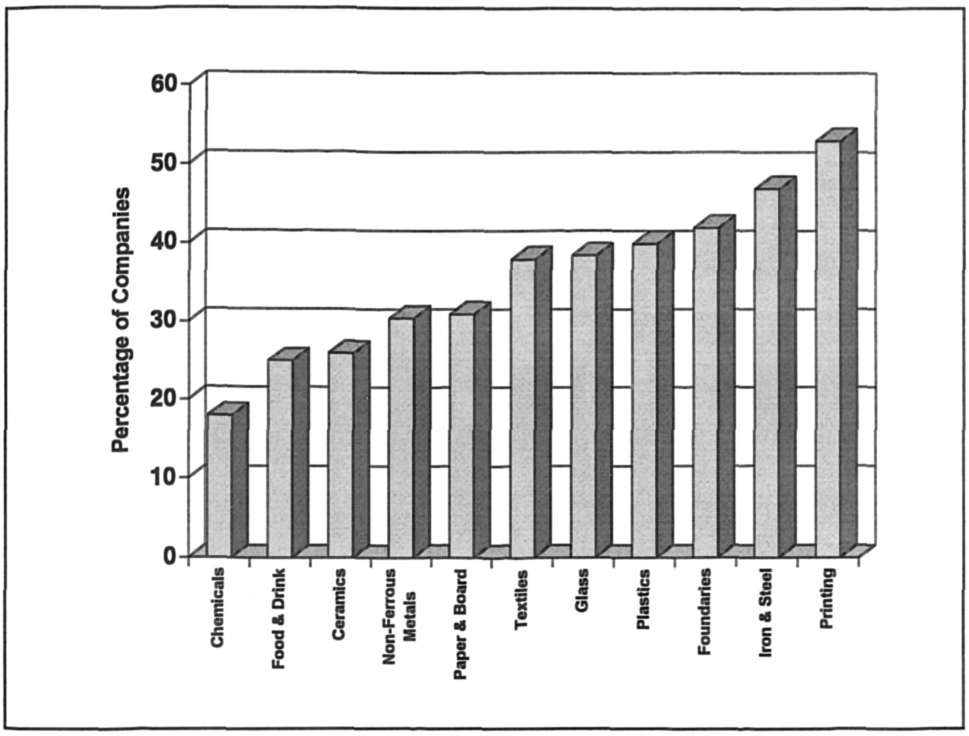
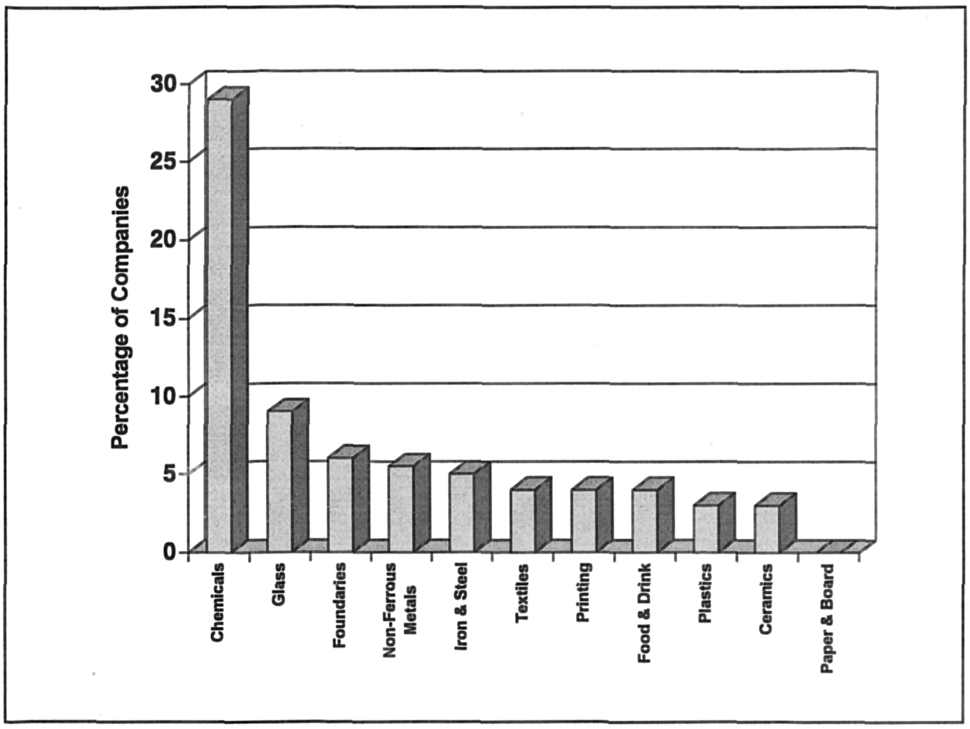
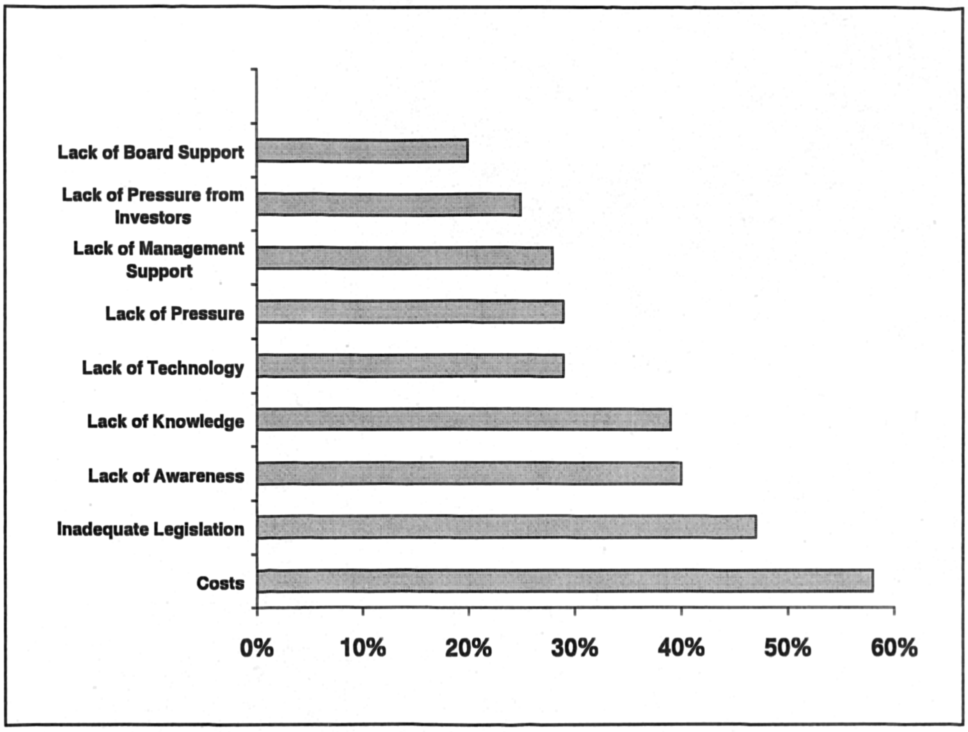


Figure 2. 12: Companies quoting environmental issues as affecting profitability (from ETBPP, 1996a)



Larger companies, employing over 250 personnel, are generally more convinced of the commercial benefits than the smaller companies (ETBPP, 1996a). In March 1997 the second *UK Business and The Environment Trends Survey* surveyed the Top 1000 UK companies and 50 leading opinion-formers on environmental issues. The research, sponsored by Entec in associated with the Green Alliance and conducted by the Moffatt Associates Partnership, found concern about the environment to be growing. 67% of companies assigned more importance to the environment compared to 1996. The proportion of companies looking beyond legal requirements had increased to 37%, from 25% in 1996. Awareness of the business benefits of investing in the environment was increasing, with 40% citing lack of awareness as a limiting factor compared to 51% in 1996 (Figure 2.13). Views varied on the impact of environmental management on profitability with 47% saying the impact was positive and only 11% negative (Moffatt Associates Partnership, 1997).

Figure 2. 13: Factors limiting business action on environmental issues (Moffatt Associates Partnership, 1997)



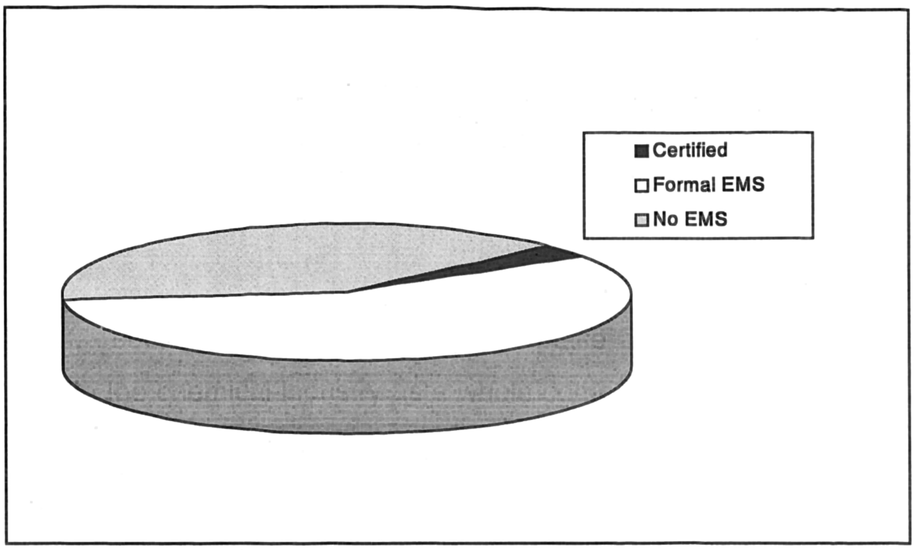
Previous research has established the extent to which companies are adopting EMSs. Each year the Chemical Industries Association (CIA), through their Responsible Care Programme, reviews the performance of the Chemical Industry. Responsible Care is a voluntary international initiative requiring participating companies to report annually to the CIA on their performance. The majority of chemical companies within the UK have signed up to the scheme (Table 2.11).

Table 2. 11: UK chemical companies committed to Responsible Care (from Chemical Industries Association, 1996)

Survey Year	Number of Sites (All Activities)	Number of Sites (Manufacturing)	Coverage of CIA Sites Manufacturing
1994	381	327	92%
1995	392	337	97%

In 1994 they found 2% had a certified system, 55% a comprehensive documented system and 43% no formal system. By 1995 this had increased to 3% with a certified system, 58% with a formal system and 39% with no system (Chemical Industries Association, 1996) (Figure 2.14). This high uptake can be explained by the greater uptake within the chemical industry as a whole compared to other sectors. In addition these companies have already demonstrated their environmental commitment, as signatories to Responsible Care.

Figure 2. 14: Environmental management systems in the chemical industry (from Chemical Industries Association, 1996)



The Institute of Environmental Management measures the uptake of EMSs in industry through their annual survey of members (ENDS Report 254b, 1996). Between 1993 and 1995 approximately 70 members, from a wide range of sectors and sizes, responded. In 1993, 20% of respondents were implementing or planning systems. By 1995 this had risen to 86%, with one third in the process of implementation. Only 10%, however, felt that their EMSs were well developed although by 1996 this had risen to 36% (Institute of Environmental Management, 1996a). This illustrates widespread support of the EMS standards within the Institute's members but is unlikely to be typical of industry as a whole. Respondents are likely to be more sympathetic towards the environment as they are members of the Institute.

The survey also found a significant increase in the number of companies developing in-house bespoke systems (ENDS Report 254b, 1996) (Table 2.12). These included SmithKline and Beacham, BP Chemicals and Zeneca. This doesn't necessarily prevent certification to a recognised standard but illustrates that some companies, especially the larger ones, prefer to design their own systems rather than adopt a standardised approach. They may not believe the standards to be suitable for their organisation or may consider them too bureaucratic (ENDS Report 254b, 1996).

Table 2. 12: Types of EMSs adopted (from ENDS Report 254b, 1996)

	1994/5	*1995/6*
BS 7750	43%	30%
EMAS	12%	8%
ISO 14001	9%	10%
Own System	22%	39%
None	14%	13%

As part of Masters research at UMIST Reimann, et al., (1995) surveyed fifteen companies from a range of sectors to establish their EMS status (Table 2.13). The findings concluded a great variety in approach towards environmental management with some general categories of response (Table 2.14).

Table 2. 13: Companies involved in Survey (Reiman, et al.,1995)

Industrial Sector	***Number***
Chemicals	6
Fine Chemicals	3
Food Products	1
Manufacturing supplier	1
Nuclear	1
Pulp & Paper	1
Petrochemicals	2

None of the companies involved had an advanced EMS although 13% were currently implementing BS 7750 and intended to achieve certification. A further 27% were considering implementing an EMS. These figures are much lower than the surveys carried out by the Chemical Industries and the Institute of Environmental Management. They are more likely to represent the average as a range of different industrial sectors were involved and the survey was not limited to those committed to environmental programmes.

Uptake and interest in the EMS standards is substantially greater in corporate organisations. In 1996 a survey of 84 blue chip companies, carried out by consultants Arthur D Little, found 86% to be actively monitoring developments in EMS and 90% to have implemented an initial environmental review. 69% believed an EMS would assist in legal compliance and due diligence, 31% that it would improve efficiency and reduce costs, and 41% that it would be a potential competitive advantage. Only 50%, however, felt that recognition under one of the schemes was likely to be important to their future business success. Many companies were found to be waiting for competitors to make the first move before seeking third party certification (ENDS Report 252b, 1996) (McKenna, et al., 1996).

Table 2. 14: Approaches to Environmental Management (Reimann, et al.,1995)

Category	*No*	*Explanation*
Implementing	2	Found that a formal, independent, accredited EMS was desirable and were in the process of implementing BS 7750 into their operations.
Considering	4	Found that a formal, independent, accredited EMS was desirable but were either deciding between different systems or watching the "Implementing" category to survey their experience.
Safety/Health/Environment	5	Saw the need for a formal system of environmental management, but believed that environmental concerns would be best addressed as part of a combined safety, health and environment system.
No Formal System	3	Did not see the need for a formal system although they did have some control procedures for environmental issues.
Swamped	1	So inundated with other business concerns that it barely had time to consider even basic environmental issues.

A similar survey of 115 large firms in the USA and Canada, also carried out by Athur D Little, revealed that 62% felt that third party certification to ISO 14001 was likely to be important to future business success, a higher percentage than in the UK. However, only a third expected compliance with ISO 14001 to improve their environmental performance or reduce costs (ENDS Report 252b, 1996). Many companies are not convinced about the added value of certification as they believe that most, if not all, the potential benefits can be achieved without adopting a formal standard or having it externally certified (Vogt, 1996).

A survey of the FTSE 100 companies undertaken by Business in the Environment in 1996 found the UK's top companies to be well advanced with the adoption of environmental policy and allocation of responsibilities at Board level (Business in the Environment, 1996). Almost 90% of responding companies had produced an environmental policy and 80% had assigned a board member specific responsibility for the environment. Approximately 50% reported to have at least a partial EMS in place with almost 10% of the oil, gas, chemicals, minerals and utility companies having sought external certification. None of the participants in other sectors had certified their systems against a recognised standard. The second Business in the Environment's *Index of Corporate Environmental Engagement 1997*, found significant progress with the implementation of EMSs. Those with an environmental policy increased to 95%, those with a responsible board member to 90% and those operating partial EMSs to 60% (Business in the Environment, 1998). The third index, which is due to be published during the spring of 1999, is expected to show a continued trend of increasing environmental commitment.

2.10. SUMMARY

The 1990s saw the publication of three standards for environmental management systems (EMSs). BS 7750 became fully operational in February 1995, EMAS came into force in April 1995 and ISO 14001 was adopted in September 1996. All three standards are similar in their requirements but vary in their prescriptive detail. They all specify a number of requirements of an EMS and allow organisations to have their own systems externally certified. Many elements are shared with ISO 9000, the standard for quality management systems, including the need for a policy and documented procedures.

The publication of the standards has caused significant controversy regarding their implications for industry. They have been welcomed by environmentalists for their potential to encourage voluntary environmental improvement, in particular in those areas not subject to legislation, but also criticised for their lack of performance criteria. Industry's previous experiences with quality management systems has led to concern over the degree of paper work involved and fear of bureaucracy. Concerns have also been raised that certification will become a barrier to trade and that customers will expect unrealistic requirements of their suppliers, who are often smaller with less resource availability.

Previous research on industrial environmental attitudes illustrates significant interest in the EMS standards. Many companies, especially larger corporates, have taken the first stages towards their implementation. Certification, however, remains low with many companies monitoring progress and waiting for competitors to make the first move. Barriers to EMS uptake are time, cost, fear of bureaucracy plus a lack of awareness of the potential benefits. This is illustrated by a survey of 500 organisations from France, Germany and the Netherlands undertaken by quality assurers SGS Yarsley. They found that 70% and 51% perceived time and cost, respectively, to be major obstacles to EMS implementation (Environment Business, 1996a). This demonstrates the need for greater clarity regarding the resources required to achieve certification and the implications on management practices and business performance.

CHAPTER 3

3.0. RESEARCH METHODOLOGY & DESIGN

3.1. INTRODUCTION

Research is the systematic and organised investigation into a specific problem. It consists of a series of steps to be designed and followed, with the goal of finding answers to issues of concern. Where the aim is to solve an existing problem within the workplace, with the intention of implementing the findings, it is known as applied research. In comparison, pure research, also known as basic or fundamental research, aims to contribute to general knowledge in the subject area. The nature of this study is both applied and pure. The applied element was undertaken during the design and implementation of an EMS within a large chemical manufacturing plant. The pure research aimed to investigate the business implications of adopting a formal EMS through the compilation and analysis of case-study data.

Sekaran (1992) segregates research according to its purpose and the level of knowledge in the subject area. Exploratory studies are undertaken where there is little understanding or previous research within the subject area. They call for extensive preliminary work to gain familiarity before a model can be developed for complete investigation. Such studies tend to be based on inductive, rather than deductive, research paradigms (Dermody, 1994). They are not concerned with testing existing theories or models, which rarely exist due the paucity of previous research, but on enhancing insight and understanding. They typically involve the use of qualitative research methods to derive ideas, opinions and theories directly from the empirical data (Hammersley, 1989).

As understanding and knowledge increases, research within a particular field typically moves from exploratory towards a more descriptive nature. Descriptive studies ascertain and describe the variables in a particular situation. Within organisations they are commonly undertaken to understand the characteristics of those following particular work practices or policies. They aim to present data in a systematic format to understand the characteristics of a group, offer ideas for further probing or help make certain decisions.

Descriptive studies frequently lay the foundation for the third type of research programmes, hypotheses testing. These aim to explain the nature of relationships or independence between certain factors relevant to the research (Sekaran, 1992). They are typically of a deductive and quantitative nature, involving the testing of already established ideas, theories and hypotheses, using data collected specifically for this purpose. This is commonly known as the hypothetico-deductive method of conducting research where the emphasis is not on the generation of ideas or theories, but on the methods by which these are tested (Gill, et al., 1991).

Welford (1998) refers to business research as either positivism, which is objective and quantitative, or interpretivism, which is qualitative and exploratory. He claims the majority of business related research has been dominated by objective quantitative techniques, such as research into the operation of markets and businesses using scientific method and statistics. Interpretivism, which has grown in importance since the mid 1980s, has lead to a richer understanding of the modern business enterprise by accepting the complexity of business activities which are too diverse to be described by simple models. He claims the weakness of both positivism and interpretivism are their failure to be critical or visionary and calls for research which stresses both the objective and subjective with the main aim of creating change. Findings need to be translated into action with the aim of solving a problem and creating an agenda for environmental improvement.

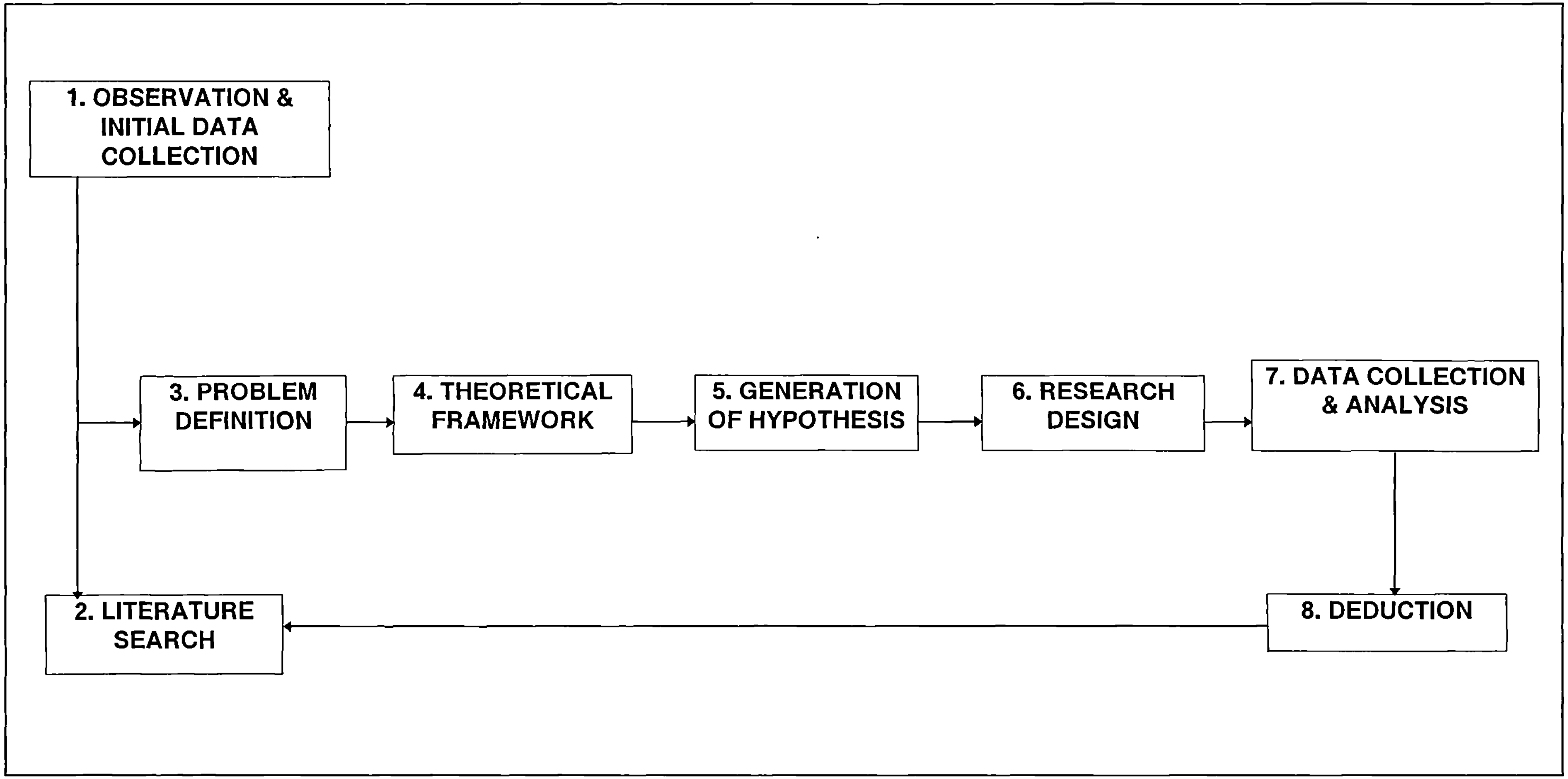
This research aims to increase knowledge and understanding of the implications for industry of adopting an externally recognised environmental standard. As advocated by Welford (1998) a large part of the research is to apply the findings to create an agenda for change. The aim is to identify EMS critical success factors and recommendations for industry and certification bodies for improving their effectiveness. As the previous chapter indicates environmental management was a rapidly evolving subject during the early to mid 1990s. At the start of the research programme the first EMS standard was available only in draft and certification arrangements had not been finalised. The lack of data or knowledge regarding the potential impact of the EMS standards initially called for an exploratory and inductive approach. This phase of the research focused on identifying the requirements of the EMS standards, both in theory and practice. As their uptake became more widespread it could move towards a more descriptive, quantitative and deductive approach.

Regardless of the research purpose or type, research methodology and design comprises eight stages (Figure 3.1). Observation and preliminary information gathering establishes the current situation in the subject area and identifies the research focus. The literature review compiles background information and studies previous research in the subject area. This enables a clear research problem to be defined and an analytical framework developed. The theoretical framework identifies the factors of importance to the research and the variables requiring investigation. Through the examination of their expected inter-relationships research hypotheses are established. This is an essential prerequisite to the research design and data collection. Finally, analysis and deduction determine the degree to which the research hypothesis can be substantiated.

3.2. OBSERVATION & INITIAL INFORMATION COLLECTION

Observation, the first stage of research, results in the researcher sensing that changes are occurring. Where this is considered to be potentially important it will lead to the gathering of preliminary information to enable the researcher to learn more about their observations. During this study the observation and initial information collection stages were undertaken during an MSc dissertation completed between March and July 1994 in Environmental Resources at Salford University.

Figure 3. 1: Steps in the research methodology (Sekaran, 1992)



3.3. THE LITERATURE REVIEW

A literature survey is necessary to ensure factors of importance are not excluded from the research design and data-collection process. It also serves to ensure familiarity with previous research and its inter-relationships with the subject of study. Traditionally the literature review will be undertaken at the start of the study period prior to the research methodology and design. The rapidly evolving nature of the subject area in this case called for a different approach. At the start of the project, September 1994, limited literature or research was available regarding the implications of adopting a recognised EMS due to the low uptake of the standards. It largely focused on describing the requirements of the standards and speculating upon their implications for industry. It identified a great deal of concern and controversy over the merit or otherwise of adopting a formal EMS. This called for an empirical investigation into the business implications of such systems to assist organisations contemplating EMS implementation in their decision making process.

The field of environmental management systems was extremely active during the period of study, October 1994 to Spring 1999 (Chapter 2). The vast quantity of research and literature published during this period called for a flexible approach where literature was continually reviewed on a chapter by chapter basis (Figure 3.2). Sources of information included books, journals, newspapers, conference proceedings, company reports, master's dissertations and doctoral research (Figure 3.3).

Figure 3. 2: Scope of the literature review

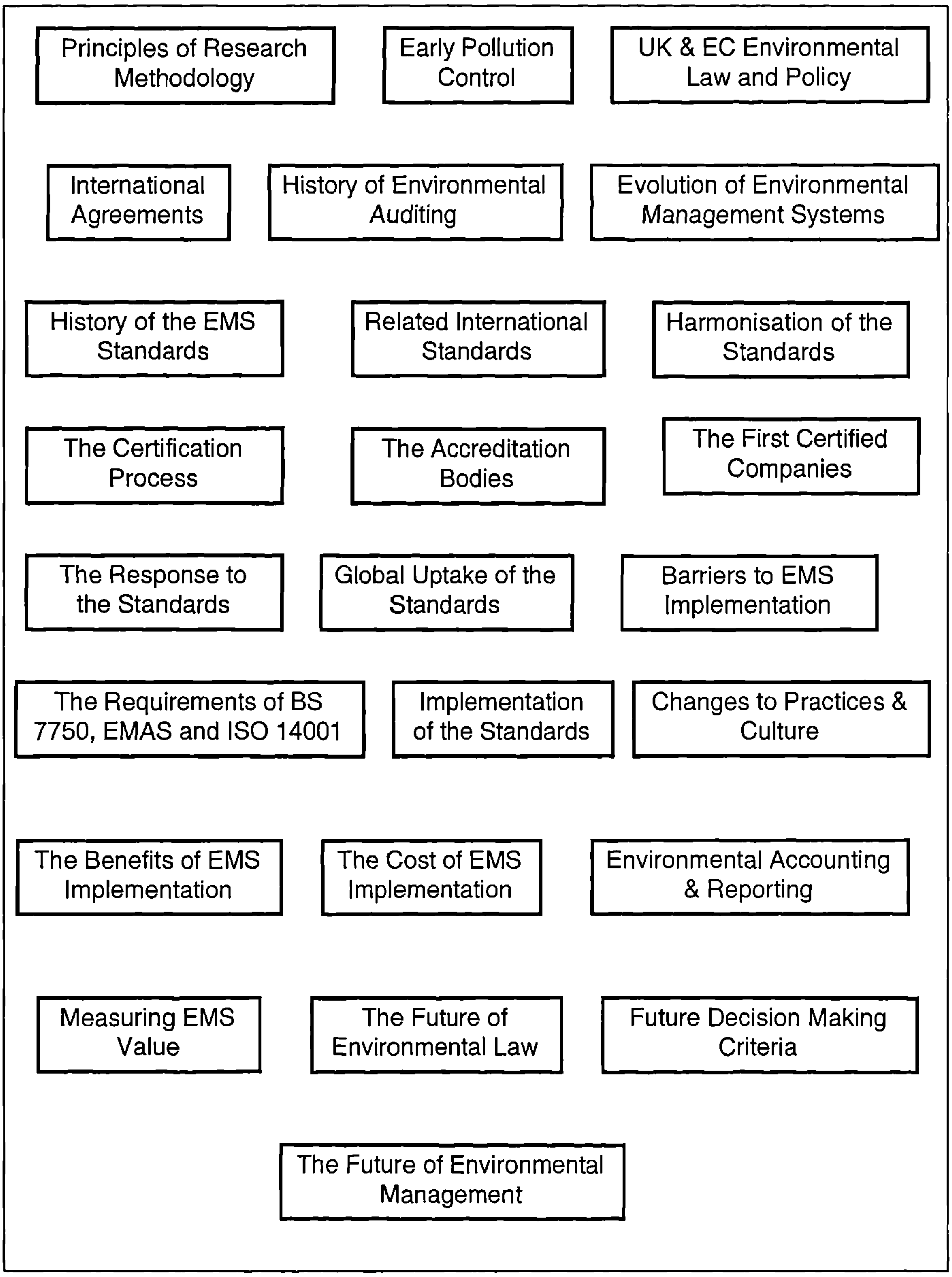
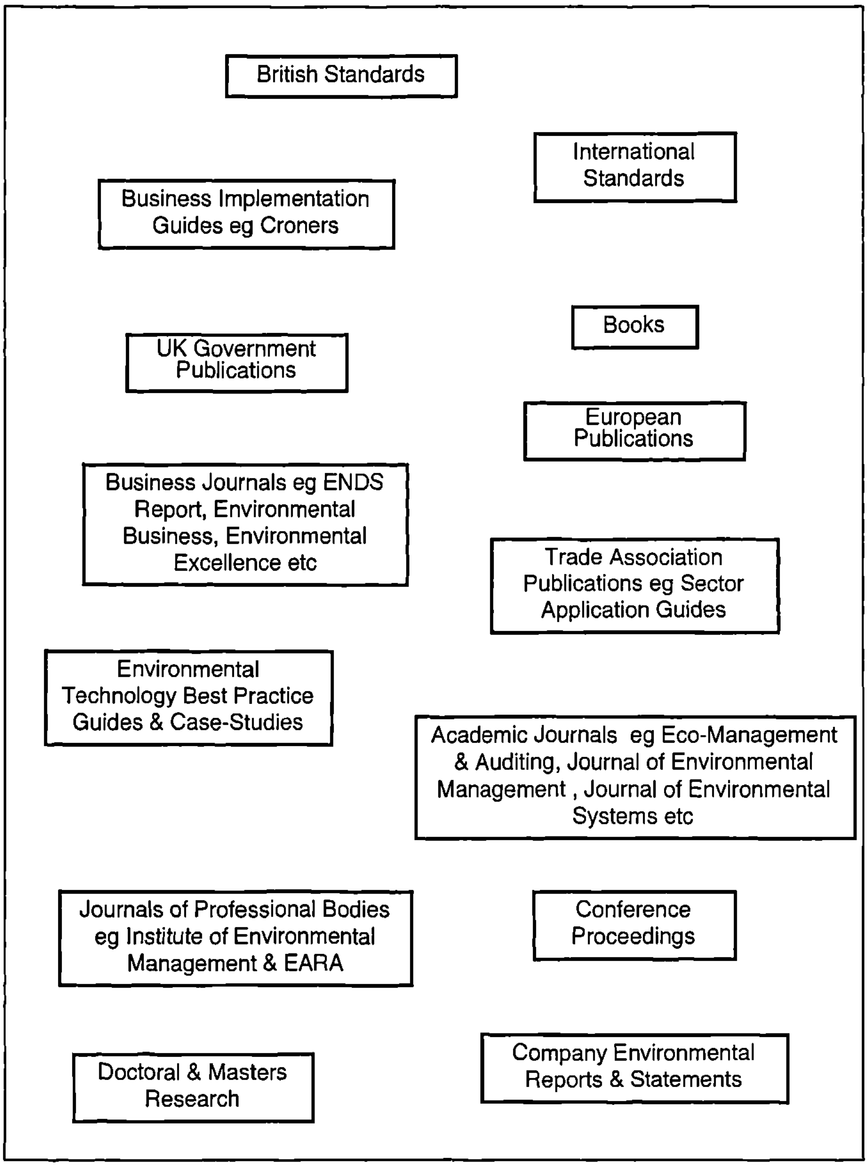


Figure 3. 3: Information sources for the literature review



3.4. PROBLEM DEFINITION

After completion of initial data collection and literature review it is essential to clearly define the issues of concern, forming the focus of further research. A problem can be defined as any situation where a gap exists between the actual and desired ideal state (Sekaran, 1992). The problem statement needs to be a clear, precise, succinct statement of the question or issue to be investigated with the goal of finding an answer or solution. Its nature depends on whether the research is applied or pure. Within the realm of applied business research, such statements focus on solving existing problems where a manager is looking for a solution or feels the situation could be improved. In comparison pure research focuses on areas where some conceptual clarity is needed for theory building or situations where the researcher aims to answer a question empirically. As this study programme comprises both applied and pure research two distinct research problems were required.

Applied Research Problem Statement:

How can an EMS, meeting internationally recognised standards, complementary to existing quality and health and safety systems be designed and implemented for a large chemical manufacturer ?

Pure Research Problem Statement:

What are the implications for industry of the internationally recognised EMS standards and how can the variability in their impact be explained between organisations ?

3.5. THEORETICAL FRAMEWORK

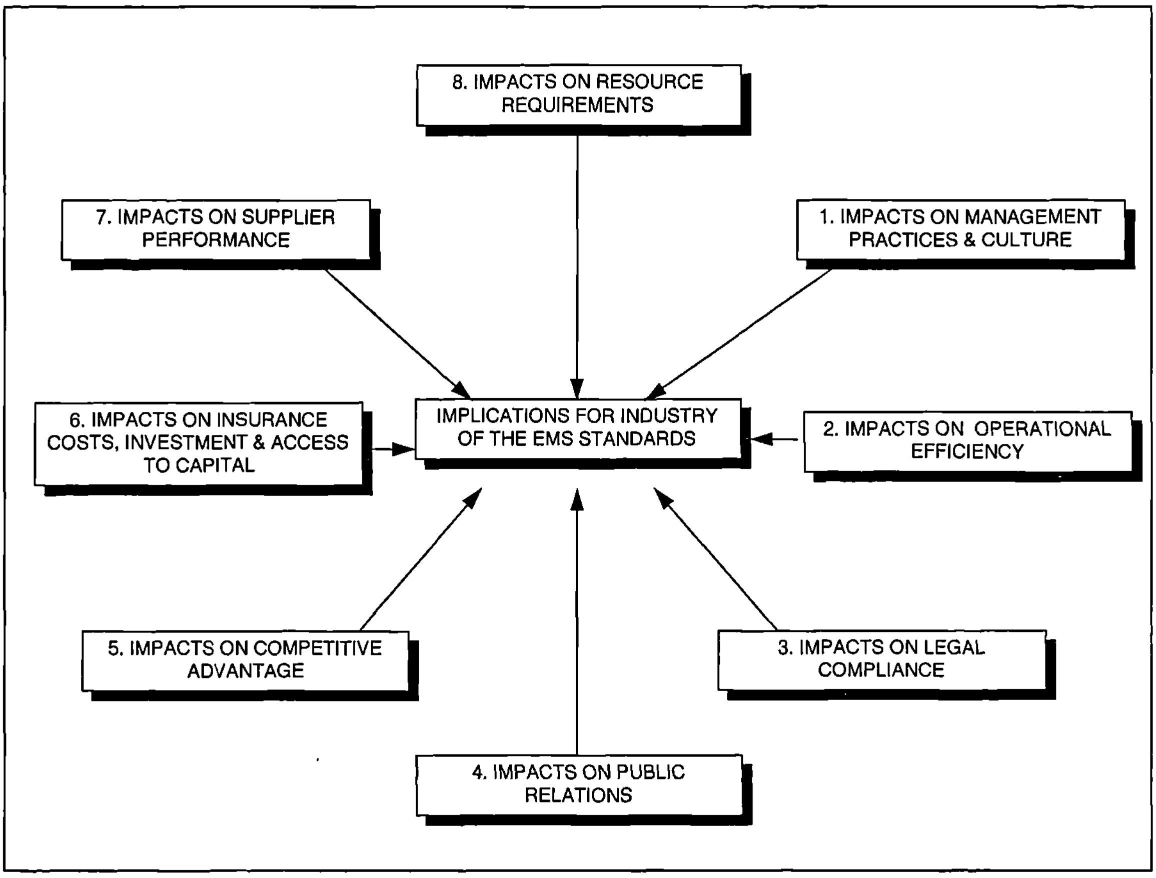
A theoretical framework is a conceptual model identifying variables of importance to the research and predicting their relationships. It is an essential element of the research methodology and design as it identifies those parameters requiring consideration during the planned research. It is based purely on theory and aims to predict relationships to be tested during the empirical research. Variables, factors which take on differing or varying values, can be dependent, independent or moderating in nature (Sekaran, 1992).

3.5.1 The Dependent Variable

The dependent variable is of primary interest and the main focus of the research. In the case of this study it is the business implications of adopting a recognised EMS, the variability of which needs to be explained or predicted. The research aims to identify these implications and predict their variability between organisations.

There are a number of factors to be considered in determining the implications for industry of the EMS standards (Figure 3.4). This requires the independent variable to be sub-divided into smaller more manageable components. The research needs to explore the scale and importance of each of these as they all contribute towards the overall impact of the standards. They will have a critical impact in determining the extent to which an EMS is beneficial to a particular organisation.

Figure 3. 4: A theoretical framework for identifying the implications for industry of the EMS standards



Component 1: Impacts on management practices

The previous chapter suggests that an EMS will change working practices and company culture. Its impacts on environmental performance; documentation; decision making; integration of management disciplines and employee awareness and motivation all require investigation. The value, whether positive or negative, of these changes needs to be analysed in terms of their benefits to the organisation.

Component 2: Impacts on operational efficiency

Environmental initiatives have the potential to improve operational efficiency through reduced waste, raw material and energy consumption. The extent to which implementing an externally recognised EMS improves efficiency requires measuring through the cost savings achieved.

Component 3: Impacts on legislative compliance

A fundamental aim of an EMS is to ensure legislative compliance (Chapter 2). The extent to which they achieve this in practice must be considered during the empirical research. Improvements in legislative compliance can be measured by comparing the number of incidents and prosecutions before and after implementation. Industry's perceptions regarding the extent to which their EMS has improved their understanding of legislation and ability to deal with future requirements is also a useful indicator.

Component 4: Impacts on public relations

Implications for public image require consideration when investigating the industrial impacts of an EMS. Changes in the number of environmental complaints may provide an indication of performance in this area. This, however, requires care as an increase may reflect improved recording mechanisms or abnormal activities such as demolition or construction work. A company's perception of their public image also provides a useful indication of any changes to their image. The extent to which an EMS has resulted in increased activity in the local community will also provide an indication of changing public relations.

Impacts on public image are interrelated to other research variables. The degree of compliance with legislation, for example, will influence public perceptions. A prosecution, resulting in media attention, is likely to substantially damage a company's image. Likewise poor supplier environmental performance may have negative repercussions on a customer.

Component 5: Impacts on competitive advantage

Customers are becoming increasingly concerned about the environmental performance of their suppliers. The implementation of an EMS has the potential to improve competitive advantage by ensuring that the requirements of both existing and potential customers are met. The extent to which an EMS influences competitive advantage is difficult to measure as in most cases the environment will be one of many criteria influencing supplier choice. It may be possible in some cases, however, to identify new contracts which have been secured or existing contracts maintained as a result of EMS certification. The number of customer enquiries regarding the environment can also be used as a measure of the extent to which an EMS is likely to improve competitive advantage.

Component 6: Impacts on insurance premiums, investment and access to capital

To reduce the commercial risk of investment, loan of capital and insurance, financial institutions are increasingly becoming concerned about environmental performance. The existence of a certified EMS has the potential to reassure them and facilitate enhanced investment and easier access to capital. The influence of an EMS on investment and access to capital must therefore be considered during the research. This is most effectively monitored through direct questions to participating organisations.

Component 7: Impacts on supplier environmental performance

The EMS standards require the environmental effects of suppliers to be considered. If these are deemed to be significant a programme is required to reduce their impact (Chapter 4). Improved supplier environmental performance may benefit the customer by ensuring security in supply of raw materials. In addition it has the potential to enable suppliers to become more competitive, with the ultimate affect of reducing raw material costs. Impacts on supplier environmental performance can be investigated by monitoring the extent to which companies with EMSs improve their supplier relationships and encourage them to adopt higher environmental standards.

Component 8: Impacts on resource requirements

A key issue for industry is the likely costs associated with an EMS. Human resources can be measured through the time spent implementing and maintaining the system. In addition the capital expenditure, certification and consultancy fees require investigation.

It can be anticipated that the degree of resources committed to implementing and maintaining an EMS will influence the results of the system. A high degree of capital expenditure, for example, is likely to result in greater improvements in environmental performance. An example would be the installation of improved storage and containment facilities as this would reduce the risk of accidental releases. A further example is the installation of water recycling facilities thereby improving operational efficiency.

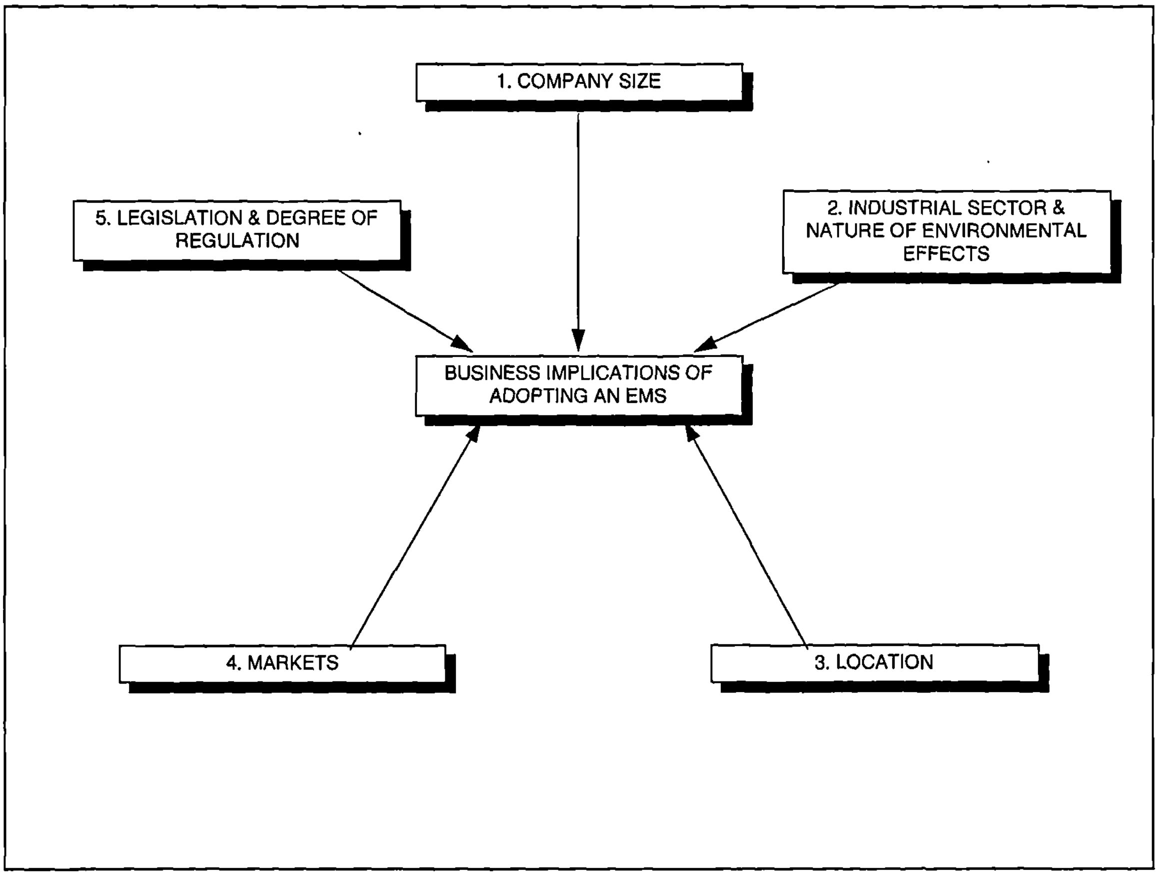
3.5.2 The Independent Variables

Independent variables influence the dependent variable. Whenever there is a change in the independent variable there will also be a corresponding increase or decrease in the nature or value of the dependent variable (Doran, 1995). An aim of this research is to identify factors influencing the business implications of an EMS and to establish the nature of these relationships. A number of factors can be predicted to influence the impact of an EMS (Figure 3.5)

Variable 1: Company size

The relationship between company size and the implications of adopting an EMS requires investigation. A large multi-site organisation with a number of complex manufacturing processes may find an EMS more beneficial than a smaller company. Likewise company size might be expected to influence the costs of implementation. It may be predicted that the larger the company the greater the costs. Alternatively, larger organisations are perhaps more likely to have specialist skills and the ability to spread costs throughout the organsation (Patton, et al., 1995). Their systems may also be more advanced, requiring relatively little further effort to meet the requirements of an external standard.

Figure 3. 5: Potential independent variables to be considered during the empirical research



Variable 2: Industrial sector and nature of environmental effects

The industrial sector of an organisation might be expected to influence the value of an EMS. Those sectors perceived to be environmentally damaging, for example, may benefit more in terms of improved public image. The chemical, nuclear, transport, paper or wood products sectors would fit into this category. It can also be reasoned that the range and complexity of environmental effects will influence the resources required during the implementation and maintenance of the system.

Variable 3: Legislation & degree of regulation

The extent to which a company is regulated may influence the benefits of adopting a certified system. Those companies in high impact sectors, such as the chemical and nuclear, which are the most tightly regulated can be predicted to experience greater benefit in terms of improved legal compliance and risk minimisation.

In analysing the data, consideration must be given to changes occurring to meet legislation or for other business reasons. Whilst an organisation may be able to demonstrate improvements in environmental performance these are not necessarily attributable to the EMS. Improvements implemented to meet legislation, for example, would be required regardless of the EMS and are therefore coincidental. This is particularly relevant to those processes prescribed for regulation under Integrated Pollution Control by the Environmental Protection Act 1990. In this case an improvement programme is required by the enforcing authorities.

Variable 4: Markets

The markets in which a company is active might be expected to influence the value of an EMS in terms of improvement in competitive advantage. Those who export to countries with tighter environmental legislation, for example, may find that customers demand higher standards from their suppliers. By demonstrating their environmental credentials through EMS certification suppliers may be in an improved position to expand their export markets. This can also be predicted to be true of companies supplying UK organisations which have a commitment to source materials from suppliers with high environmental probity. The influence of these variables on EMS value requires investigation during the empirical research.

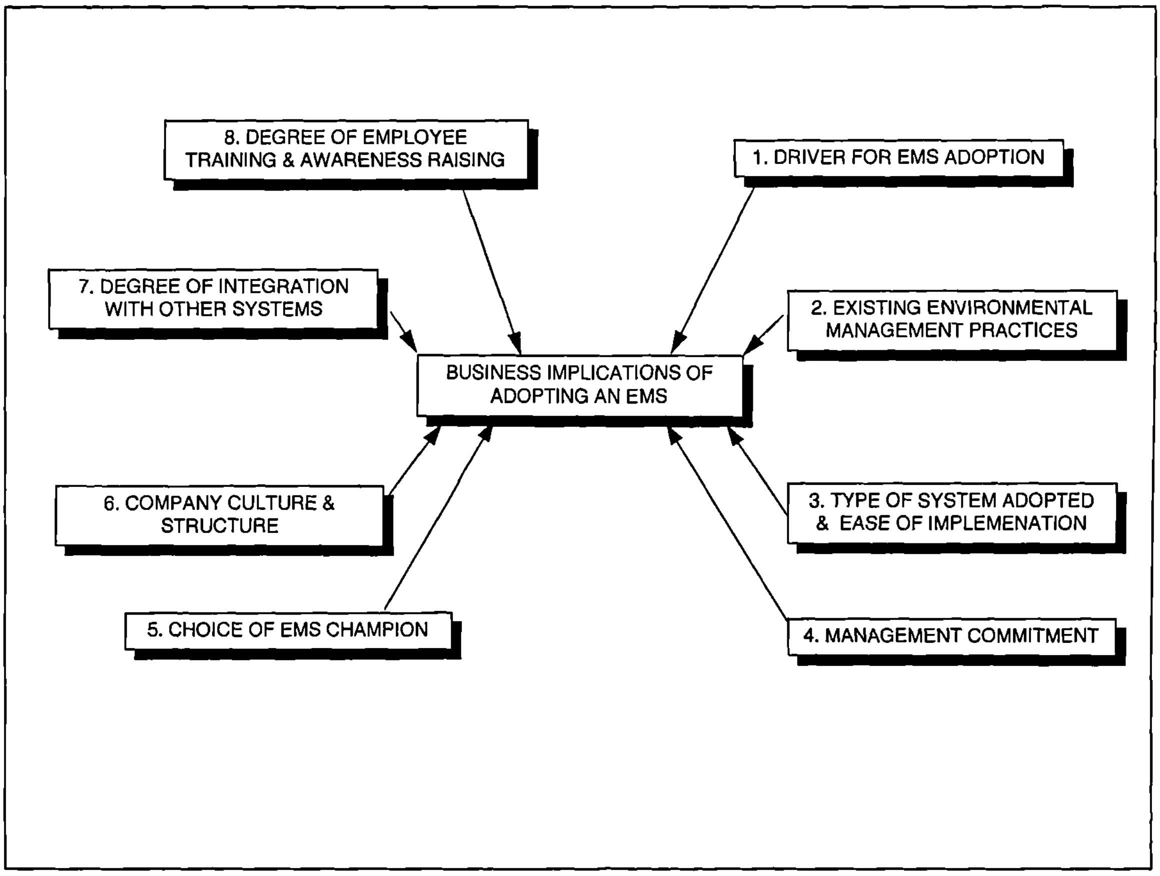
Variable 5: Location

The influence of site location on EMS value merits consideration. It may be predicted that organisations operating from sites adjacent to residential communities will experience increased problems in terms of their public relations. External certification has the potential to benefit such companies through the demonstration of environmental commitment to local residents.

3.5.3 Moderating Variables

The presence of a third moderating variable, or factor, may have a strong effect on the relationships between the independent and dependent variables. These are criteria within an organisation which may constrain or enhance the ability to effectively pursue a chosen direction (Ghobadian, 1998). In determining the implications of adopting an EMS it is necessary to take a number of potentially moderating variables into account (Figure 3.6).

Figure 3. 6: Potentially moderating variables to be considered during the empirical research



Variable 1: Driver for EMS adoption

Companies are motivated to adopt an EMS for a variety of reasons. The extent to which the driver influences the overall direction and value of the resulting systems requires consideration. It is therefore important to include company's motivation for adopting the system during the research design and data collection.

Variable 2: Existing environmental management practices

An organisation's starting point with regard to environmental management can be predicted to influence the implications of adopting an EMS standard. It might be expected that the costs of implementation would be lower for those organisations with advanced systems already established. However, it could be predicted that the resulting benefits would be reduced as there is little room for further improvement.

Variable 3: The type of system chosen and its ease of implementation

Companies have the choice of whether to base their EMS on BS 7750, later replaced by ISO 14001, EMAS or to design an in-house system. They also have options regarding whether to seek external certification. The type of system adopted and whether it is externally certified may influence its industrial value. Registration to EMAS can be predicted to improve public relations more substantially than ISO 14001, due to the requirement for an externally validated public statement.

The ease of implementation and their industrial applicability of the various EMS standards must be taken into account. Consideration must be given to how the standards work in practice and their ability to meet industry's needs. If they are difficult to interpret and hard to apply to certain organisations their value will be reduced. Conversely if industry finds a standard easy to apply and realistic in its requirements they will contribute more to enhancing business performance.

Variable 4: Management commitment

The influence of management commitment on EMS success requires investigation. If the commitment is not apparent it can be anticipated that the resulting benefits will be reduced.

Variable 5: Choice of EMS champion

Strong leadership is a key mediating factor in a company's ability to effectively pursue its chosen direction (Ghobadian, 1998). The status and experience of the person given responsibility for the EMS is therefore likely to influence its ease of implementation and resulting value. It is important to collect this information from participating companies and analyse its influence during the later stages of the research.

Variable 6: Company culture and structure

An organisation's culture may influence the effectiveness and value of an EMS. The degree of familiarity with management systems and internal auditing would be expected to influence the ease and therefore costs of implementation. Companies certified to ISO 9000 may find their environmental systems easier to operate and more effective, as they have previous experience of management systems. Conversely, those with a tradition of encouraging innovation and creative thinking, may perceive an EMS as a bureaucratic burden stifling the generation of new ideas (Clough, et al., 1995). Organisational structure may also impact on EMS effectiveness and value. If responsibility for the environment is split between different departments or managers this may be predicted to cause controversy over responsibilities.

Variable 7: Degree of integration with other systems

When implementing an EMS an organisation has a choice over the extent to which to integrate the system with other management disciplines. Certain organisations opt to integrate their system with an existing quality or health and safety system whilst others keep their EMS as a stand alone system. This decision may have a substantial impact on the resulting value and requires consideration during the research.

Variable 8: Degree of employee training & awareness raising

The relationship between the quantity and nature of employee training and awareness raising and the success of an EMS merits exploration. This requires investigation and must be incorporated into the research design.

3.6. RESEARCH HYPOTHESES

The theoretical framework, explaining and predicting relationships between variables of importance to the research, leads to the determination of testable hypotheses. A hypothesis is an educated guess about a problem's solution. It can be defined as a logically conjectured dependence between two or more variables expressed in the form of testable relationships (Sekaran, 1992). The hypotheses for this research is that the resource implications associated with formal certified environmental management system outweigh the resulting business benefits. The null hypotheses is that:

"*It is not beneficial for industry to adopt the internationally recognised EMS standards*"

3.7. THE RESEARCH DESIGN

The limited knowledge surrounding EMS standards and the lack of existing theories or models called for a mainly exploratory and inductive approach to the research. The low uptake of the EMS standards, at the research design time, necessitated the study to be based largely on qualitative rather than quantitative data. A key principle of qualitative research is flexibility, which is particularly important where the research aims to improve insight and understanding. The rapidly evolving nature of environmental management systems required research techniques to adapt with changing levels of knowledge. This is a typical characteristic of qualitative research which rejects the highly-structured deductive approach in favour of an unstructured research design (Table 3.1). Qualitative research accepts that businesses are too complex to be explained by simple models and theories (Welford, 1998).

Table 3. 1: Qualitative versus quantitative (adapted from Dermody, 1994)

Attributes	Qualitative	Quantitative
Functions	• Exploration • Diagnosis • Understanding • Insight	• Assessment • Description • Quantification • Hypothesis Testing
Characteristics	• Unstructured • Flexible	• Structured • Rigid
Methodology	• Semi-structured questions • Depth interviews • Small samples • Personal analysis	• Structured questions • Large representative sample • Statistically Valid • Computer analysis • Allows generalisations

Exploratory qualitative research is particularly powerful for achieving greater understanding and generating new theories. It can often provide more depth than quantitative research and is able to break-down broad, vague research statements into smaller more specific statements or hypotheses (Selltiz, et al., 1976). It is particularly useful in formulating specific research problems requiring more precise future research.

Qualitative research techniques typically involve small samples designed to survey knowledge and experience of key individuals familiar with the research subject (Crabtree, et al., 1992). These experience surveys, unlike quantitative research, are not intended to be statistically valid, but are driven by the need to expose relevant issues. The researcher's judgement is used to carefully select individuals for their experience or knowledge of the subject area (Patton, 1980). Data is used to uncover personal views, perceptions, experiences, fears and needs.

Experience surveys are typically supported by a detailed analysis of selected cases, focusing either on an individual, department or company. The case-study method is beneficial in providing deeper understanding and a foundation for theory development. A particular strength is its ability to deal with a wide variety of data sources including documentation, personal interviews and observation (Tull, et al., 1978). This flexibility in data collection is invaluable in situations where there is limited previous knowledge of the subject area. The rigour of the method can be improved if multiple case-studies are used.

In keeping with accepted qualitative techniques the design of this research is based on exploratory experience surveys supported by an analysis of detailed case-studies (Table 3.2).

3.8. DATA COLLECTION TECHNIQUES

Judgement, rather than random sampling techniques were adopted, for both the experience surveys and detailed case-studies. Key informants, or participants, were carefully chosen for their extensive experience of EMS implementation and operation within industry. The experience surveys collected data using structured questionnaires distributed by post. Case-study data was collected through depth interviews, documentation reviews and observations. Depth interviews, named for the level of detail obtained, involve an unstructured or semi-structured questionnaire, where the majority of questions are open-ended. The interviewer aims to encourage the respondent to talk freely about an area of the research. The issues discussed at each interview vary according to the views and knowledge of the respondent. Questions are arranged in order of detail, beginning with the general and leading to the more specific. In collecting qualitative case study data it is not sufficient to rely on memory or hand-written notes. As soon as possible after each meeting a full transcript of the conversation was developed including the author's own views and observations.

Table 3. 2: Phases in the research methodology and design

Phase	*Aims*	*Objectives*	*Methodology*
Masters Research (March - July 1994)			
	To improve understanding of developments within the field of EMS. To form the observation and preliminary data collection phases of the doctoral research.	• To identify the requirements of the draft standard BS 7750. • To collate data on the experiences of organisations implementing the standard.	• A critical review of literature on EMS published by June 1994. • A postal survey of the experiences of seven companies involved in the BS 7750 pilot trial • Depth interviews with key individuals from four companies.
Doctoral Research (Sept 1994 - Sept 1998)			
Phase 1 Desk Research	To improve understanding of the research subject, identify issues of importance and provide background to empirical research.	• To identify the theoretical requirements of BS 7750, ISO 14001 and EMAS. • To collate data on the implications of adopting an EMS standard.	• A critical review of literature relating to the EMS standards published between June 1994 and August 1998.
Phase 2 Experience Survey	To improve insight and understanding of the business implications of adopting an EMS standard.	• To explore the impacts of an EMS on working practices and company culture. • To identify and analyse the business benefits and resource requirements of an EMS	• Experience survey of 22 key individuals with extensive experience of operating EMSs within industry.
Phase 3 Case Study Research	To improve understanding of the practicalities of implementing the EMS standards within industry.	• To explore the practical interpretation of the requirements of the EMS standards • To identify approaches to EMS implementation within UK industry. • To assess the extent to which it is feasible to integrate an EMS with other management systems. • To identify external assessor's requirements.	• Five detailed case-studies of companies certified to BS 7750 / ISO 14001 and/or EMAS. • Depth interviews of respondents with extensive experience of EMS implementation within their organisation. • Judgement sample of manufacturing companies.
Phase 4 Applied Research	To apply the findings of Phases 1 and 2 within a practical industrial environment.	• To design and implement an EMS meeting BS 7750 / ISO 14001 at a large chemical manufacturing plant. • To determine a strategy for integration with existing quality and health and safety systems.	• Practical research programme established at Solvay Interox Ltd through the Teaching Company Scheme (March 1994 - December 1996)

3.8.1 Masters Research

The Masters research involved the author being placed at a large chemical manufacturer, Solvay Interox Ltd, for five months during the spring of 1994 (Goodchild, 1994). The aim of the project was to assess the practicalities of adopting an EMS standard and provide recommendations for further development of the company's existing in-house system.

To gain a practical understanding of the implications of adopting BS 7750 a survey of individuals with experience of the standard was undertaken. A questionnaire was compiled with the aim of collecting information on the approach industry was taking in designing environmental management systems. Particular emphasis was placed on the effects assessment, objectives and targets, documentation and integration with other business management systems (Table 3.3). A judgement sampling approach was adopted using a list of companies participating in the BS 7750 pilot trial, provided by the British Standards Institution. A target sample of 20 companies was chosen from a range of manufacturing sectors. Responses were obtained from seven companies (Table 3.4) and additional information was collected from published literature and conference documentation. The experience survey was supported by a detailed analysis of three cases, Bowater Drums Ltd, BNFL and UK Waste Ltd. Data was collected through a loosely structured depth interviewing technique, documentation reviews and observations during site visits.

A period of applied research at Solvay Interox Ltd was undertaken in parallel with the experience survey and case-studies. The first stage was to review the company's environmental position to identify strengths and weaknesses compared with BS 7750. This led to a series of recommendations and an action plan for EMS implementation. Options for expanding and amending existing activities to meet the requirements of the standard were investigated, in particular those for integrating the system with existing health, safety and quality systems (Goodchild, 1994).

Table 3. 3: Data collected during Masters research survey

Organisation and Personnel:
• The Management Representative for BS 7750
• Details of any site teams established for BS 7750
Environmental Effects Register:
• Details of the methodology employed for assessing environmental effects
• Number of effects identified as significant
• Details of supplier assessments undertaken
Objectives & Targets:
• Total number of objectives and targets
• Number of quantified objectives and targets
• Number of objectives and targets beyond legislative compliance
Operational Control:
• Number of operational control procedures required for BS 7750
Miscellaneous:
• Most difficult areas of the standard
• Planned certification date

Table 3. 4: Companies participating in the MSc research survey

Company Name	*No of Employees*	*Activity*
Akzo Nobel Chemicals Ltd	29	Electropolishers
Anopol Limited	140	Organic Peroxide Manufacture
Bowater Drums Ltd	200	Fibre Board Packaging Manufacture
Lancastrian Labels	60	Self-adhesive Label Printers
Seton Health Care Group plc	650	Healthcare Products Manufacture
Thomas Swan & Co Ltd	125	Chemical Manufacture
Transport Development Group	19,000	Distribution, Storage & Transport

3.8.2 Doctoral Research

The Doctoral Research comprised of four phases, each based on qualitative inductive research techniques. Each stage was designed to improve understanding and insight into the implications of adopting an EMS standard in terms of required changes to management practices, business benefits and resource implications. All four stages ran in parallel rather than chronological order.

Phase 1: Desk Based Research

The literature review was an essential pre-requisite to the research design phase in ensuring key issues were identified and areas of importance not overlooked (Chapter 3.3). It also significantly contributed towards the collection of empirical data regarding the experiences of individuals and organisations with experience of the EMS standards. Their publication during the early and mid 1990s caused extensive interest within the business community (Chapter 2). Companies amongst the first to adopt the standard were keen to publicise their experiences and achievements within business journals and conference proceedings (Table 3.5).

Phase 2: Exploratory Experience Survey

This phase of the research involved the development of a questionnaire to survey the experiences of key individuals with extensive experience of EMS implementation and operation within industry (Appendix 1.1). The aim was to collect data relating to the implications of adopting an EMS in terms of working practices, company culture, business benefits and resource requirements (Table 3.6). A range of open and closed questions were included, some of which asked participants to score their perceptions on a scale of significance.

Table 3. 5: Data on industry's experience of the EMS standards obtained through the literature review

Company Name	*Source*
Akzo Nobel Chemicals	Company Environmental Report (EMAS Statement)
Alleid Colloids	Corporate Publication
Applied Chemicals	Croner's Environmental Policy & Procedures
Autosmart	Croner's Environmental Policy & Procedures
Birds Eye Walls	Journal (ENDS Report)
BP Chemicals	Conference Documentation
Brico Engineering	Journal (BSI News)
British Opencast Coal	Croner's Environmental Policy & Procedures
Castle Cement	Journal (ENDS Report)
Cego Ltd	Company Environmental Report (EMAS Statement)
Ciba Clayton	Journal (BSI News)
Contract Chemicals	Company Environmental Report (EMAS Statement)
Design for Distribution	Journal (ENDS Report)
Layezee Beds	Department of the Environment Case-Studies
Loudwater Litho	Department of the Environment Case-Studies
National Power	Journal (Institute of Environmental Management)
Renlon Ltd	Croner's Environmental Policy & Procedures
Rover Group	Corporate Publication
Shields Special Metals	Company Environmental Report (EMAS Statement)
Silent Night Group	Journal (Quality World)
Tioxide Europe	ETBPP Literature
Vauxhall Motors	Conference Documentation
Wolstenholme International	Journal (ENDS Report) & ETBPP Literature
Woodcote Industries	Department of the Environment Case-Studies

Table 3. 6: Question areas for the experience survey

Question Numbers	***Area of investigation***
1	Environmental activities prior to the adoption of the EMS
2	Order of importance of EMS Drivers
3	The main benefit of the EMS
4	Extent of improvements in selected areas
5	Nature of improvements in environmental performance
6	Source and quantification of financial savings
7	Impacts on financial funding or insurance premiums
8	Impacts on visits from enforcing authorities
9	Impacts on competitive advantage
10	Impacts on public image
11	Time taken to achieve certification
12	Hours spent implementing the standard
13	Responsibilities for EMS implementation
14	Use of external consultants
15	Quantity of employee training provided
16	Capital expenditure
17	Hours spent maintaining the system per year
18	Assessment of suppliers environmental performance
19	Costs of the certification process
20	Disadvantages of adopting BS 7750
21	Whether the EMS would have been implemented without BS 7750

The timing of the survey and sample choice were critical. To enable a comprehensive identification of the implications of an EMS respondents needed to have been operating their systems for a significant period of time. A time span of approximately a year was considered acceptable. To enable comparisons between organisations it was also important that respondents had been certified for approximately equal lengths of time. As the first BS 7750 certificates in the UK were not awarded until March 1995 it was not feasible to undertake the survey until the late spring and summer of 1996, by which time approximately 60 certificates had been awarded. Unfortunately there was no central source of information on these organisations. The NACCB provided the names of accredited certification bodies who each supplied lists of the organisations they had independently certified. In many cases they could not provide contact names or addresses which were obtained from business directories, directory enquiries and direct telephone contact with the company in question.

Initially the questionnaire was tested on a judgement sample of 10 organisations, representing a range of industrial sectors and company sizes. It was then slightly amended before being sent to another 37 companies achieving certification between March and December 1995. Responses were received from 22 companies, representing over 30% of UK certified companies. A broad range of industrial sectors were involved in the survey (Table 3.7 and Table 3.8). On average companies had been certified for 12 months although exact time spans varied from 9 to 20 months (Table 3.9). In each case the questionnaire was completed by an individual with direct responsibility and involvement in the implementation process (Table 3.10).

Table 3. 7: Standard Industrial Classification (SIC) of companies participating in the survey (Central Statistical Office, 1992)

SIC Code	*Industrial Sector*	*% of Companies*
DG	Manufacture of chemicals	23%
DJ	Manufacture of metal products	9%
DE	Manufacture of paper products; publishing and printing	23%
E	Electricity, gas and water supply	5%
DD	Manufacture of wood and wood products	5%
DH	Manufacture of rubber / plastic products	9%
DL	Manufacture of electrical and optical equipment	5%
DK	Manufacture of other machinery and equipment	18%

SIC Code = Standard Industrial Classification

Table 3. 8: Companies participating in the experience survey

Company Name	*Industrial Activity*	*SIC Code*
Akzo Nobel Chemicals	Speciality Chemical Manufacture	DG
Alcan Smelting & Power UK	Metal Smelting	DJ
Anaplast	Packaging Manufacture	DE
Applied Chemicals	Speciality Chemical Manufacture	DG
Arjo Wiggins Fine Paper	Paper Manufacture	DE
Autosmart	Speciality Chemical Manufacture	DG
Beacon Press	General Printers	DE
BICC Cables	Telecommunication Cable Manufacture	DK
BOC Gasses	Industrial Gas Manufacture	DG
Carson Office Furniture	Wood Based Office Furniture Manufacture	DD
Curtis Fine Papers	Printing & Writing Paper Manufacture	DE
Dunlop Ltd	Rubber Products Manufacture	DH
Epson Telford Ltd	Computer Printer Manufacture	DL
Gleaner Oil & Gas Ltd	Oil and Gas Distributor	E
Lindsey Oil Refinery Ltd	Oil Refinery	DF
NDM Manufacturing	Automotive Air Conditioning Manufacture	DK
P P Payne	Packaging Manufacture	DE
Philips Components	Glass Screen Manufacture	DK
Ricoh Products Ltd	Manufacture of Office Equipment	DK
Sheilds Special Metals	Electro Mechanical Equipment Dismantling	DJ
Thomas Swan & Co Ltd	Speciality Chemical Manufacture	DG
Wavin Buildings Products	Plastic Pipe Manufacture	DH

Table 3. 9: Time between certification to BS 7750 and participation in the survey

Company Name	Date of Certification	Time since certification
Akzo Nobel Chemicals	March 1995	20 months
Alcan Smelting & Power UK	July 1995	12 months
Anaplast	March 1995	13 months
Applied Chemicals	March 1995	12 months
Arjo Wiggins Fine Paper	September 1995	10 months
Autosmart	April 1995	11 months
Beacon Press	July 1995	12 months
BICC Cables	October 1995	9 months
BOC Gasses	March 1995	12 months
Carson Office Furniture	March 1995	15 months
Curtis Fine Papers	July 1995	9 months
Dunlop Ltd	March 1995	12 months
Epson Telford Ltd	November 1995	6 months
Gleaner Oil & Gas Ltd	June 1995	13 months
Lindsey Oil Refinery Ltd	March 1995	12 months
NDM Manufacturing	November 1995	9 months
P P Payne	March 1995	15 months
Philips Components	August 1995	11 months
Ricoh Products Ltd	July 1995	14 months
Sheilds Special Metals	March 1995	15 months
Thomas Swan & Co Ltd	March 1995	13 months
Wavin Buildings Products	August 1995	11 months

Table 3. 10: Position of individuals participating in the experience survey

Company Name	***Position of Individual Responding***
Akzo Nobel Chemicals	Technical Manager
Alcan Smelting & Power UK	Environmental Coordinator
Anaplast	Technical Services Manager
Applied Chemicals	Environmental, Health & Safety Advisor
Arjo Wiggins Fine Paper	Environment Advisor
Autosmart	Quality & Environmental Manager
Beacon Press	Managing Director
BICC Cables	Quality and Environmental Manager
BOC Gasses	Environment Manager
Carson Office Furniture	Quality & Environmental Manager
Curtis Fine Papers	Technical Manager
Dunlop Ltd	Quality Manager
Epson Telford Ltd	Senior Quality Engineer
Gleaner Oil & Gas Ltd	Quality Assurance Coordinator
Lindsey Oil Refinery Ltd	Head of Safety, Environmental & Quality Systems
NDM Manufacturing	Health & Safety Officer
P P Payne	Environmental Manager
Philips Components	Safety and Environmental Manager
Ricoh Products Ltd	Quality Assurance Manager
Sheilds Special Metals	Director for the Environment
Thomas Swan & Co Ltd	Chief Chemist
Wavin Buildings Products	Safety & Environment Manager

The number of employees at the certified sites ranged from 55 (Auto-smart Ltd) to 1,700 (Epson Telford Ltd). Over half (55%) had less than 250 employees and were therefore classed as small and medium sized enterprises (SME) (Table 3.11).

Table 3. 11: Size of companies participating in the survey

No of Employees	*No of Companies*	*Percentage of companies*
< 100	3	14%
100 - 250	9	41%
250 - 500	7	32%
> 500	3	14%

Approximately a quarter of responding companies were prescribed as Part A, for regulation under Integrated Pollution Control (IPC), and 32% as Part B, for regulation under Local Authority Air Pollution Control (LAAPC). Almost half of the sample, 45%, were not regulated under either regime (Table 3.12).

Table 3. 12: Classification of companies under Environmental Protection (Prescribed Processes and Substances) Regulations 1991

Classification	*No of Companies*	*Percentage of companies*
Part A	5	23%
Part B	7	32%
Non-Prescribed	10	45%

Phase 3: Case-Study Research

The experience survey was supported by five detailed case-studies (Table 3.13). As with the survey these were chosen using judgement, rather than a random sampling technique. Three were identified as a result of the experience survey, BICC Cables, Autosmart and Thomas Swan & Co Ltd. Contract Chemicals and J & J Makin were recommended through personal contacts from industry and consultancy.

Table 3. 13: Companies participating in depth interviews forming the basis for case-studies

Company Name	*Industrial Activity*
Autosmart	Manufacture of water-based cleaning fluids
BICC Cables	Telecommunication Cable Manufacture
Contract Chemicals	Speciality Chemical Manufacture
J & J Makin Converting	Paper Converting
Thomas Swan & Co Ltd	Speciality Chemical Manufacture

On average, depth interviews lasted for several hours and were supported by guided site tours. The case-studies were critical in improving understanding of the requirements of the standards and their business implications (Table 3.14). A semi-structured, flexible approach was adopted to the interviews using a simple agenda as the focus (Table 3.15).

Table 3. 14: Objectives of the case-study phase of the research

To improve understanding of: • industry's motivation for adopting an EMS standard • the requirements of the EMS standards • the approaches to EMS implementation being adopted within the UK • implications for working practices and company culture • the benefits of adopting a recognised EMS • the resource requirements of achieving a recognised EMS

Phase 4: Applied Research

The fourth phase, the applied research, built on the Masters research conducted at Solvay Interox Ltd. In September 1994 a Teaching Company Scheme (TCS) programme was established with Salford University's Environmental Resources Unit. TCS is a government initiative designed to strengthen the links between academia and industry. Recent graduates are employed as TCS Associates to tackle strategic industrial problems. The aim of the programme at Solvay Interox Ltd was to develop an EMS, meeting the requirements of BS 7750, which would be complementary to the Company's existing business management systems.

Table 3. 15: Question areas for the depth interviews

Item	*Area of investigation*
1	Job Title & Role
2	Company Motivation for Adopting an EMS
3	Responsibilities for EMS Implementation
4	Time Taken to Achieve Certification
5	Stages in the Implementation Process Stages
6	Focus of the Environmental Policy
7	Effects Assessment Methodology & Findings
8	Nature of Objectives & Targets
9	Documentation Requirements
10	Auditing Procedures, Schedules & Auditor Qualifications
11	Nature & Quantity of Employee Training
12	Supplier Assessment Approaches
13	Integration with Other Disciplines
14	Business Benefits of the EMS
15	Impact of the EMS on Environmental Performance
16	Internal & External Costs of Meeting BS 7750
17	Resources Required to Maintain the System
18	Certification Experiences
19	Post Certification Plans

The research project ran from September 1994 to December 1996, during which time the author was located full-time at Solvay Interox as the project manager. This high level of involvement allowed a detailed investigation into the ease of implementation of the standards. The key issues to be addressed, the problems encountered and their solutions were continuously monitored. During this time data obtained during other phases of the research were utilised in the design and implementation of the system.

In particular the detailed case studies provided invaluable experience of the practical requirements of the standards.

The author's experiences over the project at Solvay Interox also contributed towards the pure research goal of assessing the implications of the EMS standards for industry. Throughout the project observations, interviews and document reviews were used to obtain information relating to the extent to which adopting a recognised EMS standard affected the company. Changes in management practices required to meet the standards, the benefits and resource requirements were continuously monitored.

3.9. ANALYSIS OF THE DATA

Qualitative research involves the analysis of large amounts of unstructured or semi-structured data. This requires formal data analysis techniques for which there are different approaches. The first is to develop an analysis chart for each question resulting in a structured database of company's responses. This technique is ideal for structured interviews or surveys and was therefore applied to the analysis of the experience surveys. The application of simple statistical approaches allowed trends in responses to be determined.

Less structured qualitative data can be analysed through transcript based analysis using a flexible framework. Information obtained from a variety of sources is dissected and re-ordered under broad subject headings to fit the researcher's developing ideas. The main benefit of this approach is the researcher's freedom in structuring and shaping the format of the thesis. This approach was adopted to the analysis of data relating to changes in management practices, business benefits and resource implications of adopting a formally recognised EMS (Chapters 7, 8, and 9). Information obtained from all four phases of the research was dissected and re-ordered under subject headings. These chapters therefore draw on data obtained from desk based research, experience surveys, case-studies and the applied research at Solvay Interox Ltd. Collated data relating to a particular subject, regardless of its source, allowed a full picture to be developed.

3.10. A CRITICAL REVIEW OF THE RESEARCH METHOD

Qualitative research, which is based on interpretivism, is frequently criticised for its lack of objectivity and statistical validity. Most researchers believe it is impossible to achieve objectivity within qualitative research (Dermody, 1994). In comparison to quantitative research, which is based on positivism, its emphasis is not on reliability, validity or representativeness. It should therefore not be appraised in terms of the attributes and goals of quantitative research. The two methods are based on fundamentally different philosophies and have different aims and objectives. Qualitative research does not intend to provide statistical findings which will hold true for situations outside the research study but is based on improving insight and contributing to knowledge through theory development. It is intentionally flexible in allowing the focus and aim of the research to be re-defined as understanding improves. Its major strength is its suitability to situations which are not sufficiently understood to allow the testing of pre-developed theories or hypotheses.

A commonly cited weakness of qualitative research is the difficulty of generalising the results to a broader sample (Welford, 1998). The reliability of case study research is limited largely because of the small sample size. It is only possible to generalise from a single or small numbers of case-studies where a fundamental understanding of the situation has been achieved. In such cases the process of generalisation requires extreme care and is only possible in a limited number of situations. Findings can only be generalised to particular situations rather than to populations or samples. This is certainly true for the case study and applied phases of this research which are based purely on interpretivism and qualitative research methods. The findings relate solely to the individual companies studied and will not necessarily apply to a broader sample (Chapter 11). As the experience survey is based less on qualitative interpretivism and more on objective quantitative methods it is therefore perhaps easier to generalise from the results. This is only possible with an understanding of the sample size, nature of participating companies and the timing of the study. There is little doubt that industry's experience with EMS implementation will vary according to a number of internal and external factors (Chapter 10).

Although the findings of case studies are difficult to generalise to other situations they achieve a high level of external validity. This is largely because the research is carried out within the appropriate context, in this case within the industrial environment, with the substantial involvement of the researcher. Gummerson (1991) describes validity as a continuous process, integrated with theory, that requires the researcher to continuously assess assumptions, revise results, retest theories and reappraise the limitations of the research method.

3.11. SUMMARY

The research methodology followed a typical approach of initial observation, problem definition, literature review, theoretical framework, hypothesis development and the collection and analysis of data (Sekaran, 1992). The nature of the study is both applied and pure. The applied element is concerned with how a recognised EMS, compatible with existing business management systems, can be designed and implemented at a large chemical manufacturing company. The pure element focuses on identifying and analysing the implications for industry of adopting such a system.

The rapidly evolving nature of the subject coupled with the scarcity of previous research necessitated a flexible exploratory approach. The lack of established theory relating to the subject called for an inductive study aiming at achieving greater insight and understanding. This would allow for the generation of ideas and theory which could be tested through future quantitative and deductive research. Data were collected through the typical qualitative methods of experience surveys and case studies. A survey of the experiences and perceptions of twenty-two companies certified to an EMS standard during 1995 was supported by five detailed case-studies. Further evidence is provided through an analysis of the author's experiences during three years spent designing and implementing an EMS, compatible with other business management systems, at Solvay Interox Ltd.

The theoretical framework is an essential element of the research as it identifies the variables requiring consideration during the data collection and analysis. In reviewing the implications for industry of the EMS standards it is necessary to identify the required resources plus the impacts on management practices and business performance. This includes changes in operational efficiency, competitive advantage, legislative compliance, public image, supplier performance, insurance premiums and access to investment. An analysis of the resource requirements calls for consideration of implementation and operation costs, capital expenditure, consultancy fees and certification charges. In determining the variability between organisations it is necessary to analyse the impacts of company size, industrial sector, markets, degree of regulation and location. Moderating variables requiring attention include the starting position; implementation approach; company culture; management commitment; choice of champion and the degree of integration with other management systems.

CHAPTER 4

4.0. THE REQUIREMENTS OF THE EMS STANDARDS

4.1. INTRODUCTION

The EMS standards set out the requirements for a management system designed to ensure continual environmental improvement and compliance with legislation and in-house policies and standards. A detailed examination of their requirements is an essential first stage for those considering implementation. This chapter reviews the requirements of BS 7750, ISO 14001 and the EC Eco-Management and Audit Scheme (EMAS) to identify their similarities and differences. The guidance contained within their appendices and in supporting standards, such as ISO 14004 and ISO 14011/1, is also examined. Literature on EMS implementation published by professional bodies and trade associations is reviewed. The requirements of the certification bodies are identified through guidelines published by the NACCB and European Accreditation of Certification (EAC).

4.2. THE REQUIREMENTS OF BS 7750 & ISO 14001

BS 7750 and ISO 14001 are split into two complementary parts. The specification section details the requirements of the EMS and the annexes contain guidance on their implementation. The EMS requirements of BS 7750 are detailed in 11 clauses, split into 23 sub-clauses (Table 4.1). Many of the same requirements are contained within the 6 clauses of ISO 14001 although their order differs (Table 4.2).

The majority of the differences between BS 7750 and ISO 14001 are in emphasis rather than content. In 1996 the NACCB's replacement, the United Kingdom Accreditation Service (UKAS), published 18 points to be addressed before BS 7750 certificates could be transferred to ISO 14001 (Table 4.3). These are discussed during the following descriptions of the requirements of the standards.

Table 4. 1 :The clauses of BS 7750:1994 (British Standards Institution, 1994a)

1	**Scope**		
2	**Informative references**		
3	**Definitions**		
4	**Environmental management system requirements**		
	4.1	Environmental management system	
	4.2	Environmental policy	
	4.3	Organisation and personnel	
		4.3.1	Responsibility, authority and resources
		4.3.2	Verification resources and personnel
		4.3.3	Management representative
		4.3.4	Personnel, communication and training
		4.3.5	Contractors
	4.4	Environmental Effects	
		4.4.1	Communications
		4.4.2	Environmental effects evaluation & register
		4.4.3	Register of legislative, regulatory and other policy requirements.
	4.5	Environmental objectives & targets	
	4.6	Environmental management programme	
	4.7	Environmental management manual and documentation	
		4.7.1	Manual
		4.7.2	Documentation
	4.8	Control	
	4.9	Environmental management records	
	4.10	Environmental management audits	
	4.11	Environmental management reviews	
Annexes			
A	**Guide to environmental management system requirements**		
	A1	Environmental management system	
	A2	Environmental policy	
	A3	Organisation and personnel	
	A4	Environmental effects	
	A5	Environmental objectives and targets	
	A6	Environmental management programme	
	A7	Environmental management manual and documentation	
	A8	Operational control	
	A9	Environmental management records	
	A10	Environmental management audits	
	A11	Environmental management reviews	
B	**Links to BS 5750 Quality Systems**		

Table 4. 2: The clauses of BS EN ISO 14001:1996 (British Standards Institution, 1996a)

1	**Scope**		
2	**Normative references**		
3	**Definitions**		
4	**Environmental management system requirements**		
	4.1	General requirements	
	4.2	Environmental policy	
	4.3	Planning	
		4.3.1	Environmental aspects
		4.3.2	Legal and other requirements
		4.3.3	Objectives and targets
		4.3.4	Environmental management programme (s)
	4.4	Implementation and operation	
		4.4.1	Structure and responsibility
		4.4.2	Training, awareness and competence
		4.4.3	Communication
		4.4.4	Environmental management system documentation
		4.4.5	Document control
		4.4.6	Operational control
		4.4.7	Emergency preparedness and response
	4.5	Checking and corrective action	
		4.5.1	Monitoring and measurement
		4.5.2	Nonconformance and corrective and preventative action
		4.5.3	Records
		4.5.4	Environmental management system audit
	4.6	Management review	
Annexes			
A	**Guidance on the use of the specification**		
B	**Links between ISO 14001 and ISO 9001**		
C	**Bibliography**		

Table 4. 3: The UKAS 18 point list of the differences of ISO 14001 compared with BS 7750 (UKAS, 1996)

1	Commitment to "prevention of pollution" is included in the policy
2	Commitment to "comply with relevant environmental legislation and regulations, and other requirements to which the organisation subscribes" is included in the policy
3	The system is designed to take due regard of the requirements for preventative action set out in the clause on "Non-conformance and corrective and preventative action"
4	The system is designed to identify environmental aspects over which the organisation can be expected to have an influence in order to determine those aspects which have or can have significant impacts on the environment
5	The management review is undertaken by top management
6	The EMS audit programme must be based on environmental importance of the activity concerned
7	Monitoring and measurement must also include recording of information to track performance, relevant controls and conformance with the organisation's objectives and targets
8	Monitoring and measurement must also include establishment and maintenance of a documented procedure for periodically evaluating compliance with relevant environmental legislation and regulation
9	The system must provide that the organisation consider processes for external communication on its significant environmental aspects and record its decision
10	Training must include awareness of the environmental benefits of improved personnel performance
11	Training must include awareness of roles and responsibilities including emergency preparedness and response requirements
12	Management representative(s) must have a defined role, responsibilities and authority for reporting on performance of the environmental management system to top management for review and as a basis for improvement of the environmental management system
13	Objectives and targets should be consistent with the environmental policy and include the commitment to prevention of pollution
14	Regard must be had to the concepts as defined of environmental aspects and environmental impacts
15	The environmental policy must support the organisation's intentions and principles in relation to its overall environmental performance which provides a framework for action
16	Continual improvement is not qualified by the EVABAT limitation in BS 7750
17	The environmental performance to be achieved by the management system must be defined in line with the clause on "environmental performance"
18	Emergency preparedness and response procedures must include provision for preventing and mitigating the environmental impacts of accidents and emergency situations, as well as identifying the potential for such situations.

Subject to the certification body confirming that the above points have been taken on board in the EMS of the organisation subject to certification, accredited certification bodies may issue certificates to ISO 14001 to organisations already certified to BS 7750.

4.2.1 The Environmental Review (BS 7750 Annex A.1.2) (ISO 14001 A.3.1)

An environmental review is not strictly required by either BS 7750 or ISO 14001 but is recommended for organisations without an existing EMS. It establishes the base-line position with regard to environmental performance and forms the basis for future improvements. Issues to be addressed include legislative compliance, environmental effects, existing management practices and procedures, previous incidents and non-compliances with legislation (British Standards Institution, 1994a) (Table 4.4). The review is typically undertaken by a team collecting information through questionnaires, checklists, interviews, direct inspection, document reviews and, in more detailed cases, benchmarking (British Standards Institution, 1996d).

Table 4. 4: Typical contents of an environmental review (from Barwise, 1996)

1.0	**RELEVANT LEGISLATION**	
	1.1	Environmental Protection Act 1990
	1.2	Control of Pollution Act 1974
	1.3	Clean Air Act 1993
	1.4	Water Resources Act 1991
	1.5	Water Industry Act 1991
	1.6	Town & Country Planning Act 1990
2.0	**ENVIRONMENTAL EFFECTS**	
	2.1	Raw Materials
	2.2	Products
	2.3	Processes
	2.4	Waste
	2.5	Mass Balance
	2.6	Water Consumption
	2.7	Energy Usage
	2.8	Hazardous Materials
	2.9	The Site
	2.10	Local Environment
	2.11	Waste Management
3.0	**MANAGEMENT**	
	3.1	Policy
	3.2	Management Structure
	3.3	Management System
4.0	**ABNORMAL OPERATIONS & INCIDENT PROCEDURES**	
5.0	**CONCLUSIONS & ACTION PLAN**	

4.2.2 Environmental Management System (BS 7750, 4.1) (ISO 14001, 4.1)

The first specific requirement of BS 7750 and ISO 14001 is the general need for a documented EMS. This involves the preparation and effective implementation of procedures and instructions. BS 7750 contains more detail specifying that the system must be designed to ensure compliance with legislation and pertinent guides to which the organisation subscribes, such as policies and codes of practice. The guidelines published by the European Accreditation for Certification specify that the system needs to have been operational for a minimum of three months before certification can be awarded (European Accreditation of Certification, 1996).

4.2.3 Environmental Policy (BS 7750, 4.2) (ISO 14001, 4.2)

Top management is required to establish an environmental policy stating the organisation's environmental intentions and principles of action. It establishes an overall sense of direction and must be written within the context of any broader corporate body's policy and with their endorsement. Both standards require the policy to clearly define the activities to be covered by the EMS.

The policy is a central document from which all other EMS elements flow. In particular it must provide for the setting and publication of environmental objectives (Gibbon, et al., 1994) (Chapter 4.2.7). It needs to be relevant to the company's activities and address the main environmental impacts. The issues outlined will depend on the type of organisation, the nature of its activities and the focus of the EMS. They are typically broad in nature and address issues such as legislative compliance, waste minimisation, energy efficiency, communications and staff training (Table 4.5). ISO 14004, the guidance standard to ISO 14001, recommends guiding principles published by government, industry associations and citizens groups be considered in policy development. These include the Rio Declaration and the International Chamber of Commerce Charter for Sustainable Development (Chapter 1). Regardless of the size, nature and complexity of an organisation, the policy should be based on the principle that all activities impact on the environment and the company is obliged to minimise these (Jones, 1997).

Both standards require the inclusion of a commitment to continual improvement. BS 7750 defines this as year-on-year enhancement of overall environmental performance but not necessarily in all areas of activity (British Standards Institution, 1994a). Improvements may be achieved by developments in products, services, processes and facilities. They may involve enhanced product quality, improvements in operational efficiency or the adoption of economically viable application of best available technology (EVABAT) (British Standards Institution, 1994a). EVABAT refers to technology which is both readily available and economically viable for the areas targeted for improvement.

Table 4. 5: Example environmental policy contents as contained in 7750: 1994 (British Standards Institution, 1994a)

1. **Reduce waste and the consumption of resources (materials, fuel and energy)**
2. **Reduce or eliminate the production of polluting releases to the environment**
3. **Design products in such a way as to minimise their environmental effects in production, use and disposal**
4. **Control the environmental effects of raw material souring (eg on habitats, on species diversity and on natural beauty)**
5. **Minimise the adverse environmental effects of new developments through strategic planning**
6. **Work towards the achievement of sustainable development**

ISO 14001 defines continual improvement as the process of enhancing the EMS to achieve improvement in overall environmental performance (British Standards Institution, 1996a). Unlike BS 7750 this implies that improvements to the management system, and not necessarily resulting environmental performance, are sufficient. The definition is not qualified with the EVABAT limitation as in BS 7750, although the guidance suggest its considered when establishing objectives and targets (British Standards Institution, 1996a).

Three of the 18 UKAS points of difference between BS 7750 and ISO 14001 relate to the policy (Table 4.3). Firstly, ISO 14001 requires a commitment to the prevention of pollution, which is not included in BS 7750. Its definition is broad ranging including the use of processes, practices, materials and products that avoid, reduce or control pollution (British Standards Institution, 1996a). These may include recycling, treatment, process changes, control mechanisms, efficient use of resources and material substitution. The benefits of prevention of pollution include the reduction of adverse environmental impacts, improved efficiency and reduced costs.

ISO 14001 also requires the inclusion of a commitment to comply with relevant environmental legislation and regulations, and with other requirements to which the organisation subscribes (British Standards Institution, 1996a). In BS 7750 this is not a specific requirement of the policy statement but the overall system must be designed to ensure legal compliance (Section 4.2.2).

BS 7750 defines the policy as a statement of intentions and principles of action of the organisation regarding its environmental effects. The ISO 14001 definition is more detailed, requiring the policy to support the organisation's overall environmental performance aims and provide a framework for action (British Standards Institution, 1996a).

Both standards require the policy to be communicated, implemented and understood at all organisational levels. External assessors require evidence that the contents have been explained to all employees. It must also be made available, in a readily understood format to interested parties, for example, through annual reports, booklets or displays. It is also important that the policy is periodically reviewed and revised to reflect changing conditions and information.

4.2.4 Organisation and Personnel (BS 7750, 4.3) (ISO 14001, 4.4.1 and 4.4.2)

The standards require the responsibilities, authorities and interrelationships of key personnel to be clearly defined and documented. These include those for assigning sufficient resources, initiating action to ensure compliance with the policy, recording problems and providing solutions, and acting in emergencies (British Standards Institution, 1994a). These should be spread across the organisation and not limited to the environment function (Table 4.6). ISO 14004 states that managers should be responsible for EMS implementation and employees accountable for environmental performance within the scope of their individual roles (British Standards Institution, 1996d).

Table 4. 6: Example allocation of environmental responsibilities (from BS 7750: 1994) (British Standards Institution, 1994a).

Senior management	• Assume responsibility for developing, resourcing, reviewing and complying with the environmental policy.
Management representative	• Ensure compliance with the standard. • Ensure that developments in environmental issues are monitored and evaluated.
Finance	• Develop and maintain accounting procedures which enable identification of costs and benefits relating to environmental management.
Personnel	• Develop and maintain appropriate effective two-way communication and training programmes on environmental management.
Other managers	• Develop and implement the EMS as it pertains to their areas of responsibility.

Both standards require management to provide sufficient resources essential for the effective implementation and control of the EMS. These include human resources, specialised skills, technology and financial resources. Human resource requirements may include the services of inspectors, analysts, engineering, pollution monitors, auditors and scientists for investigating laboratory and plant work (Jones, 1997). Material resources required for performance verification will depend on the size and nature of the business. For a typical manufacturing company they may include office accommodation, equipment, materials, inspection and test facilities, storage areas and training and conference facilities. ISO 14004 suggests an organisation begins by assigning resources where there is an obvious benefit, such as limiting liabilities and reducing unnecessary costs. As more knowledge is gained and resources become available the focus can move towards longer-term improvements (British Standards Institution, 1996d).

A management representative must be appointed with defined authority and responsibility for ensuring the requirements of the standard are implemented and maintained. Their role is one of coordinating activities across the site, not for developing and implementing all EMS activities, which should be the responsibility of line management in their particular areas. ISO 14001, unlike BS 7750, specifies that the management representative is appointed by top management and must report to the executive as a basis for improvement of the EMS. This does not necessarily mean they report to the Board of Directors in person, but that reports are submitted and considered at the highest level (Excel Partnership, 1996a).

Both standards require employees to be aware of the environmental impacts of their work activities, and the benefits of improved performance. Documented procedures must cover an analysis of training needs and arrangements for providing training and keeping records. The first stage in determining a training strategy is to identify the training needs of the workforce by assessing existing knowledge and establishing areas for further development. It is not necessary to train all staff in every aspect of the EMS. Management need to determine the level of competence, experience, formal qualifications and training necessary to ensure the capability of personnel carrying out specialised environmental functions. Training required will depend on the type of organisation, individual responsibilities and the level of competence needed (Barwise, 1996). Employees whose work involves minimal environmental impacts need only basic awareness training including an understanding of the policy and management system. Employees whose activities have a significant environmental impact need to be sufficiently trained to perform tasks in an environmentally responsible manner. Typical issues to be incorporated into a training programme include legislation, awareness of global and local issues and company specific issues. Options for delivering training include induction programmes; on-the-job training; in-house training; workshops and discussion groups; lectures and seminars; demonstrations and case studies; academic external training courses and membership of professional institutions (Barwise, 1996) (Chapter 7).

BS 7750 contains a specific clause for ensuring contractors on site are aware of the relevant requirements of the EMS (British Standards Institution, 1994a). There is no comparable clause in ISO 14001 but its requirements are covered later under operational control (British Standards Institution, 1996a) (Section 4.2.10).

4.2.5 Environmental Effects (BS 7750, 4.4) (ISO 14001, 4.3.1 and 4.3.2)

Both standards require procedures for receiving, documenting and responding to internal and external environmental communications. These include enquiries from interested parties, such as customers and the general public, and complaints from local residents. ISO 14001 also requires organisations to consider processes for external environmental communication and record their decision. This may be a commitment to communicate through environmental reports, newsletters, community liaison groups or journals.

BS 7750 requires the identification and evaluation of environmental effects and a register of those considered to be significant. This is frequently considered to be the most challenging requirement of the standard (Sheldon, 1996) (Smith, M., 1995) (Smith, D., 1995) (Hillary, 1994) (Powley, 1994) (Rowan, 1994) (Tothill, 1993). Environmental effects are defined as any adverse or beneficial impingement of activities, products and services upon the environment. They include emissions to air, releases to water, solid waste, resource consumption, nuisance and impacts on eco-systems (Table 4.7). Effects arising, or likely to arise from normal activities; abnormal activities, such as start-up and shut-down; and emergency situations, such as fire, spills, traffic accidents, explosions and vandalism need to be considered.

Table 4. 7: Issues to be considered during the identification of environmental effects for BS 7750 (British Standards Institution, 1994a)

1.	**Controlled and uncontrolled emissions to atmosphere**
2.	**Controlled and uncontrolled discharges to water**
3.	**Solid and other wastes**
4.	**Contamination of land**
5.	**Use of land, water, fuels and energy, and other natural resources**
6.	**Noise, odour, dust, vibration, and visual impact**
7.	**Effects on specific parts of the environment including ecosystems**

Both adverse and beneficial, direct and indirect effects must be included (British Standards Institution, 1994a). Direct effects are those directly controllable by the organisation, such as atmospheric emissions or liquid effluent from a manufacturing process. Indirect effects are those resulting from associated activities, such as raw materials supplied by another organisation, activities of businesses in which the organisation's reserves are invested or impacts associated with the use and disposal of products (Table 4.8).

Table 4. 8: Environmental effects matrix (from Powley, 1994)

	Pollution	***Resource Consumption***
Direct	Air Pollution Land Contamination Water Pollution Nuisance	Energy Water Materials Fuels
Indirect	Polluting effects of suppliers and customers	Resource usage by suppliers and customers

All phases in the manufacturing process must be considered from product conception, research and development, raw material sourcing, production, waste management, packaging, storage, distribution, sales and use, to ultimate disposal. Service organisations are required to address all stages, practices and procedures of service development and provision. Effects from support activities, such as planning, finance, personnel, administration and marketing must also be included. In addition the environmental performance of suppliers is to be considered and where possible alternative suppliers compared.

The scope of the effects identification includes known or suspected consequences of past activities, transferred activities and future activities. Those arising from past activities may include contaminated land or liability for former products. Future consequences may include the responsibility for continued monitoring and management of a landfill site or the decommissioning of a nuclear power station.

ISO 14001 refers to environmental aspects and impacts rather than environmental effects but has the same essential requirements. Procedures are required to identify the environmental aspects over which the organisation can control or be expected to influence, to determine those which have significant impact on the environment. Aspects are defined as the elements of an organisation's activities, products or services that interact with the environment and impacts as the resulting adverse or beneficial environmental changes (Table 4.9). This terminology helps to clarify the difference between activity, aspect and impact, all of which were confusingly referred to as environmental effects under BS 7750.

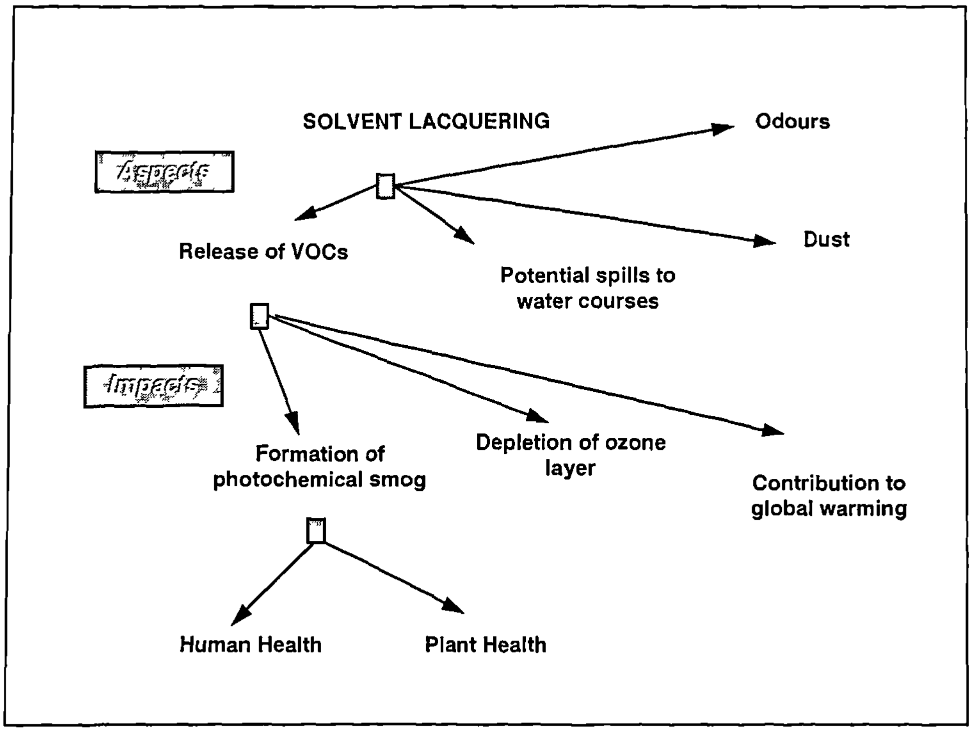
Table 4. 9: Examples of environmental aspects and impacts

Environmental Aspects	*Environmental Impacts*
Air	
CO_2, CH_4, N_2O, fossil fuels	Global warming
CFCs, halons, other chlorinated compounds	Ozone depletion
SO_2, NO_x,	Acid emissions
Volatile organic compounds (VOCs)	Low level ozone formation
Water	
Organics	Oxygen demand
Phosphorus and nitrogen compounds	Eutrophication
Chemicals affecting potable water supply	Water taste
Loss of Habitat	Ecosystem disturbance
Land	
Landfilled waste	Methane gas, loss of habitats
Incinerated waste	Air emissions
Hazardous substances	Ground contamination
Resources	
Minerals / raw materials	Depletion of natural resources
Energy	Air emissions, resource depletion
Water	Depletion of natural resources
Other	
Visual	Nuisance to local residents
Dust	Nuisance to local residents
Odour	Nuisance to local residents
Noise / vibration	Nuisance to local residents

It is not uncommon for an activity to be associated with more than one environmental aspect. The use of solvent based paint results both in the release of volatile organic compounds (VOCs) and the release of particulates (Figure 4.1). Likewise each aspect may be associated with multiple environmental impacts. This is true for the release of

VOCs which contribute both to photochemical smog formation and the depletion of the ozone layer.

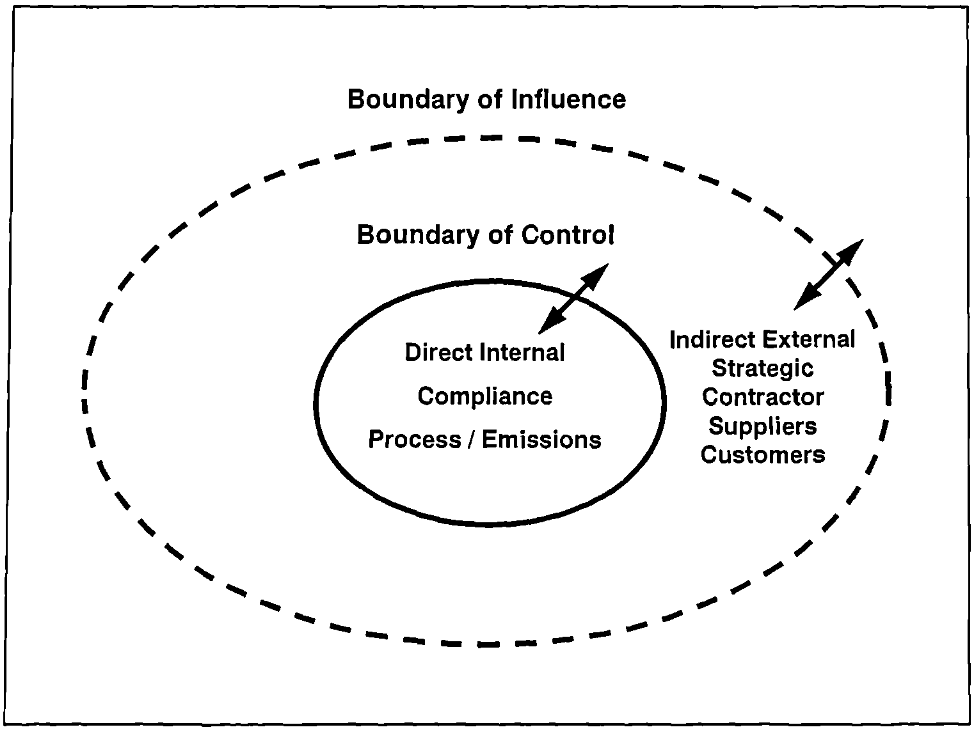
Figure 4. 1: Examples of environmental aspects and impacts of solvent lacquering (Institute of Environmental Management, 1996c)



ISO 14001 does not specifically require a register of environmental aspects and impacts but that information relating to them is kept up to date. It is hard to imagine how an organisation could demonstrate compliance with this requirement without keeping some form of documented register.

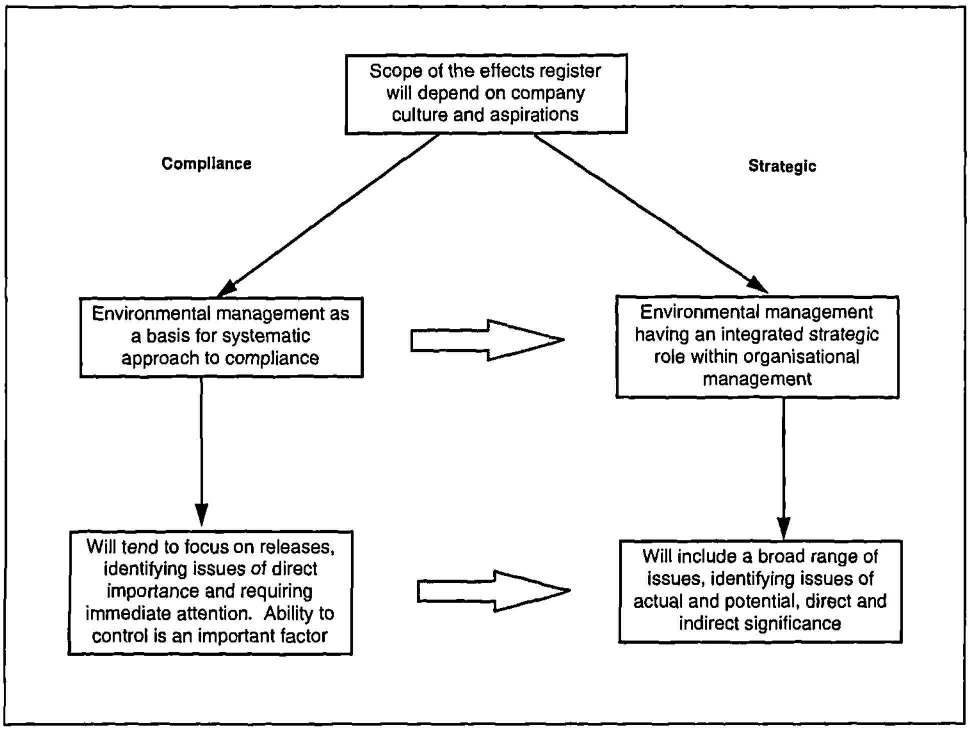
The assessment of environmental effects, or aspects, raises two key issues. The first relates to the scope of the assessment and the second to the definition of significance. The assessment's all encompassing remit means theoretically an organisation's impacts are almost infinite. In practice the scope of the assessment needs to be clearly defined. Both standards recommend that the boundary should be those over which the organisation can control or reasonably be expected to influence. This is open to interpretation and neither standard tackles the issue of defining influence. This gives those implementing them a degree of flexibility in defining the boundaries of their system. The Institute of Environmental Management (1996c) suggests this will depend on the overall aim of the system. Where legislative compliance is the objective the ability to control is an important factor and the EMS needs to focus on direct impacts. In this case the scope is likely to be limited to those over which the organisation has control. Where a more strategic role is envisaged the assessment's scope will be broader, encompassing both direct and indirect aspects (Figure 4.2). With time, after liabilities have been minimised and unnecessary costs eliminated, the register can become a strategic tool in environmental management. The emphasis should progressively move towards preventing environmental harm, converting to intrinsically environmentally friendly products and processes and the use of renewable resources (Parkman, 1995) (Figure 4.3) (Chapters 7 and 11).

Figure 4. 2: Managing the interface between control and influence (from Institute of Environmental Management, 1996c)



In defining the scope of the assessment consideration should be given to the degree of influence possible. This may include exerting pressure on customers or suppliers, investing in research and development, providing information, financial pressure or publicity (Institute of Environmental Management, 1996c). The degree of effort involved and the likely effectiveness need to be balanced. Those effects which are extremely difficult or impossible to influence can be excluded. It is important to note, however, that whilst an aspect can not currently be controlled or influenced this may change and the scope of effects assessment needs to be constantly reviewed in light of changing circumstances. Although organisations have some degree of flexibility in determining the scope of the assessment it needs to stand up to external scrutiny during certification. The register should be regarded as a store of information for future objectives and targets and therefore should include as many aspects as possible (Powley, 1994).

Figure 4. 3: The role of the effects assessment (Parkman Environment, 1995)



Following the identification of environmental effects their significance needs to be assessed. The definition of environmental significance has been widely debated (see Goodchild, 1994). In determining significance consideration needs to be given to legislation and applicable codes of practice to which the organisation subscribes. These may commit the organisation to achieving numerical pollution targets, waste reduction or the installation and use of certain technology. It is at the organisation's discretion whether to accept the evaluation implied by legislation or to undertake a more detailed assessment. A more comprehensive approach would also incorporate the views of interested parties, and the frequency and nature of environmental complaints (British Standards Institution, 1994a). ISO 14004 suggests significance depends on both environmental and business concerns (Table 4.10). Its suggestion that the cost and difficulty of changing the impact should influence the significance is misleading. These issues will determine the action taken to reduce an impact but they do not make it any less significant. It is the author's view that these issues should be taken into account during the determination of objectives and targets rather than in assessing significance.

Table 4. 10: Guidance on assessing environmental aspects and impacts as contained in ISO 14004: 1996 (British Standards Institution, 1996d).

Environmental concerns:
- the scale of the impact
- the severity of the impact
- probability of occurrence
- duration of impact
Business concerns:
- potential regulatory and legal exposure
- difficulty of changing the impact
- cost of changing the impact
- effect of change on other activities and processes
- concerns of interested parties
- effect on public image of the organisation

A wide range of different techniques are available for comparing the significance of effects. The depth of the investigation depends on the resources and knowledge available in the organisation (Excel Partnership, 1996a). At the simplest level a set of criteria can be used to determine significance which may be assigned a numerical score (Table 4.11).

Table 4. 11: Environmental effects assessment significance scale (from Hillary, 1994)

Scale	***Description***	***Criteria***
1	Negligible	Very small effect Low probability of occurrence
2	Minor	Abnormal conditions would cause a breach of statutory regulations Effect and probability of occurrence are both small
3	Significant	The activity has an effect under normal operating conditions and causes a breach of statutory regulations under abnormal conditions. Effect and probability of occurrence are moderate.
4	Major	The activity under abnormal conditions is a major breach of statutory regulations. Effect, as a result of quantity and type of material, is extensive.

The use of risk assessment to evaluate significance is frequently recommended (Jones, 1997) (Barwise, 1996) (Institute of Environmental Management, 1996c) (Chemical Industries Association, 1995) (Fawcett, et al., 1995) (Smith, M. 1995) (British Standards Institution, 1994a) (Intelex Press, 1994a). Traditionally this involves multiplying the probability, or likelihood, of an event occurring by its environmental consequence (Figure 4.4). Those with a high probability and a high consequence are considered to be significant.

An expansion of this technique is known as failure mode and effect analysis (FMEA). This involves rating an effect or aspect according to its likelihood, severity and the existing level of control (Jones, 1997) (Institute of Environmental Management, 1996c). The sum, or product, of the three scores gives a risk priority number (RPN) which determines the significance (Table 4.12). The greater the degree of management control the lower the overall rating. As improvements are introduced and control increases ratings will decrease and the effect becomes less significant.

Figure 4. 4: Environmental effects assessment using risk assessment (from Chemical Industries Association, 1995)

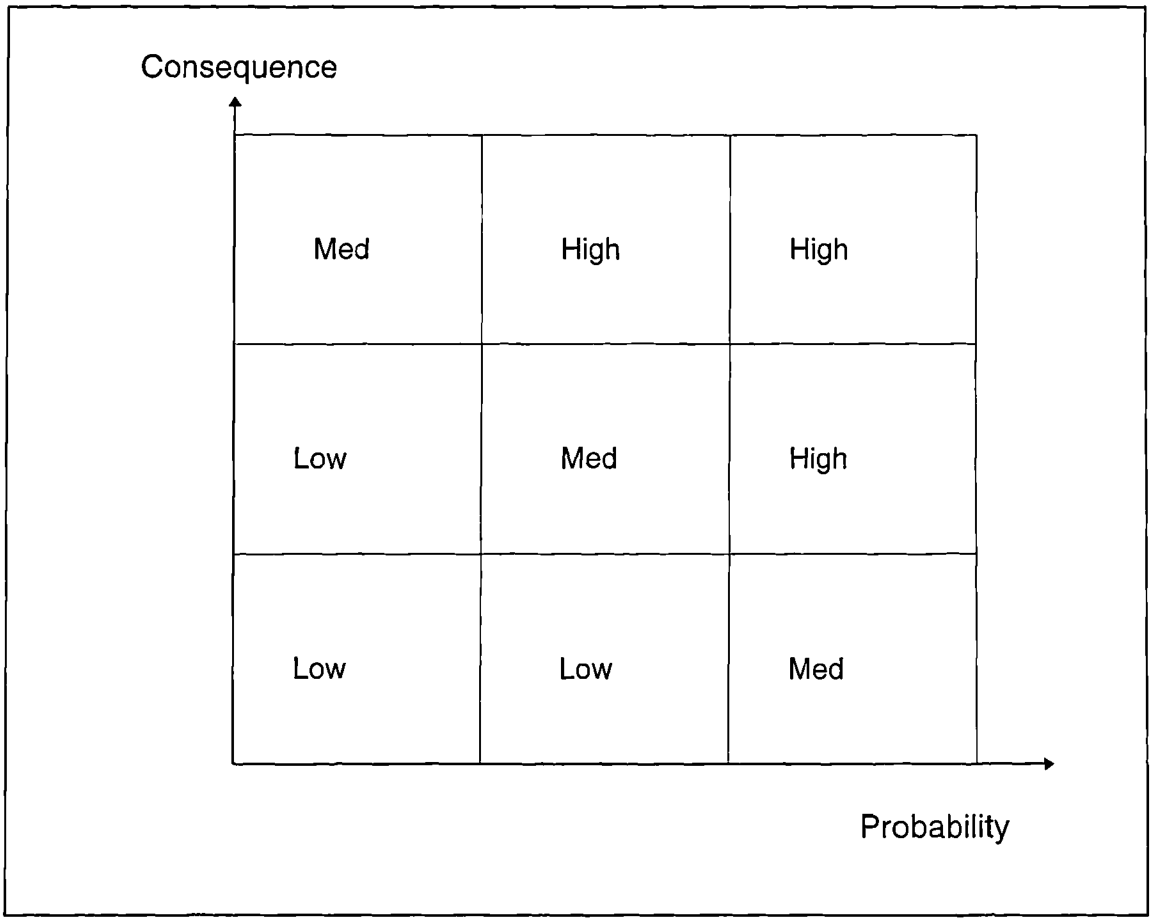


Table 4. 12: Typical environmental effects assessment using FMEA (from Jones, 1997)

Description of Effect	***Severity***	***Occurrence***	***Detection***	***PRN***	***Significance***
Sulphur dioxide	4	9	2	72	Low
Nitrogen oxides	5	8	10	400	Very High
Carbon dioxide	6	10	2	120	Moderate
Carbon monoxide	2	10	2	40	Trivial
Volatile organics (VOCs)	2	10	10	200	High
Steam	2	8	2	32	Trivial
Dust	4	8	3	96	Low
Compressed air	2	4	10	80	Low

The significance of environmental effects or aspects will vary between organisations according to their location, stakeholder pressures and environmental aspirations (Institute of Environmental Management, 1996c). Where the EMS is designed to achieve legal compliance the focus will be those impacts which could lead to prosecution. If the EMS aims to guide the direction of business development a broader set of effects will be considered significant.

BS 7750 acknowledges the subjectivity of the assessment and emphasises its aim of providing a consistent approach (Peckham, 1995). It is the role of the external assessor to make a judgment on whether the methodology employed has been successful in identifying the issues of importance. Both standards specify that organisations do not have to evaluate the environmental impacts of each product, component or raw material. A full-life cycle analysis is not required, unless specified by an in-house policy or standard.

Where an environmental aspect or effect is identified as significant, it needs to be managed within the system (European Accreditation of Certification, 1996). Depending on the situation this may involve further investigation, programmes for planned improvement or controls to maintain performance (Section 4.2.7).

4.2.6 Legal and Other Requirements (BS 7750, 4.4.2) (ISO 14001, 4.3.2)

BS 7750 requires a procedure to record all legislative, regulatory and other policy requirements and codes of practice to which the organisation subscribes. These may include planning conditions, discharge consents, process authorisations, non-regulatory guidelines and policy commitments. The register aims to demonstrate the organisation is aware of its legal obligations and is taking the necessary measures to comply (Barwise, 1996) (British Standards Institution, 1994a). It acts as a reference document for those responsible for establishing procedures to control the operations of the organisation.

ISO 14001 does not specifically require a register of regulations but procedures to ensure access to and awareness of relevant legislative, regulatory and policy requirements. In practice a simple register is often the most effective way to demonstrate compliance with this requirement to external auditors.

The process of compiling a register of regulations is closely linked to the environmental effects assessment. A logical approach is to assess processes and activities with a view to identifying both significant environmental effects and relevant regulatory requirements (Barwise, 1996). Information contained in codes of practice and regulations provides useful guidance in assessing environmental effects. The scope of the register should be environmental legislation, regulations, policies and sector codes of practice relevant to the environmental effects. It is important to demonstrate the register is relevant to the organisation and the compiler familiar with its processes, activities and products. Sources of information for compiling the register are varied and include national, European and international documents (Table 4.13).

Table 4. 13: Typical sources of information for the register of regulations (Barwise, 1996).

a)	European Union Documents
b)	International Conventions
c)	Government Consultation Papers
d)	Government Circulars
e)	Government Guidance Papers
f)	Government Approved Codes of Practice
g)	Secretary of State Guidance Notes
h)	Regulators' Guidance Notes
i)	Industry Sector Codes of Practice
j)	Company Codes of Practice
k)	Trade Journals

The register should be a working document which is regularly reviewed to reflect changes in the regulatory framework. A documented procedure detailing the mechanism by which this occurs, including responsibilities, is required.

4.2.7 Environmental Objectives & Targets (BS 7750, 4.5) (ISO 14001, 4.3.3)

Both BS 7750 and ISO 14001 require the establishment of environmental objectives and targets. Objectives are broad goals to be achieved whilst targets quantify planned improvements over specified timescales. These play a key role in directing the EMS and ensuring continual environmental improvement. They must be consistent with the environmental policy and wherever practicable quantify the commitment to continual improvement. There can be several levels of objectives, from broad system objectives to site specific ones for individual activities (British Standards Institution, 1996d).

Compliance with legislative and regulatory requirements must be a key priority when establishing objectives and targets. It is also necessary to consider the significant environmental effects, financial, operational and business requirements of the organisation, and the views of interested parties (British Standards Institution, 1994a). Typically an organisation would include a mixture of legal obligations together with other improvements essential in realising the organisation's environmental vision (Table 4.14).

It is for the company to decide which of the significant environmental effects are to be subject to improvement and the rate of progress required (European Accreditation of Certification, 1996). They should aim to achieve continual improvement but do not need to tackle all areas simultaneously. Both standards acknowledge that improvement may be impracticable in some areas, at certain times. Significant effects not subject to an objective must be managed elsewhere in the system, either through operational control or monitoring.

Table 4. 14: Examples of environmental objectives and targets (from Barwise, 1996)

Legislative Compliance

To comply with all relevant UK environmental legislation within 12 months

Energy Consumption

To replace all lighting equipment and bulbs in offices and workshops with low energy, long-life equipment and bulbs when they need replacing. This exercise should begin immediately and it is anticipated that all equipment will have been replaced over a five year period.

Raw Material Consumption

Reduce wastage of all raw materials used in each process on site by 20% per process within 5 years.

Waste Minimisation

To reduce process waste by 10% over two years by retraining operational staff and adopting a high level of maintenance of equipment.

Air Emissions

To reduce emissions of CO_2 and NO_X by 10% and 15% respectively over a five year period for named processes.

Water Emissions

To fit an in-house water treatment plant, fed from all processes, by the year 2000.

Noise

To phase out all freight vehicle entries and exits from sites in residential areas between the hours of 2300 and 0700 by the end of the year.

Transport

To give training to all haulage drivers within 12 months and to fit speed limiting equipment and tachographs to all vehicles by the end of two years.

Hazardous Processes

To substitute specific solvents currently used in the production process within three years.

Landscaping and Planning

To improve the landscape of the site area over a period of two years to support ecological diversity and lessen the negative visual impact of our plant for neighbours.

BS 7750 specifies that areas subject to objectives and targets should be those where improvement is most necessary to reduce risk and liabilities. Improvements should aim to achieve, over time, performance equivalent to the application of EVABAT. ISO 14001 does not demand this but suggests that organisations consider the use of best available technology where economically viable, cost effective and judged appropriate. In the case of processes subject to control under the *Environmental Protection Act 1990* their authorisations will establish many requirements. For other processes and activities, account should be taken of technological developments. Cost-benefit analysis can be used to assist in the identification of objectives and targets but there is no obligation to use environmental cost accounting techniques (British Standards Institution, 1994a).

BS 7750 provides more guidance than ISO 14001 and acknowledges the rate at which organisations aim to continually improve will depend on economic considerations versus the degree of environmental impact and risk involved. An organisation may wish to prioritise improvements which can be achieved at minimal cost and implemented with relative ease. Objectives requiring large capital expenditure or organisational change may not be practicable or feasible in the short-term but may be considered viable in the long-term (Barwise, 1996).

Progress in achieving objectives and targets should be regularly reviewed. If changing circumstances make their achievement unrealistic they must be modified or corrective action implemented to ensure their achievement. If this occurs failure to achieve an objective or target will not be considered a non-conformance with the standard.

4.2.8 Environmental Management Programme (BS 7750, 4.6) (ISO 14001, 4.3.4)

BS 7750 and ISO 14001 require a management programme for achieving the objectives and targets. Consistency between the policy, objectives, targets and programmes is essential in an EMS. ISO 14004 provides an example of how this should be achieved through a staged approach (Figure 4.5).

ISO 14004 suggests the first stage in developing an environmental programme is to establish an environmental strategic plan including schedules, resources and accountabilities. This provides the long term strategy, perhaps over the next 5 years, for improving environmental performance. It is useful in mapping out the organisation's interpretation and application of continual improvement and forms the basis of future detailed programmes (British Standards Institution, 1996d). Where possible the organisation should ensure integration with other plans such as those for quality, health and safety, information systems and overall business plans.

Individual programmes must contain responsibilities and the means and time-frame by which objectives and targets are to be achieved (Table 4.15). Responsibilities should be assigned at each relevant function and level of the organisation. BS 7750 also specifies that progress in achieving objectives and targets, where possible, should be taken into account during an individual's appraisal.

Figure 4. 5: Example of how to link environmental objectives, targets and plans (from British Standards Institution, 1996d)

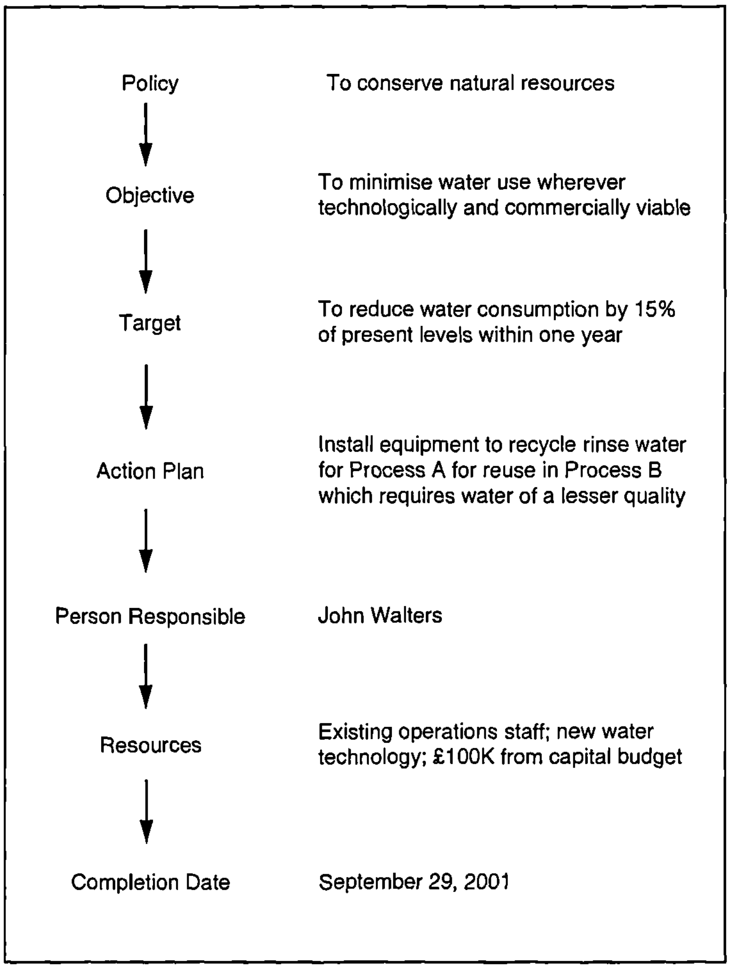


Table 4. 15: An example environmental programme (Jones, 1997).

The objective

To reduce solvent emissions from the paint shop to an acceptable level

The targets

• commencement date for the project	1/10/94
• establishment of "acceptable levels"	31/01/95
• achievement of a 20% reduction in solvent emissions	30/04/95
• achievement of a 50% reduction in solvent emissions	31/07/95
• achievement of "acceptable levels"	30/09/95
• project review date	3/10/95

The project team

I N Lestrade (project manager)
J Oldacre
D P Trevelyan

The programme

1. Quantification of total solvent usage in the paint shop and a materials balance calculated to establish the total volume of solvent released to atmosphere.
2. Identification of the various emission sources by direct measurement of atmospheric solvent concentration at selected locations within the paint shop.
3. A thorough examination of plant to find ways of preventing the escape of solvent vapour. Plant trials will be carried out for each modification.
4. Reviews of progress will be carried out monthly.

The budget

Budget allocation for this project is £10k, to be drawn from Development Department funds

The standards require programmes to be amended, were necessary, to cover the environmental impacts from new or modified developments, activities, products or services. All stages of the life cycle should be addressed including the design, raw material specification, production processes, use and ultimate disposal of new products. For new processes or installations planning, design, construction, operation and decommissioning may need to be incorporated.

4.2.9 Management Manual and Documentation (BS 7750, 4.7) (ISO 14001, 4.4.4)

BS 7750 requires a manual, in paper or electronic form, to describe the interactions of the EMS elements. Its principal function is to act as a central reference point providing direction to related documentation (Jones, 1997). It addresses each clause and sub-clause of the standard describing how their requirements have been implemented. Where a requirement is not relevant to a particular organisation, such as calibration of equipment, this needs to be explained.

The manual provides the basis for auditing the system and will be referred to by both internal auditors and external assessors during the certification process. It also provides a useful introduction and summary of the system which can be beneficial for training purposes.

The manual forms the top layer of the documentation hierarchy from which more detailed procedures, records and registers originate (Figure 4.6). The second layer consists of procedures describing general activities such as auditing and training (Table 4.16). Work instructions or standard operating procedures, describing how to undertake a particular task, form the third layer. These typically relate to operational activities, such as environmental monitoring or operating abatement equipment, and therefore usually apply to a particular area of the site. The fourth layer consists of supporting documentation such as records and registers.

ISO 14001 does not specifically ask for a manual but requires the establishment and maintenance of information to describe the core elements of the management system, their interaction, and provide direction to related documentation (British Standards

Institution, 1996a). The most common way of complying with this requirement is to compile a brief manual equivalent to that required by BS 7750.

Figure 4. 6: Documentation levels in an EMS

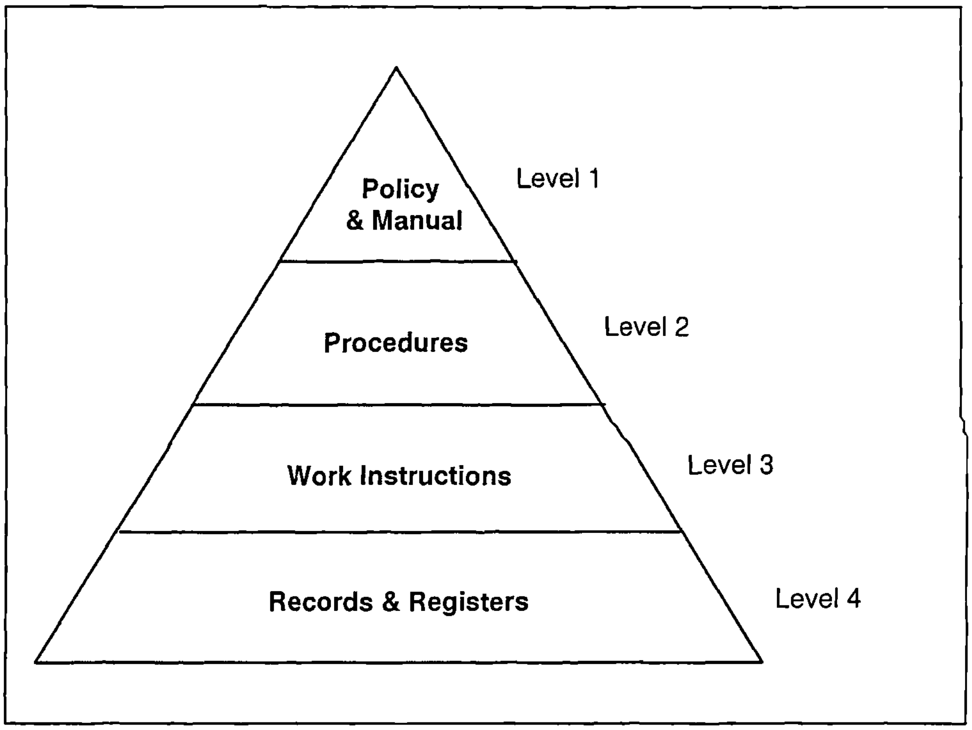


Table 4. 16: Typical EMS Procedures

Purpose of Procedure
Employee Training & Awareness
Contractor Environmental Awareness
Responding to Internal and External Environmental Communications
Identifying, Examining and Evaluating Environmental Effects
Recording Legislative, Regulatory and Policy Requirements
Specifying Environmental Objectives and Targets
Operational Control & Environmental Monitoring
Verification, Measurement and Testing
Non-compliance and Corrective Action
Environmental Management System Auditing

Both standards require a system of document control to ensure current versions of documents are available at all necessary locations and obsolete documents removed (Table 4.17).

Table 4. 17: Elements of an effective document control system

- A distinction is made between "controlled" and "uncontrolled" documents
- Controlled documents are legible, dated and easily identifiable
- All controlled copies of system manuals carry a unique holder's number
- Each controlled document is assigned a unique reference number
- A register of manual holders is maintained by the document controller
- A list of all controlled documents and their location is maintained
- The originals of all controlled documents are kept by the document controller
- All controlled documents are authorised and carry a clear signature as proof
- Copies of controlled documents for distribution should be kept to a minimum
- Amendments to controlled documents must be made only after authorisation
- All amendments are recorded by the document controller on record sheets
- Controlled documents are maintained in an orderly manner and easily retrievable
- Responsibilities are defined for the regular review of documents

4.2.10 Operational Control (BS 7750, 4.8) (ISO 14001, 4.4.6, 4.4.7, 4.5.1, 4.5.2)

This clause of BS 7750 is divided into four sub-clauses. The first contains a general requirement to define appropriate control, verification, measurement and testing activities, to ensure these are adequately coordinated and effectively performed. The second requires that all functions, activities and processes which have the potential to significantly affect the environment are carried out under controlled conditions. This is fundamental to the success of any management system and is concerned with the management of risk and resources (Barwise, 1996).

Operational control requires the identification of critical parameters that govern the process. It is based on the premise that if these can be kept firmly under control the process will not run the risk of environmental incidents (Jones, 1997). It is achieved through a series of checks, tests and measurements. These are specified in documented procedures and work instructions containing acceptable operating criteria. They also need to define the actions to be taken during abnormal operations including accident and emergency situations.

The third sub-clause requires procedures to verify compliance with the management programme, targets, manual and work instructions and for maintaining records of the results. This involves monitoring, measuring, testing and calibration and may require the establishment of environmental performance indicators. It is likely to involve the collection of data on emissions, energy and water consumption. The standards also require measurement and test facilities to be adequately safeguarded from unauthorised adjustments or damage. To effectively measure compliance with objectives and targets it may be necessary to establish environmental performance indicators.

Organisations have a degree of flexibility in determining the scope of operational control activities. BS 7750 specifies that all activities, including procurement and contracted activities, need to be controlled where they may result in an infringement of the policy, objectives or targets. These are normally the activities which lead to, or have the potential to lead to, significant environmental effects. They will include activities subject to regulatory control or prioritised for improvement in the policy or objectives (Jones, 1997). They may be direct activities, such as design, production and distribution, or indirect activities, such as raw material sourcing, purchasing and product use. Support activities, such as finance, personnel and administration, may also need to be covered if they result in significant environmental effects.

The type of control and verification activities adopted should be appropriate to the nature, complexity and environmental significance of the activity, function or service to be controlled. Whilst simple procedures may be sufficient in an office based department more complex monitoring and control would be needed in a manufacturing company.

The final requirement of operational control is for investigation of non-compliances and implementation of corrective and preventative action. These include breaches of legislation or the failure to follow procedures or meet objectives. They can be sudden and accidental, or long-term. Their cause must be identified and could be a failure in equipment, human error or a deficiency in the management system. The corrective and preventative action required depends on the severity of the non-conformance and could require changes to documentation, working practices or new equipment. Any resulting changes to procedures must be recorded and long-term projects should form part of the management programme.

In addition to the requirements of BS 7750, ISO 14001 requires a procedure for periodically evaluating compliance with relevant environmental legislation and regulations. In practice, however, this does not necessarily require the documentation of additional procedures as the activities of the management review meetings usually cover legislative compliance (Chapter 4.2.13).

4.2.11 Environmental Management Records (BS 7750, 4.9) (ISO 14001, 4.5.3)

Records are required to demonstrate compliance with the EMS and to record the meeting of objectives and targets. Their nature will depend on the organisation but will include those for auditing, training, non-conformances, communications and monitoring (Table 4.18). Both standards require procedures for the identification, maintenance and disposal of records. They must be legible, easily retrieved and protected against damage.

4.2.12 Environmental Management Audits (BS 7750, 4.10) (ISO 14001, 4.5.4)

Audits are required to determine whether EMS elements comply with planned arrangements. They check whether the system is implemented effectively and fulfills the environmental policy and objectives. Their aim is to identify weaknesses and improvements to the EMS and play an essential role in ensuring continual improvement (Sayre, 1996) (Houldin, 1995a).

Table 4. 18: Examples of EMS records

- **Environmental laws or other relevant requirements**
- **Complaint records**
- **Training records**
- **Process and product information**
- **Inspection, maintenance and calibration records**
- **Pertinent contractor and supplier information**
- **Incident reports**
- **Information on emergency preparedness and response**
- **Information on significant environmental aspects**
- **Audit results**
- **Management reviews**

The standards require an audit cycle, programme, plan and procedures (Table 4.19). The programme specifies the activities and areas to be audited together with their frequency which should depend on the environmental significance. External assessor's will look to see that those associated with significant environmental effects, previous non-conformances or organisational change are audited more frequently (Houldin, 1995a and 1995b) (Table 4.20). BS 7750, unlike ISO 14001, recommends a maximum audit cycle of three years with most areas being audited every year.

Procedures are required to specify audit arrangements and responsibilities. Several guidance standards to ISO 14001 have been published on environmental auditing. General principles of auditing are found in ISO 14010 and guidelines for audit procedures in ISO 14011/1 (British Standards Institution, 1996b, 1996c). These specify three stages in an audit from pre-audit activities, to conducting the audit through to post audit activities. Each phase consists of several steps (Table 4.21).

Table 4. 19: Auditing terminology used in the EMS standards (Institute of Environmental Management, 1995)

The audit cycle:

- The period over which all parts of the organisation are audited.

The audit programme:

- The timetable, projected over the audit cycle, of what parts of the organisation are to be audited when. The programme also assigns responsibility for these audits.

The audit plan:

- The details for individual audits, including the schedule for the audit and audit meetings, personnel to be involved, required documentation, checklists and questionnaires etc. and the audit report distribution.

Audit procedures:

- Procedures which apply to the audit process from setting the audit programme, undertaking the audit, following up on results and assigning responsibilities.

Table 4. 20: Recommended audit frequency for EMS elements (from the Institute of Environmental Management, 1995)

Audit Frequency	*EMS Elements*
3 months	Areas of non-conformance and change
6 months	Areas where potential for impact is deemed significant
1 year	All other system elements

Suitably trained internal or external personnel may carry out audits as long as they do so impartially and objectively. BS 7750 specifies that auditors be independent of the area being audited wherever practicable. It is acknowledged that this may be difficult in small organisations with limited personnel.

External assessors must be convinced of the effectiveness of the internal audit system before they are able to award certification. The guidelines published by European Accreditation of Certification require the audit system to be fully operational and effective but provide little guidance relating to how this can be determined (European

Accreditation of Certification, 1996). This is largely at the discretion of the individual certification bodies.

Table 4. 21: Typical steps in an environmental audit

Pre-Audit Activities:	
Step 1	Schedule the audit to occur in the audit programme.
Step 2	Define the purpose and scope of the audit.
Step 3	Make pre-audit notifications as required.
Step 4	Prepare for the audit with an audit plan and checklist. Conduct as much preliminary review of documentation as possible.
Conducting the Audit:	
Step 5	Hold an audit entrance meeting to introduce the auditor(s) and the audit objectives and to identify contacts and necessary resources for the audit.
Step 6	Perform the audit by collecting objective evidence through interviews, reviews, examinations and observations.
Step 7	Hold an audit exit meeting to discuss audit findings and get clarifications or corrections.
Post Audit Activities:	
Step 8	Document the results of the audit.
Step 9	Present the report to responsible management, with distribution required by the procedure or as requested by senior management.
Step 10	Conduct a follow up on any corrective and preventative actions for identified nonconformities or weaknesses.

4.2.13 Management Review (BS 7750, 4.11) (ISO 14001, 4.6)

The final requirement of both standards is for management to hold regular meetings to review the ongoing suitability and effectiveness of their EMS. The possible need for changes to the policy, objectives and other EMS elements need to be addressed in light of the audit results, changing circumstances and commitment to continual improvement (Table 4.22). Before certification can be awarded at least one management review must be completed and the results documented (European Accreditation of Certification, 1996).

Table 4. 22: Issues to be addressed in the management review (British Standards Institution, 1994a)

1. Results of internal and external audits
2. Progress against objectives and targets
3. Continuing suitability of the environmental policy and procedures
4. Emerging environmental concerns
5. Developing environmental issues
6. Potential regulatory developments
7. Concerns of interested parties
8. Market pressures
9. Changes in activities
10. Changes in the sensitivity of the environment

The requirement for the management review is almost identical in both standards apart from one important difference. ISO 14001 requires the review to be undertaken by top management. This will ensure that the EMS is given the highest priority within the organisation.

4.3. THE REQUIREMENTS OF EMAS

The EC Eco-management and Audit Scheme (EMAS) was implemented in Member States through Council Regulation 1836/93 (European Commission, 1993a). The 21 Articles cover administrative arrangements, including the requirements of participating companies and environmental verifiers; site registration and fees; and the responsibilities of the competent body (Table 4.23). The detailed requirements of the scheme are found in the 5 Annexes of the Regulation (Table 4.24).

Table 4. 23: Articles of the Eco-management and Audit Regulation

Article Number	*Article Title & Description*
Article 1	**The eco-management and audit scheme and its objectives:** defines the scheme's aims & relationship with existing environmental laws
Article 2	**Definitions:** defines the 15 terms used in the regulation e.g. site, environmental audit, industrial activity & accredited environmental verifiers.
Article 3	**Participation in the scheme:** explains the elements a site must undertake to become registered to the scheme.
Article 4	**Auditing and validation:** outlines who may conduct a sites internal environmental audit, how and at what frequency; and details accredited environmental verifiers' activities.
Article 5	**Environmental statement:** lists the information required in a statement & explains simplified annual statements.
Article 6	**Accreditation & supervision of environmental verifiers:** defines accreditation systems for environmental verifiers which member states are required to establish.
Article 7	**List of accredited environmental verifiers:** defines frequency and where lists should be published.
Article 8	**Registration of sites:** explains site registration & deregistration by the competent body.
Article 9	**Publication of list of registered sites:** defines how lists of registered sites should be published in the EC's official journal.
Article 10	**Statement of participation:** defines where sites may use the statement.
Article 11	**Costs and fees:** allows member states to set up charges.
Article 12	**Relationship with national, European and international standards:** explains under what conditions standards may be used in conjunction with the scheme.
Article 13	**Promotion of companies' participation in particular small and medium-sized enterprises:** states how member states may promote company involvement in the scheme.
Article 14	**Inclusion of other sectors:** defines under what conditions other sectors may be included.
Article 15	**Information:** defines how member states may promote and publicise the scheme.
Article 16	**Infringements:** gives member states powers to act in case of non-compliance with the regulation.
Article 17	**Annexes:** states that the annexes may be adapted before the regulations review date.
Article 18	**Competent bodies:** defines and ensures the neutrality of the competent body.
Article 19	**Committee:** sets up the structure and voting procedure for the committee.
Article 20	**Revision:** sets the time limit for the commission review of the entire regulation.
Article 21	**Entry into force:** gives the dates when the regulation enters into force and when it will apply in the member states.

Table 4. 24: The annexes of the Eco-management and Audit Regulation

Annex Number	*Description of Annex*
Annex I	Details the requirements for a company's environmental policy and a site's environmental objectives and programmes, EMS systems similar to BS 7750 and good management practices.
Annex II	Details the requirements concerning site environmental auditing, its methodology, coverage and frequency.
Annex III	Details the accreditation criteria for environmental verifiers and their functions and actions during verification.
Annex IV	Shows four examples of the statement of participation with its graphic symbol which may be used to advertise participation in the scheme.
Annex V	Lists the information that needs to be supplied to the competent body in an application for registration to the scheme.

Many requirements are common to BS 7750 and ISO 14001, including a policy, programme, management system and internal audits. Although all three standards are similar EMAS is more stringent than BS 7750 and ISO 14001. The European Commission officially recognises ISO 14001 as equivalent to the management system requirements of EMAS as long verifiers check for compliance with those areas detailed in the bridging document produced by CEN (Table 4.25).

To become registered eligible companies must complete seven steps (Table 4.26). The first stage involves documentation of a company wide environmental policy detailing overall environmental aims and actions. As in BS 7750 and ISO 14001 it must contain a commitment to complying with relevant environmental legislation. The terminology of EMAS differs from BS 7750 and ISO 14001 by asking for continuous rather than continual environmental improvement. Although the relevance of this has been widely debated it is unlikely to be consequential in practice. The important issue is that organisations can demonstrate improvement in certain areas of their activities. The definition of continuous improvement is qualified in EMAS, as in BS 7750, with the requirement that the company works towards EVABAT.

Table 4. 25: Differences in the requirements of EMAS and ISO 14001 as detailed in the "bridging" document produced by CEN (contained in Institute of Environmental Management, 1998a)

EVABAT:
EMAS requires companies move towards levels of performance compatible with EVABAT. ISO 14001 only suggests this is considered.
Environmental Review:
Although a preparatory review is required by EMAS, it is only recommended under ISO 14001. However, existing data forming part of the EMS can be used to meet this requirement in those companies already certified to ISO 14001.
Environmental Policy:
EMAS requires a commitment to *continuous* environmental improvement rather than *continual* improvement required by ISO 14001.
Aspects & Effects:
EMAS and ISO 14001 use different terminology in this area and EMAS lists the type of effects operators should consider.
Environmental Audits:
The environmental audit in EMAS includes the requirement to audit performance whereas ISO 14001 does not. However, monitoring of performance is addressed under other clauses of ISO 14001. EMAS specifies an audit frequency of 3 years which is not included in ISO 14001.
Communications:
EMAS explicitly requires specific types of communication to public authorities and the public and contractors whereas ISO 14001 does not.
Definition of Site:
EMAS must be applied to a specific site involved in manufacturing activities. ISO 14001 can be applied to any organisation, or part, with separate management.
Legal Compliance:
EMAS states that companies must comply whilst ISO 14001 states they must be committed to compliance.
Registers:
ISO 14001 does not explicitly require compilation of registers but states information must be kept up to date thereby implying the need for documented registers.
Environmental Statement:
EMAS requires a publicly available environmental statement.

Table 4. 26: The seven steps to EMAS registration

Stage	*Requirements*
1	A Company Environmental Policy
2	An Environmental Review
3	An Environmental Programme
4	An Environmental Management System
5	An Environmental Audit System
6	An Environmental Statement
7	Verification and Validation

EMAS is more prescriptive in its requirements of the policy statement than BS 7750 and ISO 14001 by requiring the organisation addresses the 12 issues contained in Annex 1C of the Regulation (Table 4.27). The basis for the company's policy are the 11 good management practices contained in Annex 1D (Table 4.28).

Table 4. 27: The 12 issues to be addressed within the framework of the environmental policy and programmes and audits for EMAS

1	**Assessment, control and reduction of the impact of the activity concerned on various sectors of the environment.**
2	**Energy management, savings and choice.**
3	**Raw materials management, savings, choice and transportation as well as water management and savings.**
4	**Waste avoidance, recycling, reuse, transportation and disposal.**
5	**Evaluation, choice and reduction of noise within and outside the site.**
6	**Selection of new production processes and changes to production processes.**
7	**Product planning (design, packaging, transportation and changes to production processes).**
8	**Environmental performance and practices of contractors, subcontractors and suppliers.**
9	**Prevention and limitation of environmental accidents.**
10	**Contingency procedures in cases of environmental accidents.**
11	**Staff information and training on environmental issues.**
12	**External information on environmental issues.**

Table 4. 28: Good management practices to form the basis for the company policy required for EMAS.

1. A sense of responsibility for the environment amongst employees at all levels, shall be fostered. 2. The environmental impact of all new activities, products and processes shall be assessed in advance. 3. The impact of current activities on the local environment shall be assessed and monitored, and any significant impact on the environment in general, shall be examined. 4. Measures necessary to prevent or eliminate pollution, and where this is not feasible, to reduce pollutant emissions and waste generation to the minimum and to conserve resources shall be taken, taking into account of possible clean technologies. 5. Measures necessary to prevent accidental emissions of materials or energy shall be taken. 6. Monitoring procedures shall be established and applied, to check compliance with the environmental policy and, where these procedures require measurement and testing, to establish and update records of the results. 7. Procedures and action to be pursued in the event of a detection on non-compliance with its policy, objectives or targets, shall be established and updated. 8. Co-operation with the public authorities shall be ensured to establish and update contingency procedures to minimise the impact of any accidental discharges to the environment that nevertheless occur. 9. Information necessary to understand the environmental impact of the company's activities shall be provided to the public, and an open dialogue with the public should be pursued. 10. Appropriate advice shall be provided to customers on the relevant environmental aspects of the handling, use and disposal of the products made by the company. 11. Provisions shall be taken to ensure contractors working at the site on the company's behalf apply environmental standards equivalent to the company's own.

The second stage in EMAS requires a preliminary review analysing environmental issues, impact and performance of the site's activities. Unlike BS 7750 and ISO 14001, which require a review for companies with no existing EMS, this forms an essential element of EMAS. The same list of environmental issues to be covered by the policy must also be addressed in the review (Table 4.27).

Following completion of the review, the next stage requires specific objectives consistent with the company policy. As in BS 7750 and ISO 14001 an environmental programme is required to designate responsibilities for objectives and the means by which they are to be achieved. Separate programmes are required in respect of the environmental management of projects relating to new developments, products or services.

Stage four requires an EMS including organisational structure, responsibilities, practices, procedures, processes and resources for implementing the environmental policy. Its requirements share many common elements to BS 7750 and ISO 14001 including an environmental effects assessment, internal audit system and management reviews (Table 4.29).

The fifth step in the EMAS process is the environmental audit, which has to be carried out at regular intervals. Annex II of the Regulations sets out requirements concerning environmental auditing and references the guidelines contained in the international standard ISO 14011/1 (Chapter 4.2.12). The EMAS definition of an environmental audit is the same as the one used by the International Chamber of Commerce. That is a systematic, documented, periodic and objective evaluation of the performance of the organisation, management system and processes designed to protect the environment. The aim of the audit is to facilitate management control of practices which may have an impact on the environment and to assess compliance with company environmental policies. The scope of the EMAS audit is broader than in ISO 14001 requiring assessments of factual data necessary to evaluate performance (European Commission, 1993). In practice, however, this is explicitly covered by ISO 14001 in the requirement to audit against the pre-determined objectives and targets.

In a similar way to BS 7750 and ISO 14001 auditors must be suitably trained and independent of the area being audited. A schedule must be established to specify audit frequencies and define each audits scope. Activities associated with the significant environmental effects, such as effluent treatment or waste management, need to be audited more frequently. Unlike ISO 14001, which does not specify a maximum audit cycle, the maximum allowable time between an audit of all the site's activities is three years.

Table 4. 29: Requirements of the environmental management system for EMAS

1.	**Environmental policy, objectives and programmes**
	Periodic review of policy, objectives and programmes
2.	**Organisation and personnel**
	Responsibility and authority
	Management representative
	Personnel, communication and training
3.	**Environmental effects**
	Environmental effects evaluation and registration
	Register of legislative, regulatory and other policy requirements
4.	**Operational control**
	Establishment of operating procedures
	Monitoring
	Non-compliance and corrective action
5.	**Environmental management documentation records**

The sixth stage of EMAS is the unique requirement to publish an environmental statement validated by an accredited independent verifier. This is the major difference to BS 7750 and ISO 14001 which merely require the policy and objectives to be publicly available. The Regulation does not specify a particular format for the statement apart from to include performance data and detail progress in achieving environmental objectives and targets (Table 4.30).

A statement must be published before first registration to EMAS and then at the end of each full audit cycle, normally three years. The exact frequency of the statement is at the discretion of the verifier who may decide a full statement is necessary on an annual basis. Where this is not the case an annual simplified statement, summarising key data and any significant changes since the previous statement, is required. In certain cases, for example in SMEs with minimal environmental impacts or where there have been few changes since the last statement, the verifier may not consider this necessary. Where annual statements are produced they only need to be verified at the end of the audit cycle.

Table 4. 30: Requirements of the environmental statement under EMAS

1.	**A description of the company's activities at the site considered;**
2.	**An assessment of all the significant environmental issues of relevance to the activities concerned;**
3.	**A summary of the figures on pollutant emissions, waste generation, consumption of raw material, energy and water, noise and other significant environmental aspects as appropriate;**
4.	**Other factors regarding environmental performance;**
5.	**A presentation of the company's environmental policy, programme and management system implemented at the site considered;**
6.	**The deadline set for submission of the next statement;**
7.	**The name of the accredited environmental verifier;**

4.4. SUMMARY

BS 7750, ISO 14001 and EMAS all require an environmental policy and a documented system of procedures, manuals and records. Environmental responsibilities must be documented and employees suitably trained. A register is needed to demonstrate awareness of relevant legislative, regulatory and policy requirements and to record any changes in the legal framework.

A key area of all three standards is the identification and assessment of direct and indirect environmental effects, referred to as aspects in ISO 14001, to determine those of significance. The scope of the assessment and the definition of significance has caused particular controversy and concern (Hunt, et al., 1993). The standards specify all effects over which the organisation can control or be expected to have an influence should be included. This allows organisations flexibility regarding the detail of the assessment which in practice will depend on the overall aim of the EMS. Organisations operating a compliance based system will focus on direct effects whilst those with a more strategic outlook will adopt a broader scope. In time, as direct effects are controlled and legal compliance achieved, companies are likely to move further towards a strategic system.

The approach adopted for determining significant effects is at the organisation's discretion. Techniques based on risk assessment, consisting of a numerical scoring system for the probability and consequence of effects, are frequently adopted. Other companies chose a simpler approach based on a verbal description of significance. The detail of the approach chosen depends on the size and complexity of the organisation's activities. Both are acceptable to meet the requirements of the standards which are concerned with consistency.

Significant effects must be managed within the system either through operational control or by the establishment of objectives, targets and a management programme to minimise the environmental impact. The standards do not attempt to specify acceptable performance criteria apart from requiring legal compliance and continual improvement. They acknowledge that improvement may not be practical in all areas, at certain times. This gives organisations seeking certification flexibility in determining the nature and degree of improvement sought.

Activities associated with the identified significant environmental effects must be carried out under controlled conditions. This may include the provision of documented procedures or the monitoring of relevant process characteristics. Procedures are also needed to verify compliance with specified requirements such as legislation and in-house standards, objectives and targets.

The final requirements of the standards are for records, audits and management reviews. Records demonstrate compliance with the policy, procedures, objectives and targets. Audits check activities conform with planned arrangements and the EMS is effective in achieving the environmental policy. These must be documented and undertaken by trained auditors. The final requirement of the standards is for regular management reviews of the ongoing suitability of the system.

EMAS is more stringent than BS 7750 and ISO 14001, in particular in its requirements for auditing and the provision of information to the general public. To become registered to the scheme it is necessary to produce an externally verified environmental statement at least every 3 years. In the majority of cases it is also necessary to publish simplified statements on an annual basis. This makes the company more accountable to the public as they must report on their environmental performance against pre-set objectives and targets.

CHAPTER 5

5.0. CASE-STUDIES FROM EMS CERTIFIED COMPANIES

5.1. INTRODUCTION

The previous chapter reviewed the requirements of the EMS standards and identified a number of key areas for discussion. Implementing organisations are given much flexibility in designing their systems. The determination of significant effects and the extent of improvement sought is largely at their discretion. As is the comprehensiveness of operational control, employee training and monitoring activities. Organisations also have the option of integrating their EMS with other business management systems, such as quality and health and safety systems. The approaches chosen are likely to reflect the organisation's motivation for adopting an EMS and their expectations of its achievements.

This chapter investigates how the requirements of the standards are being translated into practice. Five case-studies illustrate the approaches UK companies are taking to EMS implementation. Each company's motivation for adopting a recognised standard is investigated and their approach to implementation described. Particular attention is paid to the methodology adopted for identifying significant environmental effects, a key area of the standards. The focus of the system and level of environmental improvement sought is compared between organisations by examining their policies, objectives and targets. The number of documented procedures and the degree of employee training required to meet the standard is also investigated.

Experiences with external auditors are reviewed to identify the priorities of the certification bodies and common areas of system weaknesses. This will give companies contemplating EMS implementation an understanding of the level of commitment involved and an appreciation of the areas requiring special attention. It is not the intention, at this stage, to identify or analyse the costs and benefits of environmental management systems as this is covered later in the thesis.

Three of the companies studied manufacture chemicals, one manufactures telecommunication cables and the other luxury packaging items. Four are classed as small and medium sized enterprises, employing less than 250 staff. All five operated quality management systems to ISO 9000 prior to EMS adoption. Three operate processes prescribed as Part B under the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991* for regulation under Local Authority Air Pollution Control (LAAPC). One is prescribed as Part A for regulation under Integrated Pollution Control (IPC). Four were certified to BS 7750 in 1995 whilst one gained certification during 1996. All five companies transferred their certificates to ISO 14001 following the withdrawal of BS 7750 in April 1997. The three chemical companies published an environmental statement and became registered to EMAS in 1997.

5.2. BICC CABLES LTD, TELECOMMUNICATION DIVISION, BLACKLEY

BICC Cables manufacture and distribute telecommunication cables from 35 sites in the UK. The Telecommunication Cable Systems division employs 350 people on their site in Blackley, North Manchester. They gained certification to BS 7750 in October 1995, after spending five months implementing the standard. The British Approvals Service for Cables (BASEC) were chosen as the certification body because of their familiarity with the industry.

The process is prescribed as Part B under the *Environmental Protection (Prescribed Substances and Processes) Regulations 1991* due to the use of solvents, mainly methyl ethyl ketone (MEK). Emissions to atmosphere are regulated by Manchester Local Authority under Local Authority Air Pollution Control (LAAPC). The site has one effluent discharge to the River Irk, which was consented by the National Rivers Authority, now part of the Environment Agency (EA). Apart from a small amount of copper recycling and legal compliance there was no environmental management in place prior to BS 7750.

The site operates a quality management system to ISO 9001 and is firmly committed to the principles of Total Quality Management (TQM). A documented health and safety policy and manual is also established.

5.2.1 Motivation for EMS Implementation

Customer pressure and the desire to achieve a competitive advantage were the major drivers for EMS implementation. Supply chain pressure was particularly evident as British Telecommunications, who have a stringent policy regarding their supplier's environmental performance, are BICC's main customer (Chapter 8). Additional motivating factors include increasing legislation, the desire to improve public image and the need to achieve financial savings. Internal pressure from employees and the BICC Group also contributed towards the decision to adopt a recognised standard (Figure 5.1). Certification was considered to be important to demonstrate environmental commitment to stakeholders.

Figure 5. 1: BICC Cables Group Environmental Policy (from BICC Cables, 1996a)

BICC Cables, as a leading international company, is committed throughout its business to respect the environment and to make responsible use of available natural resources.

BICC Cables will pursue the use of processes, practices, materials, or products which avoid, reduce or control pollution.

In particular, it is the policy of BICC Cables to comply with appropriate legislation and regulations, monitor performance, and strive for continuous improvement in:

- **Reduction and Disposal of Waste**
- **Efficient Use of Energy**
- **Marketing Environmentally Balanced Products**
- **Risk Reduction to our Employees and Neighbours**

The Director of Personnel and Public Relations has a specific responsibility to the BICC Cables Board for ensuring that the necessary means exist within the Company to implement and monitor the effectiveness of this policy.

5.2.2 Responsibility for EMS Implementation

The Quality Manager was assigned overall responsibility for EMS implementation. A formal team for implementation was not established although he was assisted by two six-month placement students and the Engineering Manager.

5.2.3 Environmental Review and Effects Assessment

BS 7750 implementation began in March 1995 with an environmental review carried out by Lancaster University. The next stage was the compilation of the effects register which begun by identifying all materials present on site.

For this purpose the site was split into six areas:

- Production bays 1, 2 & 3
- Production bays 4, 5 & 6
- Engineers store
- General store
- Site perimeter
- Administration building

Two flow diagrams assisted in the identification of effects. The first concentrated on the entire site, identifying the main inputs and outputs of the process (Figure 5.2). Raw materials, natural resource consumption, emissions to atmosphere, releases to water, noise and waste associated with the process were identified. The second was more detailed, identifying specific inputs to the production process (Figure 5.3).

Figure 5. 2: Flow diagram identifying environmental effects at BICC Cables Ltd, Telecommunication Cable Systems, Blackley (from BICC Cables, 1995)

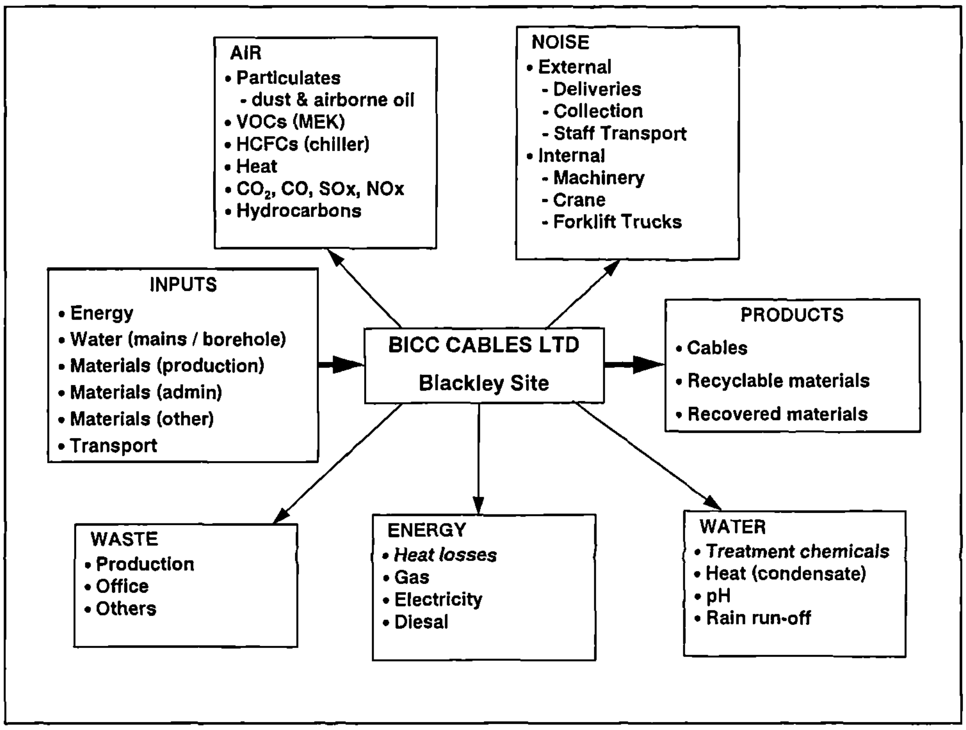
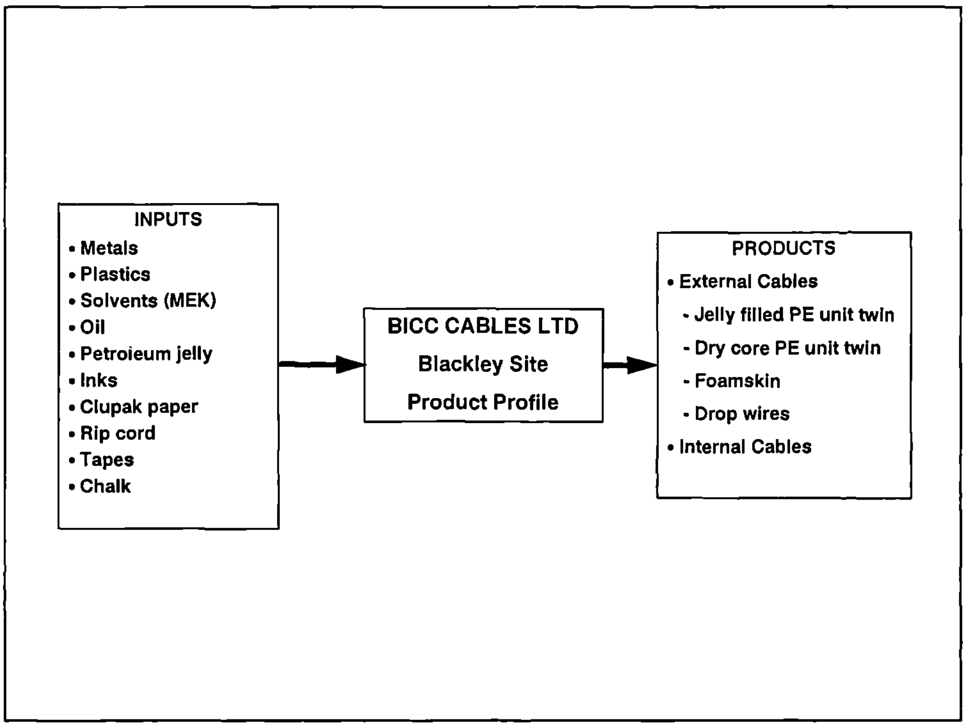


Figure 5. 3: Raw materials and products at BICC Cables Ltd, Telecommunication Cable Systems, Blackley (from BICC Cables, 1995)



An in-house methodology, developed with the assistance of Lancaster University, established the relative significance of effects by scoring their likelihood of occurrence and the severity of consequences. This approach was similar to the failure mode and effect analysis technique described in the previous chapter. Likelihood was scored from a maximum of 24 after consideration of the controls in place to minimise or eliminate detrimental consequences, the nature of materials or substances and the frequency of occurrence.

To determine the consequence each effect was scored on a scale of 1-5 against the health and safety hazard, environmental hazard, quantity, timescale and regulatory requirements (Table 5.1). An overall score for the consequence was calculated using the following formula:

$$\boxed{\text{Consequence} = (A+B) \times C \times D \times E}$$

The product of the consequence and the likelihood gave an overall significance score.

$$\boxed{\text{Significance} = \text{Consequence} \times \text{Likelihood}}$$

Effects scoring over 1000, from a maximum of 1400, were considered significant for management within the system. Numerical ratings proved to be useful indicators of performance. The cumulative score gave an overall performance rating for the site which could be monitored on an annual basis.

The weakness of this approach is its lack of applicability to all types of effects. The inclusion of quantity and timescale as assessment criteria limited the suitability of the methodology to those quantified in tonnes released over defined time-scales. Less tangible issues such as nuisance and visual impact could not be incorporated. Separate criteria were required for noise (Table 5.2) and visual impact (Table 5.3). Each positive answer scored 3 points, a partially positive answer 2 points and a negative 1 point. Noise was deemed significant if the sum of the individual scores was over 10 and visual impact when the sum was over 12. This necessity for parallel systems to ensure all elements were incorporated complicated the assessment process.

Table 5. 1: Methodology for assessing the consequence of an environmental effect at BICC Cables, Blackley (from BICC Cables, 1995)

Criteria	*Score*
A: Hazard: Health and Safety	
- No attack on any surface, no dust or odour	1
- No long term effect on human health	2
- May cause long term health effects	3
- Long term adverse effects on human health	4
- Can prove to be fatal	5
B: Hazard: Environmental	
- No real impact on any part of the ecosystem	1
- Pollution occurs but creates no long-term effect	2
- May cause long-term adverse effects	3
- Serious localised issues eg habitat destruction	4
- Contributes to global problem eg global warming	5
C: Quantity	
- Under 1 tonne	1
- 1 - 10 tonnes	2
- 10 - 100 tonnes	3
- 100 - 1000 tonnes	4
- Over 1000 tonnes	5
D: Timescale	
- Over the course of a year	1
- One month to one year	2
- One week to one month	3
- One day to one week	4
- Less than one day	5
E: Regulatory Requirement	
- Not covered by any regulations	1
- Likely to be covered by future regulations	3
- Covered by existing regulations	5

Table 5. 2: Criteria for assessing the impact of noise at BICC Cables (from BICC Cables, 1995)

• **Are sources of noise within the site identified ?** • **Are noise levels in dB(A) monitored on a regular basis ?** • **Are noise levels below any regulatory requirement ?** • **Are there any measures in place to reduce noise levels ?** • **Have there been any complaints concerning noise levels ?**

Table 5. 3: Criteria for assessing visual impact at BICC Cables (from BICC Cables, 1995)

• **Is there a site of special scientific interest or area of outstanding natural beauty located near to or within the site ?** • **Does the site have an adverse effect on property value through interfering with views ?** • **Does the site contribute adversely to traffic levels ?** • **Has the location of the site required the construction of new infrastructure that would not otherwise have been necessary ?** • **Will any development on the site cause the potential loss of ecological assets eg fauna, flora, forest, recreational areas and facilities ?** • **Have there been any complaints concerning the visual impact of the site ?**

The process identified 120 effects which included 23 different waste streams. Six were assessed as significant and prioritised for improvement within the design of the EMS:

- PVC fumes to atmosphere
- Methyl ethyl ketone to atmosphere (from cleaning and printing ink)
- Copper waste
- Tin waste
- Electricity consumption

5.2.4 The Environmental Policy

The BICC Cables Group environmental policy formed the basis of the Blackley site's policy. As required by ISO 14001 clear commitments were included to the prevention of pollution, continual improvement and legislative compliance (Figure 5.4). Commitments were also made to involve suppliers, customers and other interested parties in the environmental improvement process and to ensure full commitment of all employees. Little detail is included on the specific areas of environmental impact to be prioritised for improvement. In comparison the Group policy makes clear commitments to reduce waste, use energy efficiently, market environmentally balanced products and reduce risks to neighbours.

Despite the inclusion in the policy to involve suppliers in the process of continual improvement external auditors did not ask for evidence of compliance with this policy commitment. Whilst BICC had committed significant resources to assessing the environmental performance of their suppliers the assessors did not assign this a high priority during the audit.

5.2.5 Objectives, Targets and Programmes

Five key objectives were established after consideration of financial, operational and business requirements of the company in addition to the significant effects:

- Reduce PVC Fumes
- Eliminate MEK
- Reduce Oil Spillages
- Reduce Energy Consumption
- Reduce Material Consumption and Waste

The scope of these objectives is broader than purely tackling the identified significant effects. Raw material consumption and oils spills were not identified as significant but were prioritised for improvement. This illustrates that companies are not limited to only tackling those effects of significance but have the flexibility to incorporate other issues.

In this case the desire to eliminate liabilities and reduce unnecessary costs motivated further improvements.

Figure 5. 4: Environmental policy at BICC Cables Ltd, Telecommunication Cable Systems, Blackley (BICC Cables, 1996b)

BICC Cables Limited, Telecommunication Cable Systems, Blackley recognises its responsibility to balance its business needs by pursuing the use of processes, practices, materials, or products which avoid, reduce or control pollution.

Specifically all applicable regulatory and legislative requirements will be met or surpassed and by involving our suppliers, customers and other interested parties, we will continually improve our environmental performance.

In addition the environmental effects associated with the design, manufacture, sale and distribution of metallic telecommunication cables will be identified and evaluated with a view to reducing environmental impact.

Finally, objectives which are publicly available on request, will be set and targets achieved through an integrated Management Programme and by continuous improvement initiatives developed from BICC Cables corporate strategy and policies.

All employees are fully committed to the implementation and maintenance of an environmental management system which meets or exceeds the requirements of ISO 14001.

Environmental objectives were fully integrated with other business activities and formed part of the Company's "Vision 1997". Sixteen programmes for their achievement were set for the next twelve months and beyond (Horrocks, 1995a) (Table 5.4). In addition to the six key objectives additional programmes were established, such as reducing noise and landscaping local amenities. These were incorporated to ensure good relations with local residents and to motivate employees.

The majority of objectives committed the organisation to achieving improvements beyond the requirements of legislation. A large amount of emphasis was placed on reducing costs and improving the company's public image. Many of the projects were completed by May 1996, six months after certification (Table 5.4).

Table 5. 4: Environmental programmes at BICC Cables Ltd, Telecommunication Cable Systems, Blackley (from BICC Cables, 1996)

Environmental Programmes
Reduce PVC fumes in manufacturing (fume extraction)*
Reduce and eliminate the use of MEK
Reduce ink/oil spillages in the factory by improving storage facilities*
Reduce raw material consumption
Replacement of heaters to reduce energy consumption*
Recycling of drums*
Noise reduction*
Install acoustic guarding core lines
Monitor electrical consumption and reduce usage*
Monitor water consumption and reduce usage
Waste management programme (recycling of waste cables)*
Aluminium can recycling scheme*
Reduce paper consumption
Landscaping local amenity
Establish BT packaging recycling*
Return wooden drums to customers*

* Completed within 6 months after certification

5.2.6 EMS Documentation

As the Management Representative for BS 7750 also managed the ISO 9000 system environmental requirements were incorporated into the existing quality manual. The resulting "Business Manual" referenced ISO 9000 and BS 7750, in addition to in-house procedures. This approach was felt to increase staff commitment and reduce effort required in maintaining the system. Updating one manual would be less resource intensive than two separate manuals. Environmental procedures, however remained distinct from the quality system, to ensure environmental requirements could be easily identified. It was felt that the combined procedures would not be sufficiently specific to ensure the environment was assigned a high priority.

5.2.7 Employee Training

Extensive resources were committed to environmental training. An introductory session, of an hours duration, was delivered to all 350 people on site. Forty key members of staff attended a more detailed one-day training session. In addition four employees attended a three day internal auditor training course delivered by external consultants.

The external assessors from British Approvals Service for Cables (BASEC) highlighted the need for extensive employee training and awareness raising. They commented on the lack of a refresher training plan and emphasised that training should be a continual process. They also paid particular attention to the control of contractors working on site.

5.2.8 Post Certification Plans

Post certification BICC Cables plan to focus on the further integration of environmental issues into the business process, increasing management commitment and achieving continuous improvement. Business and local community benefits are to be balanced and objectives focused on achieving continued financial savings (Horrocks, 1995b) (Chapter 8).

Since certification the Company has established the BICC Cables UK Forum to exchange best practices within the group (pers. comm. Horrocks, 1996). The Blackley site is working with BASEC to assist them in becoming environmental verifiers for EMAS. It is then planned to publish an environmental statement and become registered under EMAS. This process was still ongoing by the end of 1998.

5.3. AUTOSMART LTD

Autosmart Ltd design, manufacture and despatch speciality vehicle cleaning and maintenance products for the transport and automotive industries. They were established in 1979 and now employ 63 people at their site in Staffordshire. Five distributors sub-let parts of the site. Products are sold in the UK by a national network of distributors whose mobile "showrooms" demonstrate products to car dealerships, valeting companies, fleet operators, workshops and bodyshops. They also export throughout the world, primarily to Scandinavia, Australia, Ireland and Europe.

Products are manufactured by mixing and heating in vats. The process is not prescribed for IPC or Local Authority Air Pollution Control and there are no discharges to the sewer system or local water courses (pers. comm. Munro, 1996). Besides an informal policy of designing new products to include environmental considerations little environmental management was in place prior to BS 7750 (Counsell, et al., 1995).

Certification to the quality standard ISO 9001 was achieved during 1989. In 1992 Autosmart became involved in the BS 7750 pilot trial working with Environmental Consultants, Aspects International Ltd. A grant was obtained under a DTI Manufacturing Initiative to assist with consultancy costs. Aspects Certification Services were chosen because of their involvement in the BS 7750 pilot trial. Because of their previous experiences with ISO 9000 assessment Autosmart expected the EMS assessment to focus on documentation. This was not the case and environmental assessors spent the majority of time on-site reviewing working practices and plans for environmental improvements. No non-conformances were identified and the company became one of the first to gain certification to BS 7750 in April 1995. The certification process was perceived to be valuable in identifying opportunities for improvement on which the company has since acted (Counsell, et al., 1995).

In March 1997 their BS 7750 certificate was transferred to ISO 14001. An environmental statement, detailing performance against environmental objectives, has since been established leading to EMAS registration in July 1997.

5.3.1 Motivation for EMS Implementation

When BS 7750 was first published in 1992 senior management viewed certification as a means of demonstrating environmental commitment (Robinson, 1996). The main motivator was to meet pressure from customers and improve public image. Certification was seen as a way of differentiating the company from its competitors and demonstrating environmental commitment to stakeholders (Counsell, et al., 1995).

5.3.2 Responsibility for EMS Implementation

The Total Quality Management (TQM) Department was assigned responsibility for the environment. The Quality and Environmental Manager had overall responsibility for overseeing and co-ordinating the implementation of the standard.

5.3.3 Environmental Review and Policy

A preparatory review formed the first stage in the implementation process. This was undertaken by a 3 man steering team from Operations, the Technical Department and Materials Control with the assistance of the company's consultants (pers. comm. Munro, 1996). Following the review and identification of important issues an environmental policy emerged (Figure 5.5). This contained the standard commitments to prevention of pollution and continual improvement as required by ISO 14001. In addition commitments were included for reducing waste and minimising the impact of products. It required customers and suppliers to be informed about the company's environmental policy but no clear commitment to considering environmental probity during supplier selection.

Figure 5. 5: Environmental policy at Autosmart Ltd (Autosmart, 1997a)

"Good Environmental Practice Makes Sense"

Autosmart Ltd recognises its responsibilities to the environment and its Board of Management is committed to the prevention of pollution and pursuing the best environmental practice whenever and wherever practicable.

The company therefore will, as a commitment to continual improvement and prevention of pollution:

* Set yearly objectives to implement an effective environmental programme, which ensures continual improvement.
* Use performance monitors to ensure that our management system is meeting the yearly objectives.
* Use our BS EN ISO 9001 design procedures to reduce the environmental effects of our products.
* Control and reduce waste and emissions arising from our manufacturing operations.
* Meet, and where possible exceed, all environmental legislative requirements of the industry.
* Inform suppliers and customers of our environmental policy and management system.
* Monitor use of human and material resources, with the aim of reducing environmental impact.
* Ensure that our plant and equipment is capable of supporting our environmental objectives.
* Provide training and education to management, staff and sub-contractors to ensure that the policy is understood and implemented.
* Cooperate and communicate openly with interested parties towards the shared goal of environmental improvement.
* Simplify lines of authority and communication within the company and develop straightforward systems.

5.3.4 Environmental Effects Assessment and Objectives

The approach adopted for assessing environmental effects was based on typical risk assessment involving scoring frequency and consequence on a scale of 1 to 5. The chosen technique was simpler than that at BICC Cables and contained no predetermined assessment criteria. Instead a list of issues requiring consideration during the scoring of consequence, including the nature and scale of the impact, legal requirements and the views of interested parties, was included in the procedure (pers. comm. Munro, 1996). This increased flexibility allowed the methodology to be applied to all types of effects including nuisance and indirect effects. The process identified 25 of significance which were categorised under normal, abnormal, emergency, past and planned activities. These included water and energy consumption, waste production, routine effluent to surface and foul sewer and the risk of accidental contamination of drains.

Suppliers environmental probity was assessed through a postal questionnaire. Three suppliers failed as they lacked a clear environmental policy. They were audited during a site visit and advice provided on environmental management systems. Each supplier then documented a policy to maintain their position on the approved supplier list (pers. comm. Munro, 1996).

5.3.5 Objectives, Targets and Programmes

Eight objectives were developed to reduce environmental impact, ensure legislative compliance and improve process efficiency (Autosmart, 1997). One on waste minimisation led to the development of an inventory of solid waste. Programmes were established to recycle paper, cardboard, aluminium cans, glass, tins, pallets, drums, scrap metal and fluorescent tubes. A second objective on energy efficiency led to a monitoring programme and the reduction of vessel temperature and mixing times required for product manufacture. Monitoring water consumption revealed the company had been providing water for another company on the site which had been increasing their water bills. Improved wash-down procedures also reduced costs by reducing effluent sent to drain.

To prevent accidental water contamination drains were colour coded, blue for surface water and red for the foul sewer. A capital improvement programme modified the drainage system in the manufacturing areas. All drains were diverted to a sump which was regularly emptied by specialist waste contractors. Previously there had not been a map of the drainage system and some effluents ultimately led to surface drains.

The implementation of the objectives and targets led to substantial improvements in environmental performance between 1995 to 1997 (Table 5.5). Use of hazardous materials, energy and water were substantially reduced during the period and the percentage of packaging recycled increased, with the exception of cardboard. Volume of effluent generated temporarily increased in 1995/6 due to the clean up of old effluent on site. By 1996/7 effluent generated had decreased back to original levels and a programme is planned to reduce it over the next few years.

Table 5. 5: Environmental performance between 1995 and 1997 at Autosmart Ltd (from Autosmart, 1997)

Performance Indicator	Change in performance between 1995 and 1997
Use of Hazardous Materials	• Reduction of 55 tonnes per annum
Energy Efficiency	• Reduction of 21% per litre of product made
Water Usage	• Reduction of approx 22%
Effluent	• No change
Cardboard Recycling	• Decrease of approx 18%
Steel Drum Recycling	• Increase of approx 30%
Plastic Drum Recycling	• Increase of approx 100%
IBC Recycling	• Increase of approx 25%

Further objectives were established for 1997 to 2000 containing quantified targets to reduce resource consumption and efficiency (Table 5.6). These were included in the environmental statement for EMAS produced in July 1997 (Autosmart, 1997). The majority of these committed the company to achieving improvements beyond the scope of legislation.

Table 5. 6: Environmental Objectives for 1997 - 2000 at Autosmart Ltd (from Autosmart, 1997)

• **To reduce consumption of raw materials classified under CHIP as dangerous to the environment by 20% per litre of product made.**
• **To reduce consumption of electricity per litre of product made by 10%**
• **To reduce consumption of water per litre of product made by 10%**
• **To have no breaches of discharge consents and improve product yields by 5% to reduce effluent**
• **To inspect our distributor's operations quarterly to ensure that they are following our environmental guidelines**
• **To continue to achieve clear audits in the Aerosol Plant**
• **To monitor employees exposure to hazardous substances annually**
• **To increase the volume of waste that we recycle by 10% over the next 3 years**

5.3.6 EMS Documentation

Autosmart's long-term aim was to fully integrate environmental and quality systems. Initially, due to the draft status of BS 7750 and the changing nature of the EMS standards, the environmental manual was kept separate. Several months after certification an integrated Quality, Environmental, Safety and Health (QUENSH) Manual was established. Effort was focused on simplicity and its length limited to 20 pages. Its flexible format allowed health and safety requirements to be easily incorporated in the future.

Wherever possible, existing quality procedures, such as auditing, non-conformances and training, were modified to incorporate environmental requirements. This limited the number of additional procedures required to thirteen which were later reduced to nine (Table 5.7). Ten copies of the Environmental Procedures Manual were issued to key members of staff.

Table 5. 7: Environmental procedures at Autosmart Ltd (pers. comm. Munro, 1996).

Procedure Number	***Procedure Title***
EMS 1	Legislation
EMS 2	Effects Identification and Evaluation
EMS 3	Objectives, Targets and Programmes
EMS 4	Contractors
EMS 6	Emergencies
EMS 7	Communications
EMS 8	Waste Management Procedures
EMS 12	Water and Energy Usage
EMS 13	Distributors

The legislation procedure (EMS 1) specified the arrangements for recording relevant legislation. The register, an appendix to the procedures manual, listed the names of approximately ten acts and regulations. No detail was included relating to the duty imposed by the legislation or the actions required to ensure compliance. The environmental effects procedure (EMS 2) described the mechanisms and responsibilities for identifying significant effects and maintaining the register. Although none of the standards specifically requires procedures for objectives, targets and programmes the company decided this would be useful (EMS 3). The resulting document described the arrangements for establishing objectives and targets and reviewing progress towards their achievement.

The contractor procedure (EMS 4) specified that all contractors must read the environmental policy and sign to verify this has been completed. All visitors are required to read the information printed on the back of their passes before admittance to the site. The emergency procedure (EMS 6) contained emergency contact names and a 24 hour bleep number in case of incidents. The communications procedure (EMS 7) and the distributors procedure (EMS 13) specified the provision of advice to customers and distributors regarding the hazardous nature of the products and their correct disposal. The waste management procedure (EMS 8) described the actions required to ensure compliance with the Duty of Care and Special Waste Regulations.

The water and energy usage procedure (EMS 12) implemented monitoring systems to quantify consumption.

5.3.7 Environmental Auditing

The internal audit process played an important role in maintaining the system and achieving continual improvement. The control of each significant effect and achievement of objectives and targets was regularly audited. A non-conformance was raised if objectives and targets were not achieved and auditors re-set objectives and targets annually.

Audits were undertaken by two trained in-house environmental and quality auditors. Due to the joint quality and environmental responsibilities of the auditors an integrated approach was adopted involving environmental considerations being taken into account during quality audits and vice versa.

5.3.8 Employee Training & Awareness

Employees understood the importance of adhering to documented procedures due to their familiarity with ISO 9000 (Robinson, 1996). This reduced the volume of training necessary for BS 7750. The approach adopted was to provide staff with small but frequent training sessions. This commenced with senior management and was later expanded to cover the entire organisation. All 55 staff were issued with a copy of the environmental policy statement at an awareness raising presentation lasting approximately an hour. In addition, everyone attended a one day Total Quality Management (TQM) workshop including training on quality and environment. Environmental performance was included in the quarterly "State of the Nation" talks, covering all aspects of the business. It was also discussed during monthly departmental and board meetings.

Employee involvement in the EMS was encouraged. Staff contributed in developing their own work instructions. Operational control was tackled through a team which met weekly to tackle operational quality and environmental issues. A "Suggestions for Improvement Form" encouraged recommendations and all new staff were asked for suggestions during their induction training. This was successful in producing numerous ideas which were simple to implement and incorporate into work instructions.

5.3.9 Environmental Statement for EMAS

Autosmart's environmental statement consisted of a simple leaflet containing the environmental policy, a description of the significant environmental issues and a summary of environmental performance between 1995 and 1997 (Autosmart, 1997). Graphs were included for electricity consumption, packaging sent for recycling, water consumption and effluent generated. From April 1998 the statement was to be re-issued every year (pers. comm. Hannan, 1998).

5.4. J & J MAKIN CONVERTING

J & J Makin Converting, a subsidiary of Henry & Leigh Slater Ltd, employ approximately 75 people on their site in Rochdale, Lancashire. They are part of the API Group plc, founded in 1865 and also have sites at Lyme Green and Poynton in Lancashire. Their activities include the lamination and coating of paper products predominantly used in the packaging of luxury items, cigarettes, spirits, cosmetics and confectionery. The first stage in the process is the lamination of two substrates using water based adhesive. This is followed by the mixing, application and drying of a top coat of solvent based or aqueous lacquers. The final stage involves slitting, sheeting, guillotining and wrapping of the product prior to despatch and distribution.

The process is prescribed as Part B under the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991* due to the large volumes of solvents consumed (pers. comm. Fleming, 1997) . Authorisation to operate has been granted from Rochdale Metropolitan Borough Council and atmospheric emissions must comply with the requirements specified in the *Process Guidance Note PG 6/17* for the lamination of paper.

The Rochdale and Poynton sites are both certified to ISO 9002, whereas Lyme Green has no formal systems in place. At present J & J Makin Converting are the only site certified to a recognised environmental standard. They began implementing BS 7750 during the summer of 1996 and were certified by BSI in January 1997. Their certificate was converted to ISO 14001 in March 1997 but they currently have no plans to become registered to EMAS (pers. comm. Fleming, 1997).

5.4.1 Motivation for EMS Implementation

The main pressure to adopt BS 7750 resulted from the API Group who encouraged each site to achieve certification. They recognised the importance of protecting the environment and saw the standard as a mechanism for achieving competitive advantage (pers. comm. Thirkhill, 1997). A positive public image was particularly important because of the often negative perceptions of timber based products.

5.4.2 Responsibility for EMS Implementation

The requirements of the standards were largely implemented by the Technical Manager, who also had responsibility for the quality system. A team approach to implementation was not adopted although the Technical Manager is assisted by the Quality and Environmental Systems Manager who has day to day responsibility for management systems.

5.4.3 Environmental Review and Policy

The first stage in the implementation of BS 7750 was to undertake an environmental review. This was completed by external consultants, Envirotech, through their European funded project to provide environmental support to small and medium sized enterprises in Greater Manchester. The next stage was to document an environmental policy statement. This covered all three sites of Henry & Leigh Slater Ltd and contained commitments to minimise waste, conserve resources and encourage sourcing of timber from sustainable forests (Figure 5.6). No mention is included to design products to minimise their impact which is surprising considering the large quantity of solvent based lacquers used by the company. The policy referenced the actions to be taken to achieve these commitments including achieving certification to ISO 14001 and ensuring employee awareness.

Figure 5. 6: Environmental policy at Henry & Leigh Slater Ltd (Henry & Leigh Slater Ltd, 1997)

The Environmental Policy of Henry & Leigh Slater requires the Company to manage all of its activities so that the environmental impact of its operations, processes and systems are controlled by conditions, objectives and targets. These are based on the philosophy of continual improvement and are consistent with all relevant legal requirements.

1. Henry & Leigh Slater shall:

- identify and meet all current applicable legislation, regulations and codes of practice.
- have the Company Environmental Policy and Environmental Manuals readily available for public inspection.
- assess the impact of current and proposed operations, processes and systems
- design new operations, processes and systems with the aim of minimal environmental impact.
- aim to minimise the creation of waste.
- aim to minimise the consumption of resources.
- aim to prevent pollution.
- encourage sourcing of raw materials from sustainable sources.

2. Henry and Leigh Slater will achieve this by means of:

- management of the Company's activities to achieve certification to BS EN ISO 14001, the Environmental Management Systems Standard.
- awareness and understanding of the Company Environmental Policy Statement. This was initially carried out by internal presentations within the Company and was addressed to all employees at all levels. Future new employees will be communicated to as per the relevant site's Training Procedure.
- displaying the Policy in the main Reception area and ensuring that it is otherwise available for viewing upon request.
- the Company's Environmental Policy is written so as to be consistent with both the Company's Quality Statement and the Company's Health and Safety Policy.
- The Environmental Policy is defined by the Company Chief Executive and Board of Directors and is regarded as an integral part of the Company business strategies.

Maintaining the Company Environmental Policy is the responsibility of the Chief Executive supported by the Board of Directors together with the Environmental Management Representatives, Management Team and all Personnel at each site.

5.4.4 Environmental Effects, Objectives and Targets

A complex in-house methodology was designed to assess the significance of environmental effects. Each site's activities were divided into process stages and their effects scored on a scale of 1 to 3 against weighted criteria (Table 5.8) (Table 5.9). Individual scores were multiplied by the weighting factors and their sum gave an overall score for each effect. They were also assigned a hazard rating according to the severity of the impact on the environment and local communities (Table 5.10).

Table 5. 8: Criteria for assessing environmental effects and their relative weighting at J & J Makin Converting (Henry Leigh & Slater Ltd, 1997a)

	Criteria	*Weighting*
A	Compliance with Company Environmental Policy	Score x 2
B	Compliance with Environmental Legislation	Score x 3
C	Health & Safety Concerns	Score x 3
D	Customer Concerns	Score x 2
E	Local Community Concerns	Score x 1
F	Financial / Insurers Concerns	Score x 1
G	Financial Implications	Score x 1
H	Industry Codes	Score x 1

Table 5. 9: Guidance for assigning significance scores for environmental effects at J & J Makin Converting (Henry Leigh & Slater Ltd, 1997a)

Score	*Criteria*	*Definition*
1	A	Full compliance with environmental policy
	B / H	No environmental legislation / codes of practice
	C to G	Low risk or concern level
2	A	Monitoring required to comply with environmental policy
	B / H	Monitoring required to comply with legislation / codes of practice
	C to G	Moderate risk or concern level
3	A	Work required to comply with environmental policy
	B / H	Work required to comply with legislation / codes of practice
	C to G	High risk or concern level

Table 5. 10: Guidance for assigning an environmental hazard rating for environmental effects at J & J Makin Converting (Henry Leigh & Slater Ltd, 1997a)

Score	***Definition***
High	Repeated or extreme impact on local environment or residents
Medium	Transient impact on local environment or residents
Low	No impact on local environment or residents

Significant effects were identified after consideration of both the numerical rating and the environmental hazard potential. High numerical scores accompanied with either a high or medium hazard rating were considered to be significant. This was the case for five of the environmental effects (Table 5.11).

Table 5. 11: Significant effects at J & J Makin Converting (Henry Leigh & Slater Ltd, 1997a)

Effect	***Rating***
VOC emissions to atmosphere from lacquering and laminating	35M
Liquid waste from lacquers and solvent use	33H
The use of solvent based lacquers such as Nitrocellulose & Shellac	33H
Operating noise of machinery and material movements	25-27M
Waste (landfill and discharge to drains)	21-23L

The weakness of this methodology was its failure to accommodate effects resulting from abnormal and emergency operating conditions. The likelihood of occurrence, a key issue for considering abnormal events, had not been incorporated into the assessment criteria. This necessitated effects associated with abnormal and emergency situations to be identified separately through a verbal description of the risks and control measures. Existing control was considered sufficient and none of the risks felt to be significant.

The Site Driving Group reviews the effects register annually. Amendments resulting from changes in processes, products, legal or working practices are drafted by the Technical Manager and authorised and re-issued by the Henry & Leigh Slater Group Appointed Person for Environmental Matters (GAPEM), currently the Technical Manager at the Poynton Site.

5.4.5 Objectives, Targets & Programmes

Six environmental improvement programmes were established referencing the relevant effects, target dates for completion and responsibilities (Table 5.12) (Figure 5.7). Progress was monitored every six months and programmes amended when necessary. Objectives were included for both ensuring legislative compliance and reducing waste and energy consumption. Several, however, focused on establishing monitoring systems rather than reducing impacts. None of the targets were quantified in terms of reduction in emissions or improvements in efficiency, meaning that planned and actual performance could not be compared.

Table 5. 12: Environmental programmes at J & J Making Converting (J & J Makin Converting, 1995 - 1997)

Number	*Programme Title*	*Target Date*
1/97	To measure and monitor gas and electric usage on site; to compare with production output and establish rate of use; to monitor trends, control use and assess future impacts.	Ongoing
4/96	To reduce waste volume to landfill sites by purchasing a waste compactor and by using closed waste skips.	On hold
3/96	To monitor and target waste volume sent to landfill.	Completed June 97
2/96	To eliminate the use of solvent based lacquers hence reduce VOC emissions to comply with the Environmental Protection Act 1990.	December 98
1/96	To monitor external noise levels and ensure conformance to planning constraints.	Ongoing
1/95	To eliminate usage of heating oil, eliminate bulk storage of solvents, reduce consumption of gas and electricity by consolidating all activities under one roof.	Completed April 1996

Figure 5. 7: Example environmental programme at J & J Makin Converting Ltd (from J & J Makin Converting, 1995-1997)

SITE IDENTIFICATION	SITE 1 POYNTON	SITE 2 ROCHDALE	SITE 3 LYME GREEN
(Tick as appropriate)		✓	

ENVIRONMENTAL EFFECT:

- Energy consumption
- Risk of water contamination

OBJECTIVE:

- To eliminate the usage of heating oil
- To eliminate the use of bulk storage of solvents close to a major water course
- To reduce consumption of gas and electricity by consolidating all activities under one roof

TARGET (Dates: Requirements: Responsibilities)

Start 1st October, 1995

Completed 1st April, 1996

CRITERIA FOR MEASUREMENT / VERIFICATION OF PROGRESS (Responsibility)

- Total elimination of heating oil purchases (savings £24K per annum)
- Total elimination of bulk solvent storage tanks
- Approximately 33% saving in electricity (£40K per annum)
- Approximately 70% saving in gas (£50K on previous budget per annum)

MEANS OF ONGOING VERIFICATION (Responsibility)

Check all gas and electricity bills

AUTHORISED BY:

(Print Name) **DATE:**

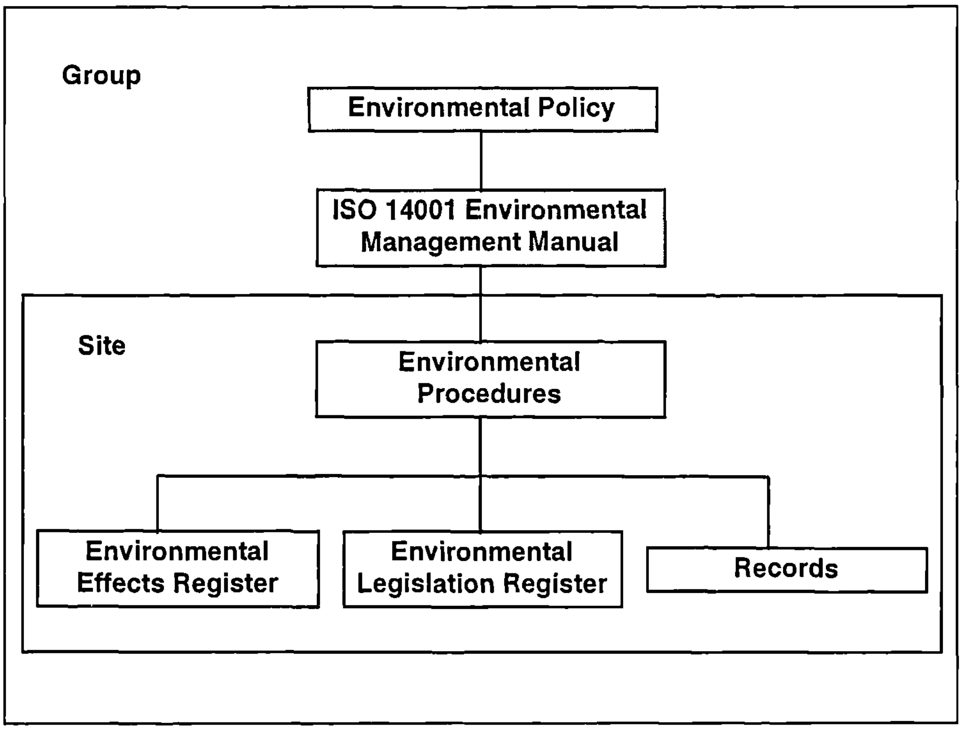
SIGNED:

By April 1996, six months before certification, the use of heating oil and the bulk storage of solvents were eliminated. Electricity consumption was reduced by 33% and gas by 70% after consolidating all activities in one building (J & J Makin Converting, 1995-1997). By June 1997 a monitoring system was established for waste sent to landfill although quantified targets have not been set. Following certification further improvement has been slow with no new projects initiated between January 1997 and May 1998.

5.4.6 EMS Documentation

EMS documentation was organised in four levels (Figure 5.8). The policy and manual were developed as Group documents applicable to all three Henry & Leigh Slater sites (Henry & Leigh Slater Ltd, 1997). Procedures, registers and records were specific to the individual sites.

Figure 5. 8: EMS documentation layers at J & J Makin Converting (Henry & Leigh Slater Ltd, 1997)



The EMS was developed as a stand alone system separate from the quality system. It contained 28 procedures, 19 of these were operational and 5 were concerned with the management system (Table 5.13).

Table 5. 13: EMS procedures at J & J Makin (J & J Makin Converting, 1997)

Number	***Title***
EM1	Training
EM2	Communication
EM3	Objectives and Targets
EM4	Disaster Recovery Plan Update
EM5	Management Review
EM6	Review of Register of Environmental Aspects
EM7	Register of Legislative Requirements Update
EM8	Duty of Care - Waste
EM9	Environmental Incidents Reporting
EM10	Internal Auditing
EM11	Environmental Records
EM12	Document Control
EM13	Visitors and Contractors
EM14	Modification - Process
EM15	Monitoring - Energy Use
EM16	Monitoring - Project Specified Areas
EM17	Monitoring - Air Emissions
EM18	Monitoring - External Noise Levels
EM19	Discharges to Water
EM20	Hazardous Chemicals and Materials
EM21	Contingency Plans
EM22	Modification - Product
EM23	Purchasing
EM24	Office Support Activities
EM25	Monitoring - Raw Material Use
EM26	Monitoring - Site Appearance
EM27	Monitoring - Support Material
EM28	Transport Operation

The document control procedure specified that individual sites could not amend documents without agreement and authorisation at Group level. This meant that updating the system was bureaucratic and allowed individual sites little flexibility. It is planned to change this limitation to facilitate maintenance of the system and encourage individual site ownership (pers. comm. Fleming, 1997).

5.4.7 Employee Training

Each employee's training needs were individually assessed and a training programme established (Figure 5.9). In early 1997, prior to certification, all staff attended a 2-hour awareness raising session. Since then no formal training has been undertaken although environmental incidents are discussed regularly at team meetings and the Environmental Driving Group (EDG) meets every three months (pers. comm. Fleming, 1997).

5.4.8 Environmental Auditing

Internal audits were based on procedures rather than ISO 14001 clauses. 24 audits were required to cover the 28 procedures as in some cases one audit would cover several procedures (Figure 5.10). The audit schedule was based on an audit cycle of a year, implying that every procedure was audited at least annually. Activities associated with significant environmental effects were audited more frequently with the control of hazardous chemicals being audited every 3 months. The large number of audits, two a month, caused problems in meeting the audit schedule. In the future it is planned to rationalise the number of audits by increasing their scope.

Auditing was undertaken by five trained auditors consisting of representatives from the technical department and production. Each auditor would undertake approximately 6 audits a year. The procedure adopted involved developing a checklist, undertaking the audit, writing a report and raising non-conformances where necessary.

Figure 5. 9: ***An example training needs analysis at J & J Makin Converting (J & J Makin Converting, 1997).***

EMPLOYEES NAME: Mike Higgins	**CLOCK NUMBER:** Staff
MAIN JOB: Customer Services Manager	**YEARS IN JOB:** 2
BRIEF DESCRIPTION OF JOB TASKS: • Attending to customer complaints • Investigating complaints • Overseeing wax development • Deputy Technical Manager • BS 7750 Internal Auditor	
LEGISLATION Does the Manager / Operator need to be aware of any environmental legislation which is relevant to their main job ? **If yes, please state:** As Deputy Technical Manager needs to be aware of all solvent laws, waste laws etc	**Yes / ~~No~~**
Does the Manager / Operator need to have any specialist skills training to operate / measure / carry out the necessary dust / noise / solvent monitoring etc ? **If yes, please state:**	**~~Yes~~ / No**
Recommended Training Programme: 1. Basic Awareness Package 2. Brief on System and Contents (BS 7750) 3. BS 7750 Internal Auditor Training	**DATE:** 6/11/97
Signed..................................	**Departmental manager**
Signed..................................	**Staff member**
Signed..................................	**Technical manager**

Figure 5. 10: Audit Schedule 1997/8 at J & J Makin Converting (J & J Makin Converting, 1997).

Area / Procedure	ISO 14001 Clause	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept
Environmental records	4.5.3	EVERY AUDIT											
Training	4.4.2	EVERY AUDIT											
Contingency plan	4.4.7	EVERY AUDIT											
Policy, objectives & targets	4.3.3												
Improvement programme	4.3.4												
Document control	4.4.5												
Environmental incidents	4.4.7												
Legislation register	4.3.2												
Environmental aspects register	4.3.1												
Management manual / reviews	4.6												
Internal audits	4.5.4												
Monitoring - air	4.5.1												
Monitoring - energy	4.5.1												
Monitoring - site appearance	4.5.1												
Waste - Duty of Care	-												
Visitors and contractors	-												
Training and communication	4.4.2 / 4.4.3												
Modification - process	4.3.4												
Modification - products	4.3.4												
Hazardous chemicals & materials	-												
Transport operations	-												
Monitoring - raw material	4.5.1												
Monitoring - support materials	4.5.1												
Disaster recovery plan	4.4.7												

5.5. THOMAS SWAN & CO LTD

Thomas Swan & Co Ltd employ 120 people in the manufacture of polymers, resins and fine chemicals at their site in Consett, County Durham. The family-owned business is registered to ISO 9000 and committed to the Chemical Industries Association's Responsible Care principles. They were amongst the first to gain BS 7750, being certified by the British Standards Institution in March 1995. Their certificate was transferred to the draft ISO 14001 in May 1996. EMAS verification was undertaken during December 1996 and registration to the scheme awarded by BSI in early 1997.

Due to the volumes of chemicals handled in the process the company is prescribed as Part A under the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991* for regulation by the Environment Agency under Integrated Pollution Control (pers. comm. Richardson, 1996).

5.5.1 Motivation for EMS Implementation

Thomas Swan & Co has traditionally maintained a close relationship with their customers and in the early 1990's began to receive increasing numbers of customer environmental enquiries (pers. comm. Richardson, 1996). Certification to BS 7750 was seen as a mechanism to ensure their expectations were met and achieve a competitive advantage.

Besides the desire to meet customer's requirements legislative pressure on the company had significantly increased. This started in the 1980s with the Classification, Packaging and Labelling of Dangerous Substances (CPL) Regulations and was followed by the European Inventory of Existing Commercial Chemical Substances and the Control of Substances Hazardous to Health Regulations 1988. Pressure increased again in the early 1990s with the publication of the Environmental Protection Act. A formal EMS was adopted to ensure continued awareness and compliance with this rapidly changing legislation.

The poor public image of the chemical industry and the general public's increasing environmental concern provided additional motivation. Registration to the Chemical

Industries Association's Responsible Care programme provided some reassurance to local residents but was not considered to be sufficient (Richardson, 1995). Its lack of a commitment to continuous improvement, in particular, led the company to seek certification to a recognised environmental standard (pers. comm. Richardson, 1996).

5.5.2 Responsibility for EMS Implementation

Responsibility for BS 7750 was assigned to the Chief Chemist, who also had responsibility for research and quality management. The system was originally developed by technical staff and was transferred to production through an Environmental Management Team. This consisted of eight members meeting every few weeks to review progress with implementation. The inclusion of representatives from production was considered to be invaluable as an in-depth knowledge of all aspects of the business was required (pers. comm. Grosevenor, 1996). Top level commitment was seen to be essential and was achieved through the "Environmental Executive Team". This consisted of eight top managers, including the Managing Director, who met every six months to discuss strategic issues such as certification, policy and objectives.

5.5.3 Environmental Effects Assessment

A complex numerical rating system was adopted for assessing environmental effects, based on the technique of failure mode and effect analysis (FMEA) (Thomas Swan & Co Ltd, 1994 and 1994a). The likelihood of occurrence, likelihood of detection and severity of the consequences of each effect were scored and the sum indicated overall significance (Table 5.14). This approach was slightly modified to that for FMEA contained in the previous chapter as control has been substituted by likelihood of detection. These are related, as the greater the control, the greater the chance of detection. Control, however, is more general in its definition applying to management as well as detection. It is therefore more easily applied to effects such as resource consumption and supplier control.

The effects assessment identified over 70 significant environmental effects, which were later rationalised to 30 (pers. comm. Richardson, 1996). To facilitate communication to employees these were summarised to waste, resources, materials handling and perceptible effects such as noise, odour and visual impacts. These were considered to be the four "static" significant effects which would not change over time.

Table 5. 14: Methodology for assessing environmental effects at Thomas Swan & Co (Thomas Swan & Co Ltd, 1994)

Likelihood of occurrence		*Likelihood of detection*		*Likelihood of consequence*	
Criteria	*Rank*	*Criteria*	*Rank*	*Criteria*	*Rank*
Very high	5	Certain	0	None	0
High	4	Very high	1	Minor	2
Moderate	3	High	2	Low	4
Low	2	Moderate	3	Moderate	6
Very low	1	Low	4	High	8
None	0	Very low	5	Very high	10

5.5.4 Environmental Policy, Objectives & Programmes

A publicly available document contained the quality, health and safety, and environmental policies (Thomas Swan & Co Ltd, 1996). The environmental policy consisted of a simple commitment to the prevention of pollution and continual improvement, supported by four strategic objectives (Figure 5.11). These focused on risk minimisation, environmental protection and communication but little detail was included on waste minimisation, energy conservation, product design or the source of raw materials. Previously the objectives had included a commitment to comply with legislation. This was later removed at the request of the external assessors who considered this suitable for the policy but not sufficiently detailed to constitute an objective (per. comm. Grosvenor, 1998). Quantified performance targets were not published but specific targets were established for individual management programmes (Thomas Swan & Co Ltd, 1994b), which were deemed confidential. Information relating to improvement programmes could be obtained from their EMAS statement, published in 1996, which summarised previous and ongoing initiatives. These were far reaching and broad in scope covering issues such as improvements to piping and storage, energy efficiency, transport and supplier performance (Table 5.15).

Figure 5. 11: Environmental policy statement at Thomas Swan & Co Ltd (Thomas Swan & Co Ltd, 1996).

It is the POLICY of the Chemicals Division of Thomas Swan & Co Ltd to:

- Give a commitment to protect and conserve the environment, with particular regard to the prevention of pollution and continuous improvement.

The related OBJECTIVES are to:

- Conduct all site operations to a high standard of safety, efficiency and environmental awareness, with particular focus on significant environmental effects.
- Communicate openly with customers, employees, suppliers, the local community and other interested parties on relevant environmental issues.
- Ensure that the company, its employees and visitors comply with this policy and all other social, moral and legal environmental requirements.
- Maintain registration to an international environmental management standard.

To assist in meeting the above requirements, the company will:

- Ensure that overall environmental responsibility remains with a senior manager.
- Continue to provide appropriate environmental training for all employees.
- Select and carry out its manufacturing practices having regard to both the local environment and the operations involved.
- Continue to operate a controlled environmental management system which includes comprehensive audit and review procedures. This includes review of this policy.

Table 5. 15: Summary of environmental programmes at Thomas Swan & Co (from Thomas Swan & Co, 1996a and 1997)

• Reduction in the number of process ventilation points (target date 1998)
• Continual improvement of purification / filtration facilities in the production areas
• Monitoring and targeting systems for yield, quality, waste, materials and energy
• Re-routing of trade effluent from the Crookhall sewage works to the larger Consett works
• Improved thermal insulation of hot oil and steam pipes (completed 1994)
• Improved thermal insulation of reaction vessels and storage tanks (ongoing)
• Substitution of gas for heating oil (completed 1997)
• Electricity supply power factor correction (completed 1996)
• Upgrading of the nitrogen distribution pipework (completed 1996)
• Installation of full site containment (ongoing)
• Review of storage conditions to ensure that non-compatible materials are not stored together
• Scrutiny of customers and suppliers using environmental management questionnaires (started in 1993)
• Auditing key customers (1995), suppliers (1995) and transport contractors (started in 1993)
• Use of bulk handling, where appropriate, to reduce the number of handling operations (ongoing)
• Restriction of goods transported through Crookhall during unsociable hours
• A comprehensive preventative engineering maintenance schedule (ongoing)
• Installation of a less dusty packaging plant and a more energy efficiency cooling unit (completed 1997)

Annual environmental performance in terms of environmental releases and resource consumption was calculated and compared to the previous years performance (Table 5.16). The increase in releases between 1994 and 1995 can be explained by the introduction of a new process, the manufacture of additives used in the rubber industry. This led to increased waste and resource consumption compared with the replaced product range. The environmental implications of the new process were addressed and appropriate action taken, including the introduction of many environmental improvements. The process has since been adopted as a model of Best Practicable Environmental Option (BPEO) by the Environment Agency (Thomas Swan & Co, 1996a). Between 1995 and 1996 water consumption, energy consumption, process waste and trade effluent per tonne of product were reduced (Thomas Swan & Co, 1997).

Table 5. 16: Environmental performance at Thomas Swan & Co (from Thomas Swan & Co, 1996 and 1997)

	Quantity per tonne of product			***Total Quantity (tonnes)***		
	1994	1995	1996	1994	1995	1996
Process waste (tonnes)	2.0	2.4	2.3	8,500	10,200	11,500
Trade effluent (tonnes)	4.8	6.9	6.7	21,000	29,000	33,600
Measured emissions to air (tonnes)	0.007	0.004	0.004	30	18	20
Calculated emissions to air (tonnes)	1.7	1.5	1.6	7,400	6,400	8,000
Consumption of water (gallons)	3,300	4,100	3,000	14.5 mill	17.5 mill	14.9 mill
Energy (gigajoules)	20	21	18	85,000	90,000	89,000
Raw material (tonnes)	2.1	2.2	2.2	9,250	9,400	10,910

The external auditors from the British Standards Institution focused on consistency between objectives, targets and the management programme. They were concerned by the lack of a clear link between the objectives and the management programme. This identified individual projects and assigned target completion dates but did not reference objectives. To solve the problem each objective was supported by a minimum of one target and improvement project. An example being a target to undertake 12 supplier audits a year assigned to the objective to communicate openly with customers, employees, suppliers and the local community.

5.5.5 Employee Training

A matrix of job descriptions versus required environmental knowledge identified training needs. The first draft of a training plan included tight deadlines for the deliverance of courses. This proved difficult to achieve and timescales were later removed to avoid assessors raising non-conformances when deadlines were not met (pers. comm. Richardson, 1996).

External assessors emphasised the importance of employee environmental training. They questioned individual employees on their understanding of the policy and relevant elements of the EMS.

5.5.6 EMS Documentation

The implementation of the EMS required only 4 new procedures plus the modification of 20 - 30 existing ones (pers. comm. Richardson, 1996). Operational procedures were integrated to cover all business activities including quality, health, safety and the environment. It was not necessary to document any additional procedures to transfer from BS 7750 to ISO 14001. Assessors considered the additional ISO 14001 requirement for a procedure to periodically evaluate compliance with legislation to be met by the on-going review activities of the Environmental Management Team.

5.5.7 Environmental Auditing

Every six months a team of six people spent a week undertaking an environmental audit. Each audit covered two process areas and consisted of vertical and horizontal elements. Vertical audits, also known as system audits, reviewed compliance with EMS elements whilst horizontal audits, or compliance audits, looked at operational issues such as raw materials, housekeeping and maintenance. In compliance with EMAS each audit is repeated at least every 3 years, with certain audits undertaken more frequently depending on the severity of the associated environmental effects.

5.5.8 EMAS Registration

EMAS requires an environmental review whereas BS 7750 and ISO 14001 only recommend this where there is no existing EMS in place (Chapter 4). Thomas Swan & Co had not undertaken a full review prior to BS 7750 as much information had previously been compiled to meet regulator's requirements. Rather than demanding a retrospective review, which would have been of little additional benefit, the British Standards Institution, their chosen EMAS verifiers, accepted a list of existing reports and IPC Applications.

The Environmental Management Team spent a year compiling the data for the public environmental statement (pers. comm. Grosvenor, 1996). It took the EMAS verification body two days to verify the system and environmental statement met the requirements of the Regulation. Little emphasis was placed on the source of the data and original calculations were not inspected. The majority of the data were accepted rather than questioned. The first statement was published in November 1996 and consisted of a three page fold-out leaflet containing details of the policy, objectives and environmental performance (Thomas Swan, 1996a). Interim statements, consisting of a simple one page hand-out are to be published each year (Thomas Swan, 1997). Neither the 1996 or 1997 statements reported any environmental incidents or breaches of legislation.

5.6. CONTRACT CHEMICALS (KNOWSLEY) LTD

Since 1983 Contract Chemicals (Knowsley) Ltd have manufactured a wide range of chemicals for the international pharmaceutical, agrochemical, food and allied industries. Their 9 acre site is situated on the Knowsley Business Park between Liverpool and St Helens. It now employs approximately 160 staff and was one of three company sites achieving certification to BS 7750 by October 1996.

The British Standards Institution was contracted as the certification body and the main assessment at Knowsley required 9-12 auditing days. The Company experienced 12 different auditors and reported that each auditor's style and priorities differed (pers. comm. Kinely, 1996). Some took an office based approach whilst others carried out more practical site based assessments. Following certification one day surveillance audits have been carried out every six months by one auditor. The site became registered to EMAS in 1997 after the publication and validation of their environmental statement (Contact Chemicals, 1997).

The manufacturing processes used at Knowsley are based on traditional synthetic organic chemistry. Products are manufactured in vessels ranging in size from 200 to 30,000 litres. Raw materials are delivered by road tanker and fed to reactors from drums or bulk storage. They are reacted together under tightly controlled time and temperature conditions until the reaction has reached completion. Where necessary the end product is purified by crystallisation, distillation or solvent extraction. Solid products are dried and sieved before quality control testing, packing and despatch by road.

5.6.1 Motivation for EMS Implementation

The impetus to implement BS 7750 originated with the Group Managing Director. He perceived certification as a prerequisite for continued business (Kinley, 1996). The company's public image was under threat by a local environmental action group "Knowsley Against Chemicals". BS 7750 was adopted as a mechanism to demonstrate commitment to stakeholders, in particular the general public.

5.6.2 Responsibility for EMS Implementation

Responsibility for implementing BS 7750 was assigned to the Group Health, Safety and Environment Manager. He was assisted by a steering group, consisting of Operations Managers and the Managing Director, which met every two weeks throughout the implementation period. A master timetable designated a member responsible for each clause of the standard. Individual managers were required to report regularly to the Managing Director on their progress (pers. comm. Kinley, 1996).

5.6.3 Environmental Review

The first stage in the implementation process was the preliminary environmental review. This was undertaken with the help of consultants Robinson Fletcher at a full cost of £3,500, funded by 50% through a DTI grant scheme.

5.6.4 Environmental Policy

The next stage was to document an environmental policy detailing the company's environmental commitment (Figure 5.12). This committed the organisation to assigning environmental management equal priority to the health and safety of employees and the quality of products. Employees mandatory compliance with systems and instructions was included to demonstrate that their commitment was essential to the success of the business (Kinley, 1996).

Figure 5 12: Site environmental policy at Contract Chemicals (Knowsley) Ltd (Contract Chemicals, 1997)

The board of Contract Chemicals is committed to achieving the highest possible standard of environmental management. This commitment is essential for the future of our business. It ranks equally with our policy commitments to health, safety and welfare of our employees and the quality of our products.

Our environmental manual and the various supporting procedures, instructions and records are designed to establish, document and maintain our environmental management system.

It is the policy of Contract Chemicals to conform with the requirements of British Standard BS EN ISO 14001: "Specification for Environmental Management Systems". The systems and instructions are therefore mandatory upon all Contract Chemicals Personnel involved in the activities of the Knowsley site. It will be capable of producing objective evidence of conformance.

Additionally, as a member of the Chemical Industries Association, we are wholly committed to the guiding principles of the Association's "Responsible Care Initiative". As such, it is an integral part of our overall business policy to ensure that our activities are organised and managed to ensure an acceptably high level of protection for the health and safety of our employees, our customers, the public and the environment.

We will seek constantly to prevent pollution and improve the environmental performance of our operations. We will measure, control and where practicable progressively reduce emissions, waste output and energy use. We will focus principally on those areas of greatest potential environmental impact within our production, product development, procurements and storage operations.

We will continually assess our environmental performance against agreed objectives and targets. New investments in plant and processes will incorporate the best available techniques which are commercially viable. We will continue to work closely with all appropriate external authorities to meet all regulatory and legislative requirements.

In order to ensure the success of this important policy the necessary resources, both human and financial, will be made available. In addition, there is an on-going commitment to training and awareness to ensure that the policy is understood, implemented and maintained at all levels within the company.

Participation is welcomed from all in revising, maintaining and improving the policy to ensure that these high standards are met and maintained. Our policy and objectives are available to all interested parties.

5.6.5 Environmental Effects Assessment

In a similar way to BICC Cables and Autosmart, the methodology adopted for the effects assessment was based on risk assessment involving scoring probability and consequence. The criteria used to assess consequence were flexible and comprehensive containing a general clause to include any effect with a significant impact (Kinley, 1996). This allowed the methodology to be successfully applied to all types of effects and led to the identification of over 30 of significance.

5.6.6 Objectives, Targets & Programmes

Following the prioritisation of environmental effects 32 objectives for reducing environmental releases and improving waste management were established. The achievement of an objective to reduce volumes of trade effluent by 60% caused unforeseen problems by increasing the concentrations of other effluent parameters (pers. comm. Kinely, 1996). This illustrates the need to fully consider the overall environmental consequences of process changes prior to their implementation.

The difficulties of managing such a large number of objectives resulted in their rationalisation from 32 to 7 for 1996 (Table 5.17). The majority were quantified and specified achievement target dates. In certain cases these were long-term with target dates of up to 18 months.

The site's public statement prepared for EMAS, which was first published in 1996, consisted of a detailed 20 page document (Contract Chemicals, 1997). It reported that in 1995 oil and grease discharges exceeded consented levels (Table 5.17). Although legislative compliance is the minimum requirement of BS 7750 this did not prevent certification being granted by BSI. They were satisfied with the ambitious target for the next year to reduce releases to within 85% of the consent levels and average loading by 5% compared with 1995 values. The modification of production processes and the installation of engineering solutions were successful in reducing all parameters to 73% of the consented level. Average loadings for oil and grease were reduced by 60% but the volume of trade effluent and sulphate levels increased compared to 1995 (Table 5.17). The recorded increase in volume was due to the diversion of surface water run-off into the trade effluent drain and the increase in sulphate loading was due to changes in product range.

Table 5. 17: Environmental objectives for 1996 at Contract Chemicals (Knowsley) Ltd (Contract Chemicals, 1997)

- **Minimise the risk of contaminating surface water**
- **Improve effluent quality within 85% of discharge consent limits and reduce the average loading by 5% compared with 1995 levels**
- **Reduce water consumption by 5% compared with 1995**
- **Maintain air emissions within 85% of permitted discharge limits and incur no air emission related complaints**
- **Minimise the risk of contamination to land and ensure that land and buildings are managed in a responsible manner with regard to site aesthetics.**
- **Incorporate environmental concerns into the supplier quality audit programme**
- **Develop a costed plan by February 1996, which identifies medium and long term issues and provides proposals for energy reduction.**

Table 5. 18: Parameter effluent concentrations compared to consent levels at Contract Chemicals (Knowsley) Ltd (from Contract Chemicals, 1997).

Parameter	*Consent Level*	*1995 Mean Daily Loading*	*1996 Mean Daily Loading*	*Change*
Oil & Grease	100 mg/l	156 mg/l	63 mg/l	-60%
Volume	350 m^3/day	202 m^3/day	254 m^3/day	+20%
Sulphate	1000 mg/l	315 mg/l	372 mg/l	+15%

All other objectives for 1996 were met apart from the target to incur no air emission related complaints (Contract Chemicals, 1997). Three incidents, two involving dimethyl amine and one acetic acid, resulted in 14 complaints. In addition it was necessary to notify the Environment Agency twice during 1996 following detected emissions above consent. The first was associated with a faulty valve leading to short-term releases of hydrochloric acid and the second with the failure of a scrubbing system leading to increased concentration of VOC release. The failure to meet two of the objectives did not lead to the loss of BS 7750 certification as in all cases causes were investigated and corrective and preventative action implemented.

A number of additional activities were included within the scope of the objectives for the following year including the enhancement of the environmental auditing programme and the review of current packaging usage (Table 5.19). The objectives also contained commitments to further reduce atmospheric emissions and water consumption compared to 1996. The 1997 target for effluent quality was less stringent than in 1996 requiring releases to either be maintained to within 80% of consented levels *or* reduced by 5% compared to 1996 levels.

Table 5. 19: Environmental objectives for 1997 at Contract Chemicals (Knowsley) Ltd (Contract Chemicals, 1997)

- **Minimise the risk of pollution to the drainage system**
- **Maintain effluents within 80% of consent limits at all times or reduce mean reported values by 5% per unit effluent volume on 1996 for three key parameters**
- **Minimise total water consumption (per unit volume of production) by 5% compared with 1996.**
- **While maintaining air emissions within consented concentrations the company will seek to hold emissions within 80% of total mass emission consent limits.**
- **Minimise the risk of contamination to any land as a result of operations**
- **Carry out land quality investigations prior to the development of the new production building.**
- **Manage land and buildings in a manner with regard to site aesthetics and land utilisation.**
- **Enhance the environmental auditing programme.**
- **Review current packaging usage with a view to increasing the level of recycling and re-use.**

5.6.7 Employee Training

Extensive environmental training was required to achieve a satisfactory level of employee awareness. Everyone on the Knowsley site attended a 1 day external course organised by A.I.G Consultants, formally Robinson Fletcher (Kinely, 1996). Since certification all staff have attended 3 half-day off site courses on topics such as IPC, effluent and management systems. This resulted in substantial improvements in employee awareness although training had to be repeated 3 times before a clear improvement was seen. Achieving this cultural change in the workforce was felt to be the hardest element of implementing the EMS (pers. comm. Kinely, 1996).

A large number of staff, 25, were externally trained in auditing by attending a course approved by the Environmental Auditors Registration Association. The majority of these were also trained ISO 9000 auditors. Each EMS audit was carried out by a team of two trained auditors.

5.6.8 EMS Documentation

From the outset it was intended to integrate the EMS with the quality system. Wherever possible existing quality procedures were adapted to incorporate environmental considerations. The environmental policy and manual, however, were kept separate from the quality system to ensure their high profile.

5.7. SUMMARY

The five case-studies identify a number of key motivators for EMS implementation. All companies cited the desire to meet customers' expectations and achieve a competitive advantage to be particularly important. The three chemical companies were also motivated by the desire to improve their public image. This explains their motivation to publish environmental statements and seek registration to EMAS. Legislative compliance was also a significant motivator for companies regulated under LAAPC or IPC.

The drivers motivating individual companies are reflected in their environmental policies and overall direction of their EMSs. This illustrates how important it is to fully understand the aims of a system prior to implementation to ensure the desired results are achieved. Companies motivated by legislation tend to adopt a more compliance approach compared to others, such as Autosmart, where more strategic issues such as choice of raw materials and impact of products are incorporated. The three chemical companies invested significant effort in external communications as a key aim of their systems was to improve public image.

Management commitment is essential to the success of an EMS. All five companies recognised the important role of senior management, in particular the Managing Director, in the process of achieving certification. Day-to-day responsibility for EMS implementation is typically assigned to an existing quality manager. This was the case for four of the five case-study companies, the exception being Contract Chemicals where the Group Health and Safety Manager championed the project.

A team approach to implementation is invaluable as input is required from all business activities. Typically this consists of representatives from a range of departments, including senior management and production. Employee involvement is commonly reported to be critical by certified companies. The five participating companies all required their staff to attend a minimum of one formal environmental training session ranging from a 2-hour introduction at J & J Makin to several days per employee at Contract Chemicals. Whilst involving employees is essential changing culture and management practices was frequently reported to be the hardest element of EMS implementation.

Methodologies adopted for the environmental effects assessment are typically based on risk assessment and involve numerical rating systems. These range from simple systems, such as that at Autosmart, to complex rating systems, such as those at BICC Cables and J & J Makin. There is little added value from adopting a detailed methodology, rather it leads to confusion and the need for parallel systems to ensure applicability to all types of effects. A wide range of techniques are acceptable to the certification bodies who are looking for evidence that the necessary issues have been considered through a consistent approach. It is standard to identify approximately 10 effects as significant.

The level of environmental improvement sought varies greatly between companies. Contract Chemicals and Autosmart published seven or eight key objectives each year, many of which were quantified and supported by many individual projects. In comparison J & J Makin established only six projects over three years. In some cases third party assessors appear to give little attention to the extent of environmental improvement achieved. To ensure the standards succeed in their aim of achieving continual environmental improvement they have a responsibility to concentrate on real improvement rather than system documentation.

The most demanding and detailed targets are set by EMAS registered companies, who are required to report publicly on their progress. Of the five companies studied the most stringent targets were set by Contract Chemicals and Autosmart, both EMAS registered. In comparison the two companies not EMAS registered, BICC Cables and J & J Makin, did not attempt to quantify their commitment to continual improvement.

The lack of standardised performance indicators makes comparisons of environmental performance between certified companies difficult. This is particularly the case in those not registered to EMAS, who are not required to publish their achievements. All five companies specified objectives and targets beyond the requirements of legislation, typically in waste minimisation and energy efficiency. In this way the standards are effective in encouraging voluntary environmental improvement. None of the companies, however, included commitments to the broader principles of sustainable development in their policies or objectives.

The volume of additional documentation required for an EMS varies significantly between companies. Thomas Swan required 4 new procedures compared to 28 at J & J Makin. Adopting the strengths of existing business systems can lead to the minimisation of new documents through systems integration. Environmental requirements can be incoporated into an existing quality system, in particular the system manual and procedures for training, auditing, non-conformances and document control. This was the case at BICC Cables, Autosmart and Contract Chemicals. In comparison J & J Makin Converting and Thomas Swan & Co Ltd, chose to keep their EMS documentation distinct from other business management systems thereby increasing the number of new procedures required.

External auditors are particularly concerned with the establishment of a clear link between significant effects, objectives and management programmes. It is important that all significant effects are managed within the system and that targets and improvement programmes are established for each objective. Employee training and awareness is also frequently investigated during the assessment. All employees need to be aware of the company environmental policy and refresher training is required on a regular basis.

The case studies identify a number of lessons for companies implementing an EMS. In particular it is important to define the system aims prior to implementation, as this will influence many of the individual components. A team approach and substantial employee training and involvement are invaluable in ensuring system success. Bureaucracy can be reduced by integrating procedures with existing quality documentation. In many cases companies simplified their EMS following certification, this is particularly relevant to the complexity of the effects assessment and objectives and targets. Simple approaches coupled with several key objectives are sufficient to meet the requirements of the certification bodies. This is also true of the public environmental statement required by EMAS. As Autosmart and Thomas Swan illustrated it is not necessary to publish complex detailed reports unless the organisation believes this will be beneficial to their public image.

CHAPTER 6

6.0. EMS IMPLEMENTATION AT A LARGE CHEMICAL MANUFACTURER

6.1. INTRODUCTION

This chapter investigates the ease of implementation of the EMS standards through a detailed case study from a large heavily regulated chemical company. The author's direct involvement, as project manager, allows a comprehensive investigation into the EMS standards' requirements and the key issues associated with their implementation. In addition the problems encountered and their solutions are identified and discussed.

The first stage was to undertake a detailed review of management practices against the requirements of the standards. This was essential in determining the starting position and identifying strengths and weaknesses of existing systems. Throughout the duration of the project areas of non-compliance were addressed and brought into line with the standards. This led to the design and implementation of an EMS which would meet BS 7750 and be complementary with existing environmental, quality and health and safety systems. It was also necessary to ensure compliance with ISO 14001 which was published in draft during the implementation period.

6.2. COMPANY DETAILS

Solvay Interox Ltd is part of the international chemical and pharmaceutical group, Solvay S.A. The group has over 45,000 employees at 423 sites across 42 countries. Approximately 450 staff are employed at the manufacturing plant in Warrington and a further 80 in the Research and Development Department in Widnes. They are committed to the Chemical Industries Association's Responsible Care Programme which requires written commitment to a series of guiding principles and the annual submission of environmental performance data. During the late 1980s and early 1990s some of the initial aspects of an EMS were established, including a policy statement, employee training and a seven year improvement programme. The site is certified to the quality standard ISO 9002 and is committed to Total Quality Management and Investors in People.

Some 50,000 tonnes of hydrogen peroxide is manufactured per annum, representing 80% of the UK market. Approximately 15,000 tonnes is sold in a variety of strengths as a bleaching agent used in paper and textiles, effluent treatment and gas scrubbing. The remainder is converted on site into three products, persalts, peracetic acid and caprolactone. Persalts is a generic term describing percarbonate and perborate compounds. The three types manufactured on site are all white crystalline powders. They are used as bleaching agents in laundry products, household cleaning products, cosmetic products, textile bleaching and other applications. Peracetic acid is a powerful biocidal against viruses, bacteria, moulds, yeasts and algae. The trade name "proxitane" is used in brewing, dairy and food industries as a disinfectant or sterilant. Caprolactones have a wide range of applications because of their versatility. They add strength, resistance and flexibility to polyurethane elastomers. They also improve the manufacturing processes by ensuring consistent reactivity, low viscosity, high purity and ease of processing.

Environmental management at Solvay Interox Ltd is the responsibility of the Environment Group, part of the Technical Department. It consists of five full-time employees, the Senior Environmental Advisor, the Environmental Officer, the Environmental Investigations Officer and two contract environmental engineers. The primary role of the Senior Environmental Advisor and the Environmental Officer is the provision of advice and support to the manufacturing plants regarding environmental legislation. The Environmental Investigations Officer is responsible for undertaking technical activities including the monitoring of atmospheric emissions and liquid effluent. At the time of the research his major responsibility lay in the management of a ground decontamination team consisting of the two contract engineers plus external consultants.

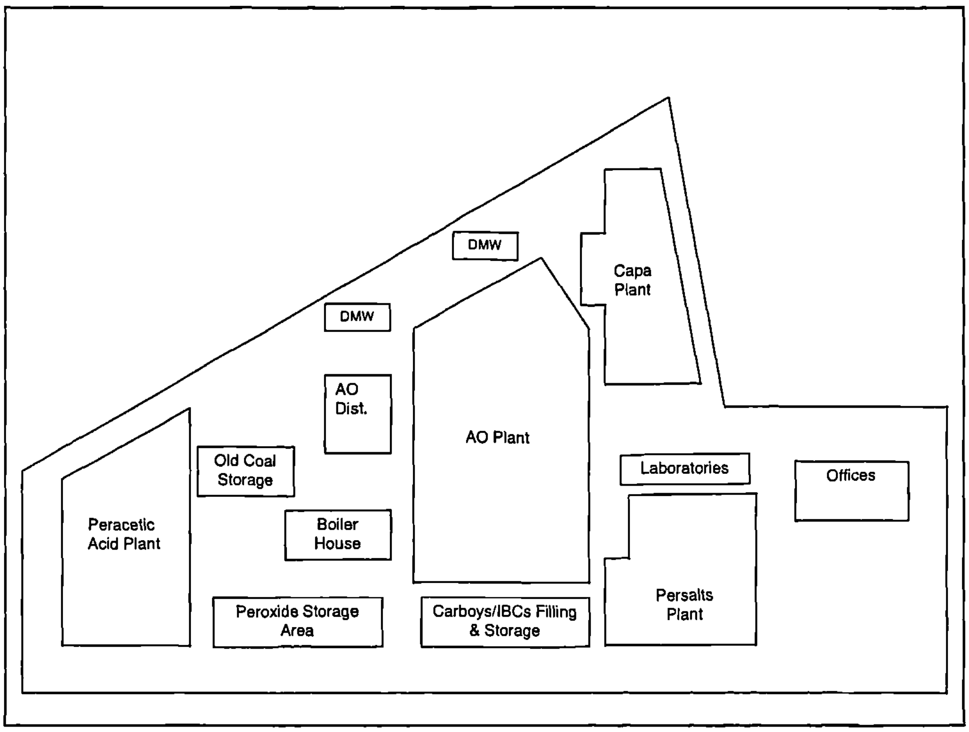
6.3. MOTIVATION FOR ADOPTING BS 7750

Pressure on the company to improve its environmental performance increased significantly during the late 1980s and early 1990s. In 1990 legislation affecting the company's activities substantially increased with the publication of the Environmental Protection Act which required four of the site's processes to be regulated under Integrated Pollution Control (IPC). Two prosecutions in the early 1990s for accidental pollution of adjacent water courses increased the company's motivation to improve its environmental control. In addition the local residential community was becoming increasingly concerned over issues such as traffic movements, noise and odours. Complaints were regularly received and plans to build a new caprolactone plant resulted in demonstrations and adverse press responses. The number of environmental enquiries from customers was also increasing. Senior management considered the adoption of a recognised EMS would improve process control and legislative compliance whilst addressing stakeholder's concerns.

6.4. SITE DESCRIPTION

The 50 acre site is situated between the Mersey Estuary and the Manchester Ship Canal, adjacent to a residential area of Warrington (Figure 6.1). It is divided into four manufacturing processes, the Auto-Oxidation (AO) Plant, the Caprolactone (Capa) Plant, the Persalts Plant and the Peracetic Acid (PAA) Plant.

Figure 6. 1: Site diagram of Solvay Interox Ltd



The manufacturing plants are supported by a gas fired boiler house, a laboratory block, a de-mineralised water plant (DMW), an office block and several dedicated storage areas. The four manufacturing processes and the boiler house are all prescribed as Part A, for regulation under Integrated Pollution Control (IPC), by the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991*. In 1993 detailed applications, specifying environmental releases and current operating procedures, were submitted to Her Majesty's Inspectorate of Pollution (HMIP). Authorisations were issued for each process specifying process improvements and emission limits for releases to air and water.

The site has three consented routes for the discharge of liquid effluent. A direct discharge to the River Mersey plus two trade effluent discharges to the foul sewer system. The sewer discharge runs to the Warrington North Treatment works for primary treatment prior to discharge to the River Mersey. The discharge direct to the River Mersey is regulated by the National Rivers Authority and the release to sewer by North West Water.

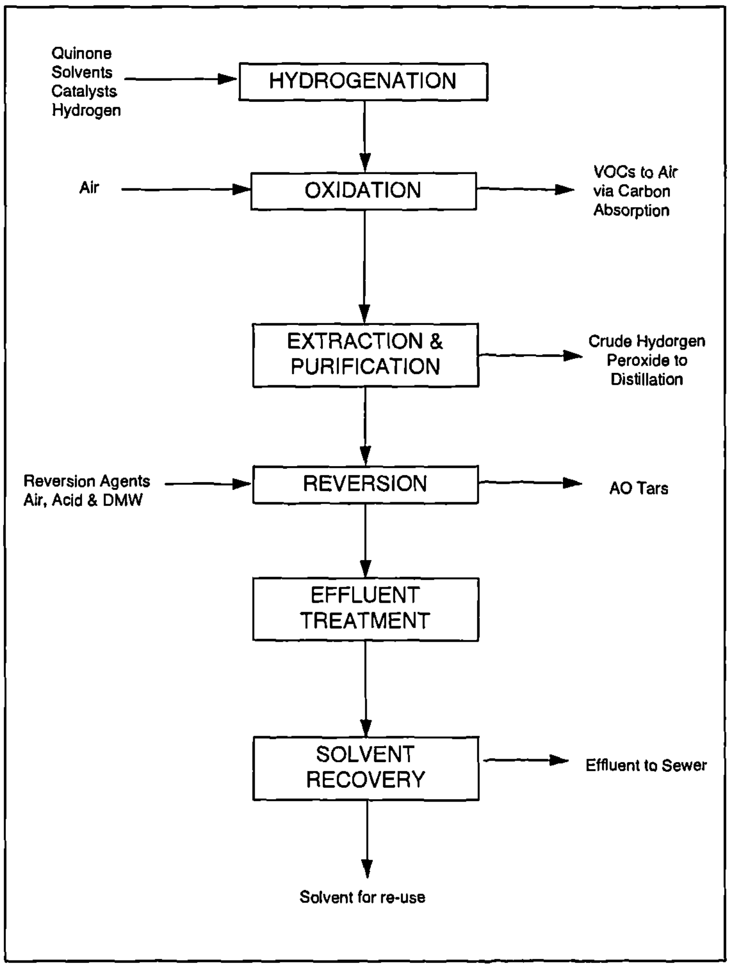
6.5. PROCESS DESCRIPTIONS & ENVIRONMENTAL IMPACTS

6.5.1 The Auto-Oxidation Plant

Hydrogen peroxide has been manufactured by the Warrington site since 1960 (Figure 6.2). Alkyl anthraquinone, dissolved in an organic solvent, is chemically reduced by hydrogen to quinol. This is oxidised by air in the Oxidiser to regenerate the quinone and produce hydrogen peroxide as a byproduct. Oxidiser off-gas passes through carbon adsorption beds to remove solvent before release to atmosphere. Crude hydrogen peroxide is extracted from the quinone solution, washed with a solvent and distilled to the required product strength.

Varying percentages of the regenerated quinone solution are fed to reversion systems to convert any unwanted byproducts back to pure quinone. This process produces a single phase aqueous, alkaline, tarry liquid waste containing quinone derivatives, known as AO tars. Because of their alkaline content they are classed as special waste under the *Control of Pollution (Special Waste) Regulations 1980*. Disposal involves transportation to a licensed treatment plant before final disposal at a fully contained landfill site.

Figure 6. 2: Process flow diagram for manufacture of hydrogen peroxide at Solvay Interox Ltd



The reversion process also produces a liquid effluent containing organic species contributing a chemical oxygen demand (COD). It contains small quantities of mercury, a prescribed substance for release to water, derived from contaminated raw materials (Solvay Interox, 1993a). Prior to discharge the liquid effluent passes through a tilted plate separator to remove free organics. A proportion passes through an air scrubber to recover volatile organics before the final effluent is discharged. Cooling water, used in the distillation of the final product, is released to River Mersey. It contains approximately 100 te/a of hydrogen peroxide which breaks down to form the environmentally benign products of water and oxygen (Solvay Interox, 1993a).

The major release to air from the AO process is the emission of approximately 15 tonnes per annum of volatile organic compounds (VOCs) from the carbon beds plus their release from numerous process vents (Solvay Interox, 1993a). The substances emitted, 2-methyl cyclohexyl acetate and aromatic hydrocarbon, are class B VOCs under the HMIP classification of organic compounds (Solvay Interox, 1993a). These are less environmentally damaging than class A compounds. A significant quantity of hydrogen peroxide, not a prescribed substance for release to air, is also released from numerous process vents (Solvay Interox, 1993a).

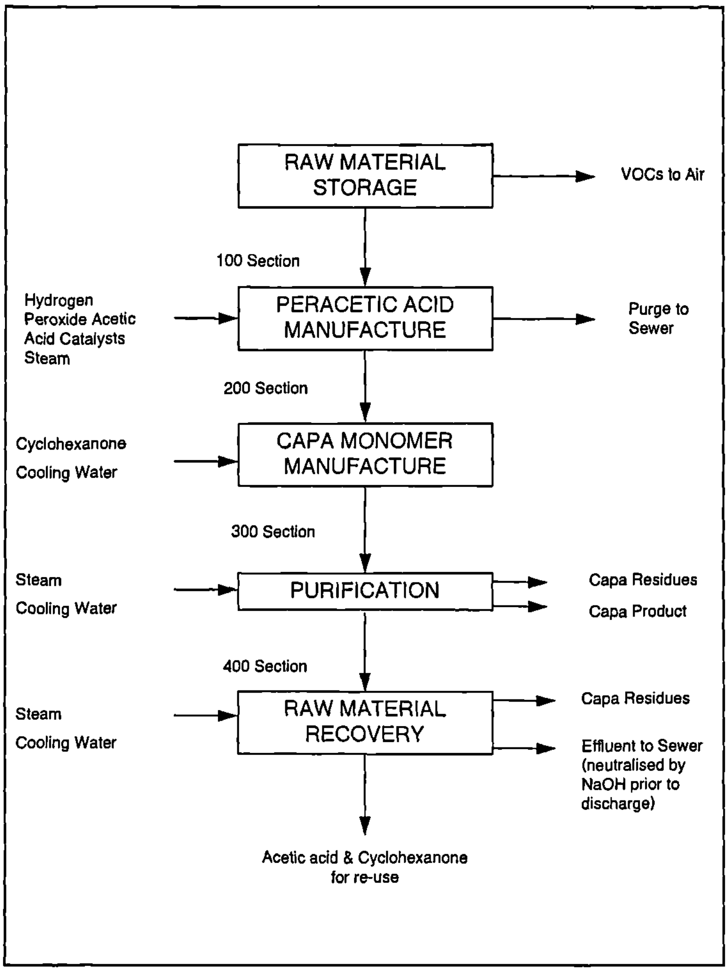
6.5.2 The Caprolactone Plant

The previous owners of the site, Laporte Industries, produced the two raw materials for caprolactone, cyclohexanone and hydrogen peroxide, and moved into caprolactone production in 1960. A small pilot plant progressed to the design and construction of the full-scale plant on the Warrington site in 1974. It produced caprolactone monomer and low molecular weight polymer. The manufacturing plant for high molecular weight polymers came on-line in 1985. The monomer is a clear, odourless liquid whilst the polymer is an opaque solid.

The continuous caprolactone monomer process is divided into four sections (Figure 6.3). The "100 section" produces peracetic acid from hydrogen peroxide and acetic acid catalysed with sulphuric acid. This is distilled and fed to the "200 section" where it is reacted with cyclohexanone to produce caprolactone. The "300 section" separates unreacted raw materials and reaction by-products by distillation to give virtually pure caprolactone monomer. Unreacted raw materials and reaction by-products are processed in the "400 section" to form re-usable acetic acid and cyclohexanone. The solid by-products, "capa residues", are collected for landfill.

The acidic process effluent, containing low concentrations of organic compounds, is neutralised by sodium hydroxide prior to discharge to the sewer system. Mercury contamination of sodium hydroxide results in small quantities, 17g per annum or a concentration of 0.06 ppb, of mercury being discharged (Solvay Interox, 1993b).

Figure 6. 3: Flow diagram for the manufacture of caprolactone at Solvay Interox Ltd



Releases to air from the cyclohexanone process consist of approximately 0.5 tonnes a year of VOCs (Solvay Interox, 1993b). The majority results from off-loading road tankers by pressurised discharge. The main compounds released are acetic acid, cyclohexanone and caprolactone monomer. These substances are considered to be the less damaging class B VOCs (Solvay Interox, 1993b).

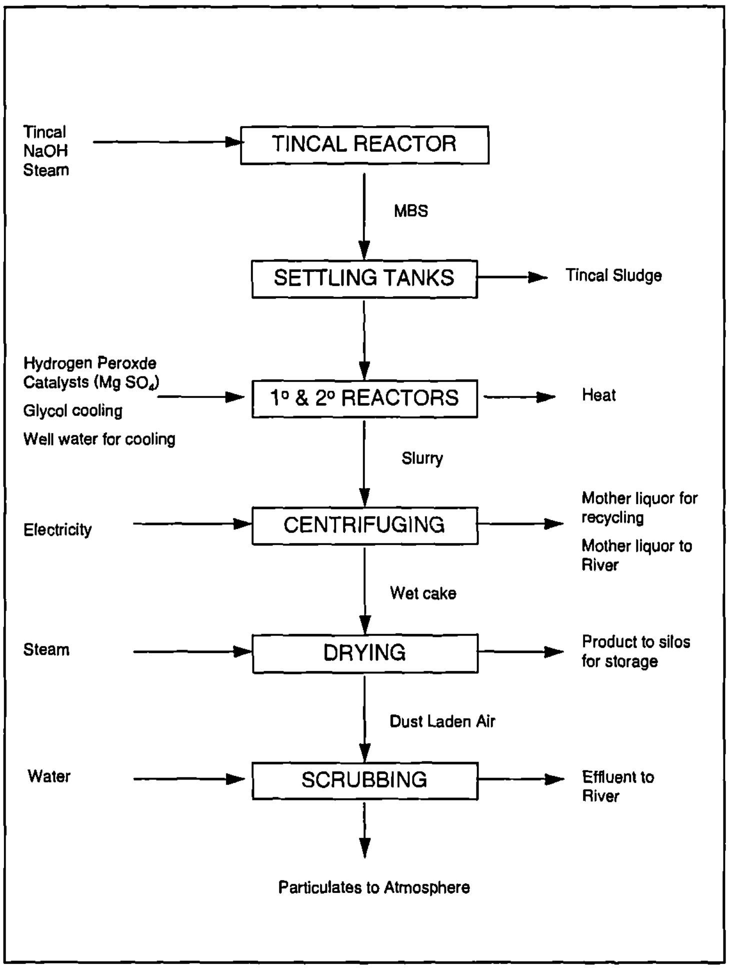
6.5.3 The Persalts Plant

The plant to produce sodium perborate tetrahydrate (PBS-4) was built in 1958. In 1977 the production of sodium percarbonate (PCS) was transferred to Warrington from the Luton site. Production line 1 produced PCS and lines 2,3 and 4 PBS-4. Later line 2 was decommissioned leaving only two lines for PBS-4 production. In 1990 the

Persalts Monohydrate plant was commissioned to produce perborate monohydrate (PBS-1).

The PBS-4 plant produces approximately 3,600 tonnes of product per annum (Figure 6.4). An ore containing boron, known as "tincal", is reacted with 47% sodium hydroxide to produce sodium metaborate solution (MBS) which is pumped to settling tanks. This extracts the boron from the ore resulting in sludge formation for disposal by landfill.

Figure 6. 4: Flow diagram for the manufacture of persalts at Solvay Interox Ltd



The MBS is pumped to dissolution tanks for reacting with hydrogen peroxide. This involves a two stage stirred reactor system. The heat of the reaction is removed by glycol coolant circulated through coils in the reactor. Magnesium sulphate, added to the feed peroxide, stabilises the product and prevents caking. The slurry is centrifuged to remove the liquid component, the "mother liquor". This is retained for recycling although surplus overflows to drain. The solid "wet cake" is fed to two parallel fluidised bed drier systems. Air for drying is heated using low and intermediate pressure steam. Dust laden air resulting from the drying process is passed through cyclones and a scrubber. This results in the release of 4 tonnes of particulates per annum to atmosphere. Surplus mother liquor from centrifuges, well water from the line 3 wet scrubber and factory floor washings mix in the drains before discharge to the River Mersey.

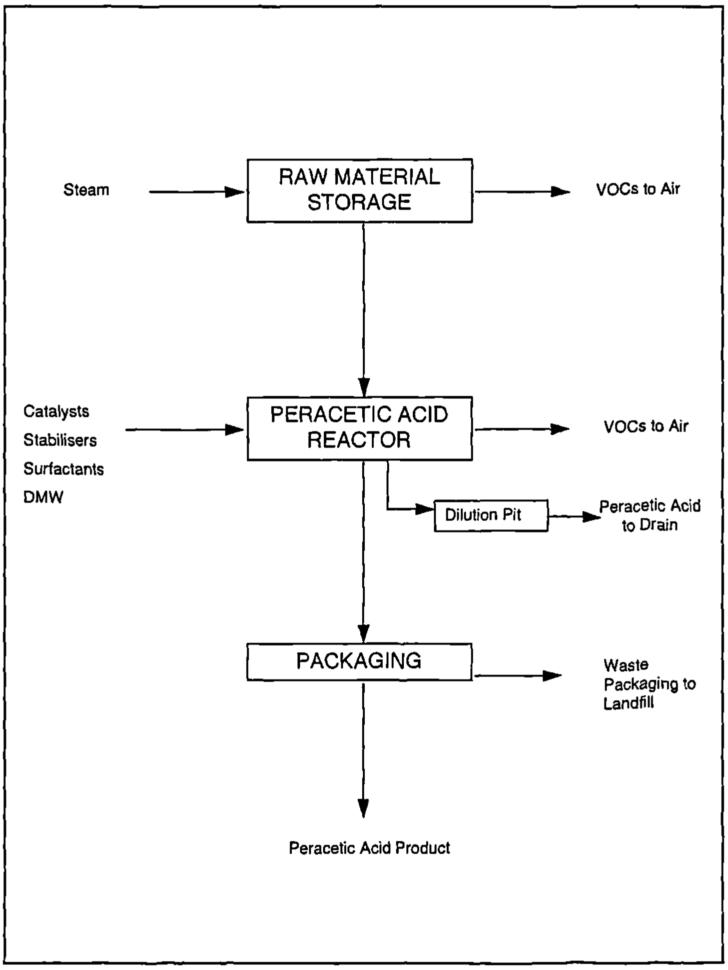
6.5.4 The Peracetic Acid Plant

Peracetic acid was first prepared on the Warrington site in 1956. Product is manufactured continuously as well as in one tonne batches. The batch process involves the addition of de-mineralised water to a reactor before the carefully controlled addition of glacial acetic acid and hydrogen peroxide (Figure 6.5). Sulphuric acid catalyst, stabilisers and surfactants are added manually. As the reaction is reversible mixtures of reactants and products are obtained. This is fed by gravity from the reactor into containers and stored on site until equilibrium is attained, taking up to five weeks depending on the grade. As acetic acid freezes at 18^0C storage tanks and pipework are heated with hot water from a tank warmed by low pressure steam. During bulk production, reactants are added direct to a road tanker and stored on site until the product reaches equilibrium. This method of production is suitable for only a limited range of grades due to hazard considerations.

Approximately 4 tonnes per annum of acetic acid and peracetic acid, classified as Class B VOCs, are released from the reactor and vessel vents (Solvay Interox, 1993a). Small quantities of hydrogen peroxide vapour, not a prescribed substance for release to air, is also released from process vessels and storage tanks.

The main effluent source is the discharge of approximately 5kg of product remaining in the reactor after every batch (Solvay Interox, 1993a). It is discharged to surface water drains where it mixes with other site effluents prior to a consented discharge to the River Mersey.

Figure 6. 5: Flow diagram for the manufacture of peracetic acid at Solvay Interox Ltd



6.5.5 The Boiler House

The Boiler House was converted from coal to gas in 1995 and is currently operated by BP Energy through a contractual agreement. The combustion plant comprises of two natural circulation boilers with a net rated thermal input of 70 MW. The boilers supply steam, at a pressure of 2,500 kPa and a temperature of 380^{0}C, for use in the manufacturing processes and space heating (Solvay Interox Ltd, 1994a). A small amount of electricity is produced by a steam turbine generator.

Each boiler is able to run on both oil and natural gas. This enables the plant to automatically switch to oil in the event of an interruption to the gas supply. Natural gas is piped onto site whilst gas oil is stored in a 452m^3 bunded tank from where it is pumped to the burners (Solvay Interox Ltd, 1994a).

Combustion results in flue gas releases of sulphur dioxide, oxides of nitrogen, carbon dioxide and carbon monoxide. Liquid effluents, consisting of boiler blowdown water and effluents from the site Demineralised Water Plants, are collected in the drainage system where they mix with effluents from the other manufacturing plants prior to discharge to the River Mersey.

6.6. MANAGEMENT PRACTICES PRIOR TO BS 7750

A review of existing activities against the requirements of BS 7750 identified many elements of an EMS to be in place (Table 6.1). Substantial environmental information was available and the Environment Group had a good understanding of legislation and the environmental impacts of the company's activities. Three IPC applications had recently been submitted to HMIP containing details of environmental effects and management practices. A draft IPC application had also been prepared for the a fourth plant should it become subject to IPC in the future. In addition Anglo Baltic Consultants carried out a substantial loss minimisation review of the processes in 1990. An environmental policy, objectives, improvement programme, environmental training and several environmental procedures had been established by 1994.

Table 6. 1: Position of Solvay Interox Ltd compared to BS 7750 in April 1994

BS 7750 Requirement	Existing Position
Environmental management system	Some documented procedures
Environmental policy	Policy & philosophy developed in 1992
Responsibility, authority and resources	Responsibilities not formally documented
Verification resources and personnel	Verification requirements identified
Management representative	No management representative assigned
Personnel, communication and training	Some ad-hoc training provided although no formal analysis of needs or training plan
Contractors	Engineering procedures covered contractor control.
Communications	Procedures for customer enquiries and environmental complaints in place.
Environmental effects evaluation	Environmental effects of accidental releases had been identified and assessed.
Register of regulations	No documented register or procedure.
Objectives & targets	Objectives included in environmental reports and target dates for improvements had been developed.
Management programme	IPC improvement programme had been developed and agreed with HMIP.
Manual	Responsible Care & Loss Prevention manual covered some elements of environmental management.
Documentation	Document control procedures were in place for ISO 9000.
Control	Standard operating procedures were in place for ISO 9000.
Records	Records were kept although there were no procedures for record keeping.
Audits	Checklists for environmental auditing had been developed.
Management reviews	No formal review of the system

6.7. IMPLEMENTATION OF BS 7750 / ISO 14001

The first stage in the implementation of a formal EMS was to develop a project plan (Appendix 2.1). Timescales were based on urgency rather than their order of appearance in BS 7750. A team, established in October 1994, met over two years to review progress with EMS implementation and investigate how business management systems could be integrated. The Health, Safety and Environmental Integration Group and consisted of six staff:

- The Technical Manager
- The Senior Environmental Advisor
- The Safety Services Manager
- The Senior Hazards Advisor
- The Technical Department Quality Advisor
- Teaching Company Associate

6.7.1 Preparatory Environmental Review

BS 7750 and ISO 14001 recommend an environmental review only where there is no existing EMS in place (Chapter 4). As Solvay Interox had a good understanding of their environmental impacts and position with regards to legislation there was little added value in carrying out a full environmental review. This will be the case for many larger companies, especially those who have been required to submit detailed IPC applications. To ensure awareness of the information available it was necessary to collate data for use during the project.

6.7.2 Environmental Management System (BS 7750 Clause 4.1)

The first specific requirement of BS 7750 and ISO 14001 is for the preparation and implementation of a system of documented procedures and instructions (Chapter 4). In 1992 the Environment Group established procedures for responding to environmental complaints and enquiries. In 1993 they issued an *Environmental Hazards Management Manual* containing procedures for handling environmental releases, tanker deliveries and waste disposal (Solvay Interox Ltd, 1993e). In the same year procedures for environmental process hazard reviews and waste minimisation reviews were written by the Technical Manager (Solvay Interox Ltd, 1993c and 1993d).

To meet the EMS standards the existing system of procedures and instructions required expansion and consolidation. A decision was required regarding potential integration with the existing ISO 9002 quality system or the *Responsible Care and Loss Prevention (RCLP)* system for health and safety. An alternative would be to have the EMS as a separate stand-alone system.

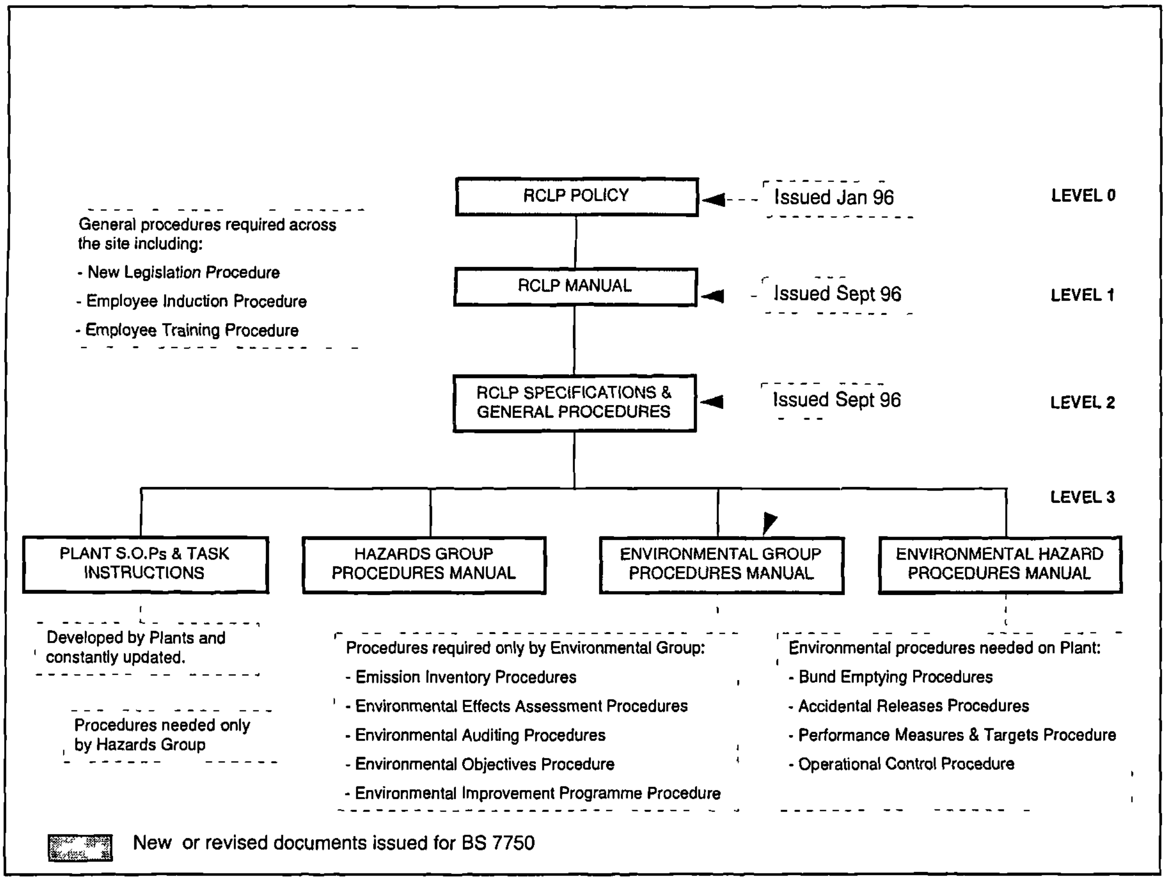
The ISO 9002 system, consisting of a policy, a management manual, general procedures and standard operating procedures (SOPs), was coordinated by the Quality Manager. There was scope to utilise the general procedures covering elements common to BS 7750, including training, document control, auditing and non-conformances. The plant specific operating procedures would also form part of the EMS as they covered activities such as process monitoring and calibration.

The Safety Manager had made significant progress in documenting a *Responsible Care & Loss Prevention* (RCLP) system for health, safety and environmental management. This consisted of a management manual plus specifications for the 21 elements of the International Safety Rating System (see Goodchild, 1994) (DNV, 1994). Health and safety formed the focus of the RCLP system which consequently had substantial weaknesses compared to BS 7750.

Initially the *Health, Safety and Environment Integration Group* planned to integrate ISO 9002, BS 7750 and RCLP into one system. Concern was expressed over whether the profile of health, safety and environment would be sufficiently high should it be integrated with the quality system. The ISO 9002 system was well established and understood. Any substantial change would be difficult to implement and require substantial staff training to ensure quality levels were maintained. In January 1995 the company decided to operate the ISO 9002 and RCLP systems separately with the EMS incorporated into the RCLP system. Established quality techniques for document control, training, non-conformance reporting and auditing would be utilised by the

RCLP system. At an operational level each plant's standard operating procedures would cover all business elements including quality, health, safety and the environment. The revised structure of the RCLP system consisted of four documentation levels, incorporating all existing health, safety and environmental procedures including the *Environmental Hazard Procedures Manual* and *COSHH Manual* (Figure 6.6).

Figure 6. 6: Revised system structure for the Responsible Care & Loss Prevention (RCLP) management system at Solvay Interox Ltd (Solvay Interox Ltd, 1996a)



6.7.3 Environmental Policy (BS 7750 Clause 4.2)

The existing environmental policy, developed in 1992, contained several weaknesses compared to BS 7750 (Figure 6.7). There was no commitment to continual improvement or to making environmental objectives publicly available. In addition the policy had not been widely publicised and few employees were aware of the contents (pers. comm. McDonagh, 1994).

A revision of the environmental policy began in January 1995, several months after the start of the project. As BS 7750 required consistency with the *Solvay Group's Responsible Care Policy* (Figure 6.8), the impacts of distribution, use and final disposal of products and communicating openly with external parties needed to be addressed.

Figure 6. 7: Solvay Interox's 1992 environmental policy (from Solvay Interox Ltd, 1994b)

- **Solvay Interox Ltd is committed to an active and ongoing plan to reduce waste at source. "Waste" embraces chemicals lost from processes to river, to sewer, to the atmosphere, to landfill and to incineration, noise and energy.**
- **We actively and continuously consider all available options for the recycling and re-use of waste, on site and off site.**
- **We consider disposals of waste to sewer, river, atmosphere or land as the last resort to be implemented. In this case, effective engineering control measures, procedural controls and monitoring systems shall be employed to ensure that such disposal causes the least practical impairment to the environment and conforms to national and local regulations.**
- **We recognise the importance of fostering good relationships with local residents and therefore aim to cause them no offence by our activities.**
- **We will co-operate in an official and positive manner to all requests for information and advice from the public and from environmental pressure groups.**
- **We will provide appropriate advice to customers on safe handling, use and disposal of the company's products.**
- **We will promote research into the development of environmentally sound processes and products.**
- **Our environmental policy will be reviewed at least annually.**

Employee commitment and involvement was considered essential. Key members of staff were interviewed and invited to suggest improvements to the 1992 policy. The general consensus was that it required summarising and additional commitments adding for suppliers and contractors; training and communications; setting performance targets and publishing progress against objectives.

Policies from other companies were used to develop a checklist of issues requiring consideration (Appendix 2.2). This was completed with managers to ensure matters of importance were not overlooked. For each proposed commitment it was ensured that evidence was available to demonstrate compliance to external assessors.

Figure 6. 8: Solvay Group's Responsible Care Policy (Solvay Interox Ltd, 1994b)

- **To apply a formal policy for protecting man and the environment, defined at the highest level and supported by all concerned.**
- **To take into account what happens to our products after use. To encourage recycling and promote correct disposal.**
- **To continue reduction of the impact of production facilities on the environment.**
- **To assess the situation and quantify the progress made in protecting and mastering the risk of accidents.**
- **To participate in defining future objectives and in developing standards.**
- **To ensure that the effects of our end products, their distribution and their use is quantified and positive as far as people and the environment are concerned and that the adverse effects are minimal.**
- **To provide information on matters affecting health, safety and the environment in a spirit of open dialogue and mutual respect.**

The revision of the policy raised the key issue of whether to integrate it with the quality or health and safety policies. Initially a separate policy emerged but it became apparent that the majority of commitments could also be applied to health and safety. This was particularly relevant as the health and safety policy also required updating, it still bore the name of the previous owners "Laporte". In comparison the quality policy was well established and much effort had been dedicated to ensuring employees understood its contents. It would be more efficient to develop an integrated health, safety and environment policy to run in parallel with the quality policy. This would minimise effort, make the most efficient use of resources and be consistent with the CIA's *Responsible Care Guiding Principles*. The new combined policy was published in January 1996 (Figure 6.9) approximately a year after the first interviews. The time taken to achieve agreement in a large organisation was offset by the benefits of many people being involved, increasing ownership and awareness.

Figure 6. 9: Solvay Interox's Responsible Care & Loss Prevention Policy for Health, Safety and the Environment (Solvay Interox Ltd, 1996a)

Solvay Interox Ltd is committed to continuous improvement of its performance as a responsible and environmentally caring organisation in line with the SOLVAY Group's "Responsible Care" principles.

Our policy is to:

Ensure that health, safety and environmental matters will always be a high priority

Provide and maintain safe and healthy working conditions, equipment and systems of work for all our employees in an environmentally acceptable manner with minimum risk to health and to protect others who may be affected by our activities.

Comply with and where appropriate exceed the requirements of all relevant laws, regulations and codes of practice.

Practice the efficient use of materials and natural resources by applying the best practicable options to all our activities.

Understand and assess the risks of our activities and control them to prevent undue risk to mankind or the environment.

Promote cooperation and good communication between and at all levels in the Company to ensure that everyone enjoys a safe and healthy workplace.

Ensure our employees and contractors have appropriate supervision, experience and training to enable them to competently meet their responsibilities in safeguarding the environment, the health and safety of themselves and others affected by their actions.

Set demanding targets and routinely measure our performance in health, safety and the environment. Publish progress against our objectives.

Provide information for employees, our neighbours, the public and appropriate authorities by regular liaison through a spirit of open dialogue and mutual respect paying special attention to address their concerns.

Promote the environmentally beneficial applications of our products. Advise and educate customers in their safe use, transport, storage and disposal.

Encourage our suppliers, contractors and customers to apply health, safety and environmental standards equivalent to our own.

A later review of the policy in September 1996 concluded that no changes were required to meet ISO 14001. As required a commitment to comply with all relevant laws, regulations and codes of practice had been included. The statement to understand, assess and control environmental risks was considered sufficient to meet ISO 14001's requirement to include a commitment to the prevention of pollution.

6.7.4 Organisation and Personnel (BS 7750 Clause 4.3)

Environmental responsibilities were clearly understood although, with the exception of those included in procedures and job descriptions, they had not been formally documented. The Environment Group was responsible for providing support and advice to the manufacturing areas regarding environmental protection and legislation. At an operational level responsibility for the implementation of procedures and guidelines lay with the Plant Managers and Team Leaders. The majority of environmental monitoring was carried out by the laboratories although in some cases it was completed by the individual plants.

Each procedure developed for the EMS specified responsibilities which were summarised in the Management Manual (Chapter 6.7.10) (Solvay Interox Ltd, 1996a). The Senior Environmental Advisor was designated as the Management Representative responsible for ensuring that the requirements of BS 7750 were implemented and maintained.

The integration of health, safety and environmental systems raised issues over responsibilities for maintaining the integrated documentation. As a temporary measure a contractor was used for this purpose, although in the long-term responsibilities for reviewing and updating documentation would need to be clearly defined.

Mechanisms previously adopted for environmental training included on site training modules, team meetings and promotional activities. Courses had been organised on general environmental awareness, IPC and environmental auditing. To date this had largely been delivered as required, rather than in accordance to a specific training plan or training needs analysis (pers. comm. McDonagh, 1994).

To meet BS 7750 a formal assessment and documentation of training needs was required. A matrix of job descriptions against training needs formed the basis for future training initiatives (Appendix 2.3). Procedures specified the responsibilities and timescales for analysing training needs and delivering training. They also required an environmental information pack to be explained to each new employee during their compulsory safety induction within the first week of employment. This contained information on environmental hazards on site and emergency responses. The policy and environmental objectives (Chapter 6.7.8) were included with details of the previous years performance.

The activities of contractors working on site were already carefully controlled by the Engineering Department. The CDM Regulations 1993 require a safety case to be established for all new developments. The substantial *Site Safety Procedures and Regulations for Contractors Working on the Warrington Site* included instructions on waste handling and emergency plans. The associated procedure, *Safety Induction for Contractors*, required all contractors to be shown a video explaining how to handle spills of chemicals. This information was also included in the *Contractor and Employee Safety Handbook* given to every contractor on site. Contractors were required to sign to verify they had attended the induction and understood its contents. A review of these existing procedures considered them sufficient to meet BS 7750 in ensuring that contractors met the requirements of the EMS.

6.7.5 Communications (BS 7750 Clause 4.4.1)

Procedures had been established in 1992 for recording and responding to environmental complaints and requests for environmental information. These were effective in ensuring complaints were investigated and corrected, and feedback provided to the complainant. To ensure compliance with BS 7750 these procedures were reviewed and updated as necessary. An additional procedure was established for undertaking an annual analysis of complaints as a mechanism for measuring environmental performance (Solvay Interox Ltd, 1996b).

6.7.6 Environmental Effects Evaluation and Register (BS 7750 Clause 4.4.2)

A substantial volume of information on environmental effects was readily available. IPC applications detailed environmental releases, storage facilities and resource consumption (Chapter 6.6). In addition, effluent streams and air releases were routinely monitored to meet legislation. In 1993 detailed environmental process hazard reviews identified and assessed the risk of accidental releases from valves, vents and spills. These identified potential releases to all environmental media and quantified their probability, frequency, severity and consequence (Table 6.2-6.5).

Table 6. 2: Scoring the probability of an event becoming an environmental hazard /release (PER) at Solvay Interox Ltd (Solvay Interox Ltd, 1993c)

Score	*Description*	
0	Impossible:	cannot happen under any circumstance
1	Unlikely:	though conceivable
2	Possible:	but unusual
5	Even chance:	could happen
8	Probable:	not surprised
10	Likely:	only to be expected
15	Certain:	no doubt

Table 6. 3: Scoring the frequency of an event occurring (FE) at Solvay Interox Ltd (Solvay Interox Ltd, 1993c)

Score	*Description*
0.1	Infrequently
0.2	Annually
1.0	Monthly
1.5	Weekly
2.5	Daily
4	Hourly
5	Constantly

Table 6. 4: Scoring the severity of an environmental hazard / release (SER) at Solvay Interox Ltd (Solvay Interox Ltd, 1993c)

Score	*Description*
0.1	Trivial releases to all environmental media or minor (based on cost of materials and disposal) releases contained.
0.5	Releases resulted in slight breach of consent limits (to all environmental media) with respect to both quantity and time or major (based on cost of materials and disposal) releases contained.
1	Nuisance releases resulted in affecting neighbours.
2	Releases of dissolved chemicals resulting in severe breach of consent limit for surface waters or air respectively.
4	Releases of separate phase chemicals resulting in severe breach of consent limits for surface waters and air respectively.
8	Releases causing permanent environmental damage (eg inorganics, metals in the environment or chemicals/oils in the ground).
15	Releases of listed hazardous (toxic, flammable) chemicals to all environmental media.

Table 6. 5: Scoring the consequences of an environmental hazard / release (EER) at Solvay Interox Ltd (Solvay Interox Ltd, 1993c)

Score	*Description*
0	Releases contained within the site.
2	Releases reaching site's boundaries
4	Chemicals reaching distances of up to 1 miles from the site's boundaries.
8	Chemicals reaching between 1-3 miles or liquid releases to shallow groundwaters.
12	Chemicals reaching over 3 miles or liquid releases to deep groundwaters.
NOTE: Distances are measured to the furthest point in the path of the release, at which the concentration of chemicals is such that they cannot threaten the life or health of any living creature or they cease to be a nuisance to neighbours.	

The product of the four values gave an environmental hazard rating number (EHRN) indicating the overall degree of environmental risk. Hazards were classified according to their EHRN (Table 6.6).

(EHRN) = (PER) x (FE) x (SER) x (EER)

Table 6. 6: Categories of environmental risk at Solvay Interox Ltd (Solvay Interox Ltd, 1993c)

Environmental Risk	***EHRN***
Acceptable	0-1
Very low	1-5
Low	5-10
Significant	10-50
High	50-100
Very High	100-500
Extreme	500-1000
Unacceptable	over 1000

The number of potential release situations illustrates the complexity of the site's operations. Over a thousand environmental risks, including 372 potential failure situations on the caprolactone plant alone, were identified and assessed. This led to the prioritisation of 63 improvement projects, totalling a capital expenditure of £1,600,000 to be implemented during the period 1994-1998.

Also in 1993, over a year before commencement of the EMS project, extensive reviews of waste streams, including emissions to air, releases to water, solid waste and resource consumption, had been completed for each process. Several hundred waste streams were identified across the site, including 53 on the persalts plant. These were prioritised according to their cost implications.

The environmental process hazard reviews and waste minimisation reviews demonstrate that substantial resources had been assigned to identifying environmental risks and releases prior to BS 7750. These contributed towards meeting the environmental effects requirement of the standard but did not cover all the necessary elements (Chapter 4). The environmental process hazard reviews were effective in assessing the risk of accidental releases and waste minimisation reviews identified opportunities for cost savings. Neither system addressed the risks from normal activities, such as routine emissions, past activities or planned activities. Resource consumption, nuisance and indirect effects from suppliers, customers, contractors, products and transport had also not been included.

The methodology for assessing accidental releases could not be applied to less tangible effects which were not associated with the accidental release of chemicals. An alternative system was required to identify and assess effects not previously covered by the environmental process hazard reviews.

It was necessary to test different techniques to determine one applicable to the diverse range of effects. Risk assessment, based on probability and consequence, is often used to assess effects (Chapter 4 and 5). In this case, as the scope was limited to normal operating conditions, the probability is certain and the assessment needed to focus purely on the consequences. It was decided to experiment with different methodologies *using the caprolactone plant as a trial.*

A list of direct and indirect environmental effects resulting from the normal operation of the process was compiled as required by BS 7750. This included emissions to air, releases to water, solid waste, contamination of land, resource consumption and nuisance. A checklist of four criteria defined significant effects as those subject to regulatory control, a policy commitment, attracting complaints or likely to involve a commercial or financial threat. As the majority were either subject to a policy commitment or controlled by legislation a large number were identified as significant. The weakness of this technique was its failure to differentiate between their relative significance. As the policy contained a commitment to reduce waste and increase recycling this implied all waste generated was equally significant regardless of the quantity or toxicity of the substance. An additional weakness was that effects meeting legislative requirements and those causing a breach of the law were both considered to be equally significant.

Effects required rating to determine their relative significance. The second methodology involved scoring from 1 to 10 against the potential to breach legislation; cause complaints or concern of stakeholders; involve a commercial or financial threat to business security and cause environmental damage. Rating the environmental consequence involved consideration of the quantity released, toxicity of the substance and disposal route. The overall significance was derived from the product of the individual scores and effects rated on a scale of 1 - 10,000.

A problem with this technique was that effects with a high score in only one category where not considered to be significant. A breach of a consent would score 10 on the legislative category but possibly as little as 1 for the others, giving a score of 10 from a maximum of 10,000. This misleading rating detracted from the severity of the effect. The methodology was amended to ensure that if a high score occurred in any of the categories the overall rating would be high. The subsequent procedure for assessing effects was divided into three stages (Solvay Interox Ltd, 1996b) (Figure 6.10).

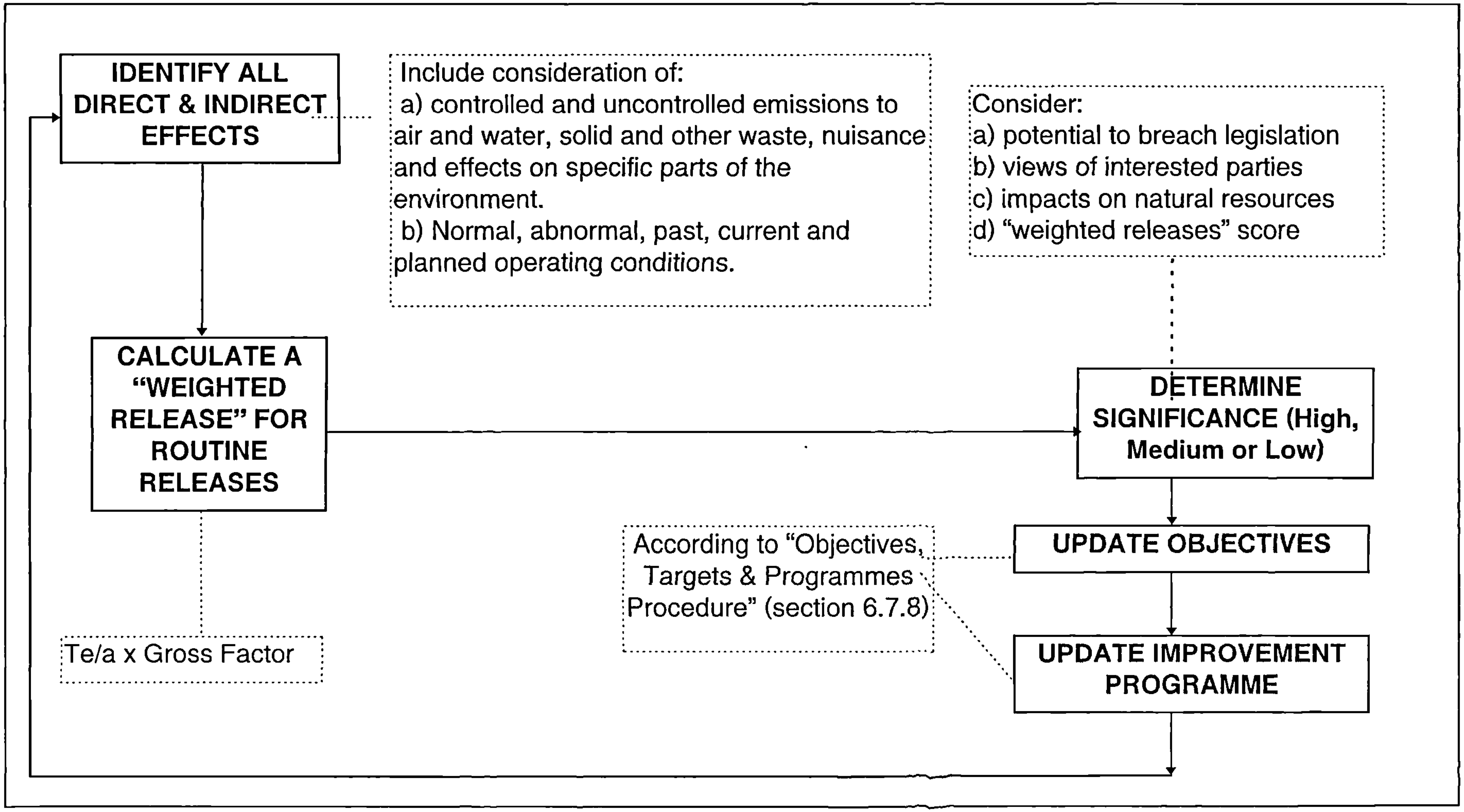
Stage 1: Identification of Environmental Effects

The site was split into six areas including a general area covering activities not associated with a particular process including engineering, maintenance, utilities, offices, support activities and transport (Table 6.7). Details of emissions to air, releases to water and waste were obtained from information routinely compiled by the Environment Group including returns to the Solvay Group Head Office (DCT), HMIP and the Chemical Industries Association (CIA). Consumption of raw materials, energy and water were obtained from the annual accounts produced by the Finance Department.

Table 6. 7: Division of site for environmental effects assessment

1.	Auto-Oxidation Plant (including Crude, New DMW, Tank Farm)
2.	Caprolactone Plant
3.	Peracetic Acid Plant
4.	Persalts Plant
5.	New Boiler House (including Old DMW)
6.	Site General

Figure 6. 10: Flow chart for environmental effects assessment of normal activities (Solvay Interox Ltd, 1996b)



The complexity of the plant and operations required the scope and boundaries of the effects assessment to be clearly defined. Numerous existing and potential release points had been identified during the environmental process hazard and waste minimisation reviews. On the AO Plant alone over 450 vents emitted substances routinely to atmosphere (Solvay Interox, 1993a). This necessitated emissions to be split into manageable units which could be easily compared to legislative limits. This meant that each effect may be derived from numerous individual emission sources.

Besides defining the level of detail of the effects assessment it was also necessary to define which effects to incorporate. The terminology of BS 7750 gives implementing organisations flexibility in drawing the boundaries of their system (Chapter 4). It is at their discretion to decide which effects they are able to control or be expected to influence. This requires consideration of the aims of the system and overall strategy of the company (Chapter 4). The system at Solvay Interox was largely aimed to minimise liabilities and ensure compliance, the assessment needed to focus on direct effects. Longer term issues such as the design of products and the activities of customers were noted but not investigated in any detail at this stage.

Stage 2: Assessing the significance of environmental effects

A technique for monitoring environmental performance developed by Rhone Poulenc and endorsed by the Chemical Industries Association, Environmental Indexing (C.I.A 1995), was used routinely at Solvay Interox. It was expanded to evaluate the significance of all emissions to air, releases to water and waste. The quantity of the substance released is multiplied by a subjective "gross factor" based on toxicity and disposal route (Appendix 2.4).

$$\boxed{\text{Significance} = \text{Tonnes / year} \times \text{Gross Factor}}$$

This gives a "weighted release" which determines the significance of the different discharges. The sum of the individual weighted releases gave an overall indication of the impact of the process (Figure 6.11). If this is divided by the quantity of product produced, periods of plant shut-down are taken into account (Figure 6.12) (Table 6.8).

This technique is also useful for performance measurement. By repeating the process each year and comparing results, changes in performance can be monitored.

Figure 6. 11: Total weighted releases (te/a x gross factor)

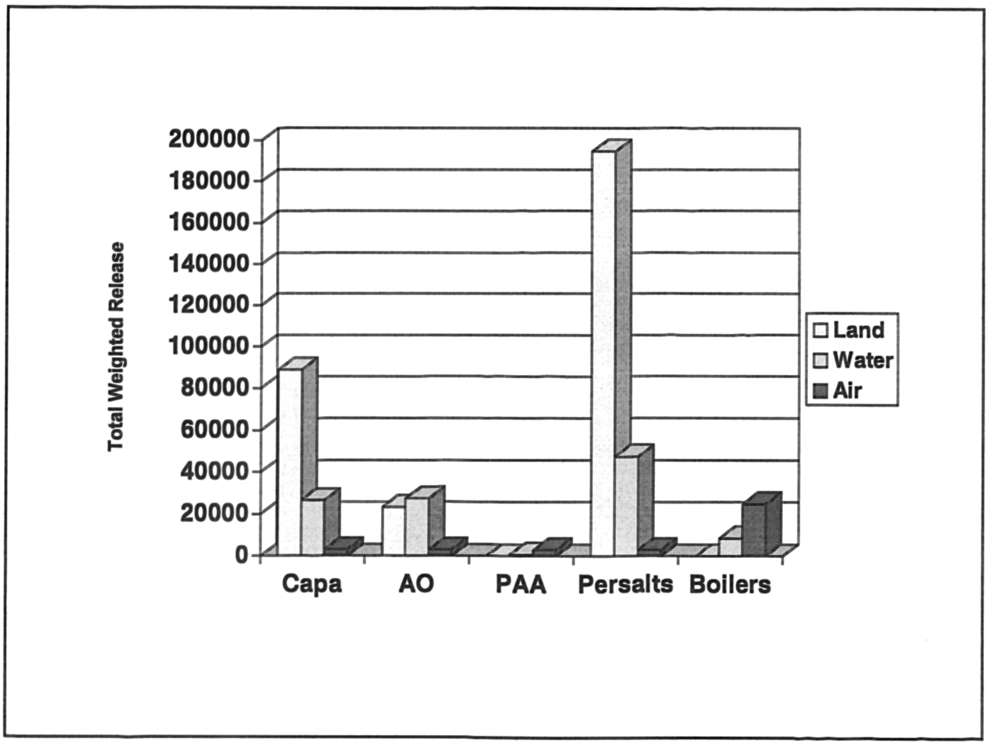


Figure 6. 12: Total weighted releases per 1000 te of product (Te/a x gross factor / 1000)

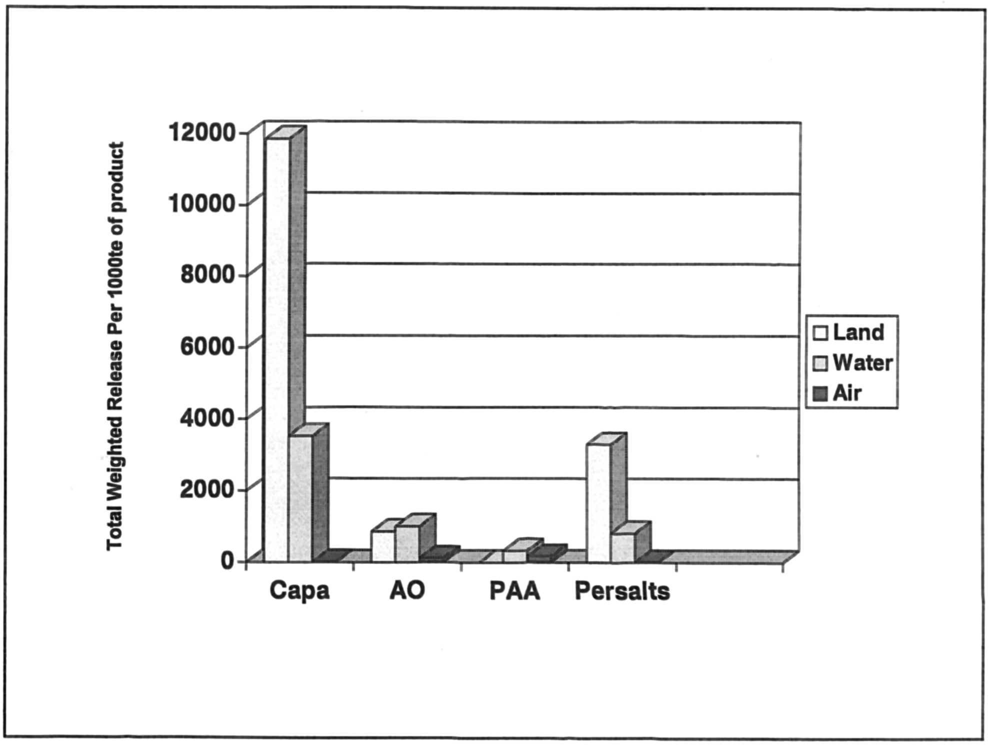


Table 6. 8: Total annual weighted releases versus production figures (1994)

Process	Total Weighted Release	Production (te/annum)	Weighted release per thousand tonne of product
Capa	115568	7,500	15407
AO	51352	27,500	1974
PAA	1189	409	490
Persalts	242169	59,000	4103

Besides the volume and toxicity of releases any likelihood of infringing legislation increases their significance. The reactions of the general public, especially local residents, also contribute towards significance. The quantity and impact of resource consumption also required consideration. These criteria, together with the weighted release, were used to rate significance (Table 6.9). Information relating to environmental effects was consulted during the assessment process (Table 6.10).

Table 6. 9: Determining significance of environmental effects at Solvay Interox Ltd (Solvay Interox Ltd, 1996b)

RATING	CRITERIA
High	High potential to breach legislation High potential to cause offence to local residents High level of public opinion High impact associated with resource usage Weighted release score > 10,000
Medium	Medium potential to breach legislation Medium potential to cause offence to local residents Medium level of public opinion Medium impact associated with resource usage Weighted release score 3,000 - 10,000
Low	No potential to breach legislation No potential to cause offence to local residents No level of public opinion Low impact associated with resource usage Weighted release score < 3,000

Table 6. 10: Information used to evaluate significance of effects

• Discharge consents from HMIP and North West Water
• IPC Authorisations (Solvay Interox 1993a, 1993b)
• Hazard ratings of raw materials
• Incident reports
• Environmental complaints

A team of three people consisting of the Senior Environmental Adviser, a placement M.Sc post graduate and the author met to determine the significance of the company's environmental effects. A consensus was reached regarding the appropriate significance rating. This ensured consistency and standardisation of the assessment. This would also be the case for determining revisions to the register which was to be reviewed on an annual basis.

The environmental effects register detailed the classification, process area, source, environmental consequence, size and the significance rating of each effect (Appendix 2.5). Of the 250 effects identified, 22 were rated of high significance and prioritised for immediate action (Table 6.11) (Chapter 6.7.8 and 6.7.9). The majority of these were significant due to their potential to breach legislation or cause local residents to be concerned.

6.7.7 Register of Legislative, Regulatory and Other Policy Requirements (BS 7750 Clause 4.4.3)

The Environment Group, responsible for communicating changes in legislation to the manufacturing areas, consulted many external business publications to identify changing legislation (pers. comm. McDonagh). In addition the company's Research & Development Department, in Widnes, maintained a library of legislation and published monthly updates.

Table 6. 11: Environmental effects of high significance at Solvay Interox Ltd

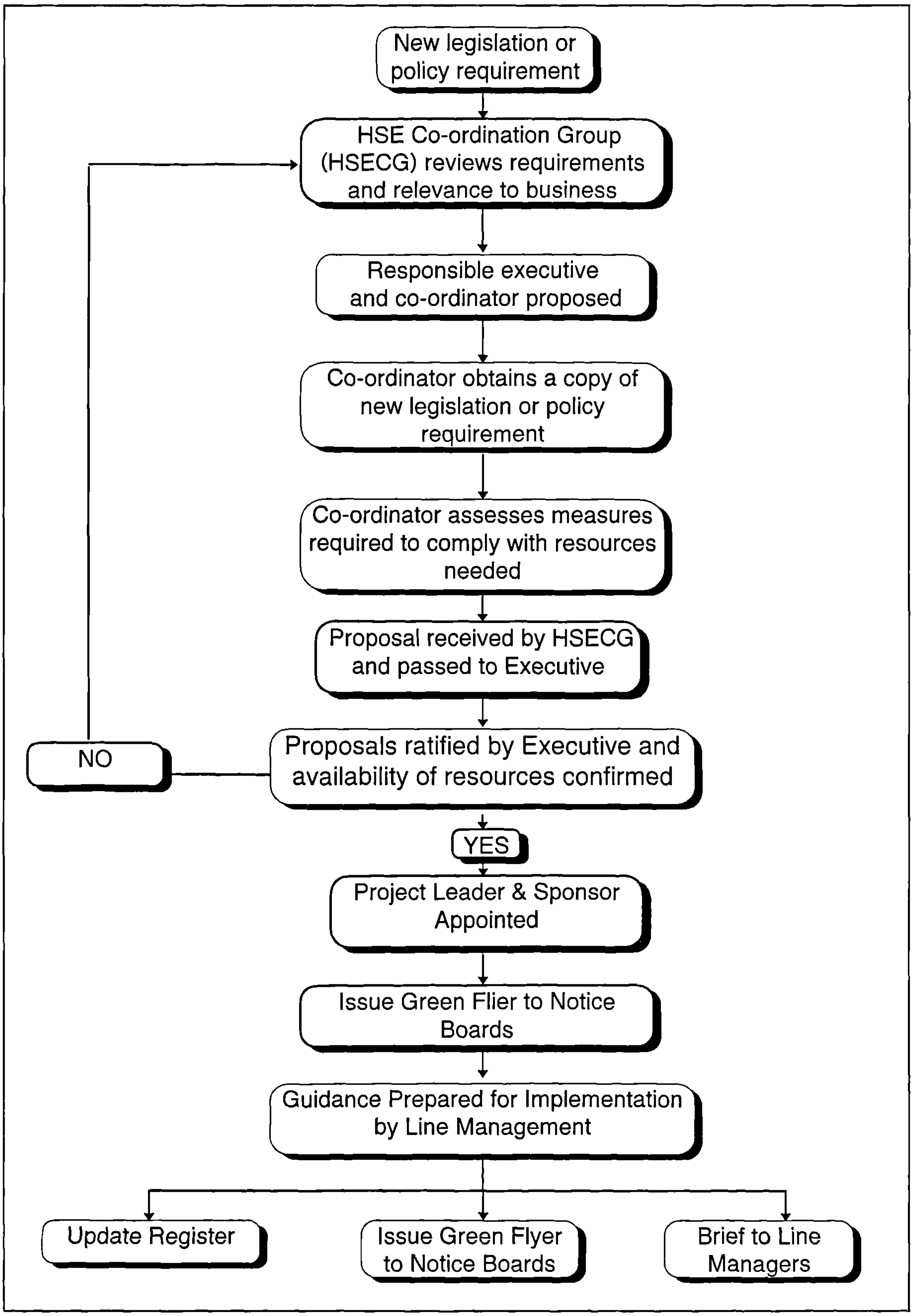
Area	Effect	Explanation
Capa Plant	Flow rate of process effluent	Potential to cause a breach of discharge consent
Capa Plant	Production of caprolactone residue waste	Weighted Effect > 10,000
AO Plant	Chemical oxygen demand (COD) of process effluent	Weighted Effect > 10,000
AO Plant	pH of process effluent	Potential to cause a breach of discharge consent
AO Plant	Production of AO tar waste	Weighted Effect > 10,000
AO Plant	Potential ground contamination	Potential to cause a breach of legislation.
Boiler House	Carbon dioxide release to air	Weighted Effect > 10,000
Boiler House	pH of effluent from old DMW Plant	Potential to cause a breach of discharge consent
Boiler House	Potential leaking effluent pit	Potential to cause ground contamination and breach legislation.
PAA Plant	VOCs from transfer and bulk storage tanks	Potential to attract complaints due to pungent odour.
PAA Plant	Reactor dump during potential emergency situations	Potential to cause a breach of discharge consent
Persalts Plant	Production of tincal sludge	Weighted Effect > 10,000
Persalts Plant	Suspended solids in PCS Effluent	Potential to cause a breach of discharge consent
Persalts Plant	Alkalinity of PBS Effluent	Potential to cause a breach of discharge consent
Persalts Plant	Noise from dryers	Potential to attract complaints
Site General	HGV movements on Taylor Street	Potential to attract complaints
Site General	Accidental releases from tanks, pipes etc due to lack of containment	Potential to cause a breach of discharge consent
Site General	Accidental releases from tanker loading/off loading activities	Potential to cause a breach of discharge consent

The Environment Group's understanding of legislation and their responsibility to keep abreast of changing legislation needed documenting to comply with BS 7750 (BSI, 1994a). The complexity of the site operations meant that a substantial quantity of legislation governs the processes. A comprehensive review identified 110 pieces of legislation (supported by 50 guidance documents from HMIP, NRA, DoE, HSE) relevant to the company's activities. Copies of over 30 Acts and Regulations, not previously owned by the Environment Group, were obtained from the Research and Development Department. The Planning Department, at the Local Authority, were contacted regarding planning permissions relevant to the site. Since its establishment in the 1950s Solvay Interox had been granted 113 permissions. These sometimes contained environmental requirements, such as noise restrictions and the shielding of new developments with trees.

A register was required by BS 7750 to summarise each legislative, regulatory and policy requirement. It detailed the responsibilities imposed and the relevant site activities (Appendix 2.6). A member of the Executive Committee, with overall responsibility, and a co-ordinator, with operational responsibility, were defined for each requirement. Their responsibilities were detailed in a supporting procedure to ensure regular updating of the register and to specify the arrangements for dealing with new legislation (Figure 6. 10) (Solvay Interox Ltd, 1996b).

The integrated nature of health, safety and environmental systems meant the procedure also applied to health and safety legislation. The compilation of these registers was the responsibility of the Safety and Hazards Departments. Each register required updating annually with changes being recorded on an ongoing nature as they were identified.

Figure 6. 13: Procedure for introducing new legislation or policy at Solvay Interox Ltd (Solvay Interox Ltd, 1996b)



6.7.8 Environmental Objectives & Targets (BS 7750 Clause 4.5)

Environmental objectives were first identified in 1993 for publication in the first issue of the environmental report (Figure 6.14) (Solvay Interox Ltd, 1994b). They were supported by a seven year improvement programme containing timescales but no quantified performance targets. They were updated in 1996, after completion of the effects assessment, for inclusion in the 1994-6 Environmental Report (Solvay Interox Ltd, 1996) (Table 6.15) The National Accreditation Council for Certification Bodies requires all significant environmental effects to be managed within the system (NACCB, 1994a). Attention was required to ensure the revised objectives addressed all effects identified as significant (Table 6.11). The resulting strategic objectives were broad in nature with each addressing a number of the individual effects. This prevented a separate objective being required for each effect which would not have been practicable.

A layered approach was adopted to establish objectives and targets. Strategic objectives were supported by key targets for 1996-1998, including the commitment to reduce VOC emissions from the AO Plant by 25% (Table 6.16). At a departmental level over 60 environmental performance indicators and targets were established (Table 6.17) (Appendix 2.7). These were agreed with plant managers responsible for each area and a procedure established for annual monitoring and reviewing.

Figure 6. 14: Environmental objectives for 1993-4 at Solvay Interox Ltd (from Solvay Interox Ltd, 1994b).

Environmental Protection

- To eliminate or minimise the risk of accidental chemical releases to the environment.
- To control effluent to the sewer and waste water to the River Mersey, significantly within future consent limits.
- To control emissions to the air.
- To eliminate the risk of ground contamination.

Waste Minimisation

- To eliminate or minimise all the waste produced.

Waste Management

- To manage waste generated on the site in an effective and efficient manner and in accordance with the "Duty of Care" legislation.

Legislative Compliance

- To comply, as a minimum, with all relevant legislation.

Environmental Training

- To ensure sustainable success in environmental improvement by enhancing environmental knowledge, experience and involvement of all personnel.

Environmental Management System

- To improve environmental performance and demonstrate compliance with relevant regulations and stated policies and objectives.

Resourcing

- To ensure success of the Environmental Improvement Plan by appointing the right number of personnel with the right knowledge and experience in the Company's environmental function.

Energy Management

- To manage energy resources efficiently and effectively by minimising, and therefore conserving, this non-reusable resource.

Figure 6. 15: Environmental objectives for 1994-6 at Solvay Interox Ltd (from Solvay Interox Ltd, 1996).

Environmental Protection

- To eliminate or minimise the risk of accidental releases to the environment, including the risk of ground contamination.

Waste Minimisation & Management

- To manage energy resources and waste generated on site in an efficient, effective manner, with emphasis on waste minimisation.

Legislative Compliance

- To comply with all current and impending relevant legislation.

Environmental Management System

- To establish a formal environmental management system.

Environmental Monitoring & Targeting

- To develop a detailed understanding of our processes and activities and their impact on the environment, hence identifying areas of environmental significance where improvement is needed.

Communications & Community Relations

- To establish an ongoing programme of local community activities involving liaison with neighbours, sponsorship and support for schools, charities and environmental improvement initiatives.

Awareness / Training

- To ensure sustainable success in environmental improvement by enhancing environmental knowledge, experience and involvement of all site personnel; developing environmental design standards and exchanging knowledge and experience on Health, Safety and Environmental matters with other organisations.

Figure 6. 16: Key targets for 1996-8 at Solvay Interox Ltd (Solvay Interox, 1996)

- Successful implementation of the £4 million site environmental improvement programme.
- Finalise development of an environmental management system to the British Standard or International equivalent.
- Completion of new site sewer and full upgrade of North West Water plc's pumping station to provide treatment of existing and new process effluents and eliminate nuisance odours arising from the station.
- Establish measures and targets in all relevant areas to ensure compliance with legislation and continuous improvement in environmental performance.
- Continued development of the community relations programme through resident liaison meetings, community sponsorship and involvement in local initiatives.
- 25% reduction in volatile organic compounds (VOCs) released to air from the Hydrogen Peroxide plant.

Table 6. 12: Examples of environmental performance indicators and targets on AO Plant (Solvay Interox Ltd, 1996a)

Measure	***1996 Target***
Compliance with sewer effluent pH consent (from daily spot sample)	90%
Compliance with sewer effluent flow consent (from flow records)	99%
Compliance with IPC limit for carbon bed VOC release (from monthly sample)	90%
Average concentration of VOCs from carbon beds (from monthly samples)	< 60 mg/l
Tonnes of VOC to air from carbon beds as toluene (from monthly sample)	< 10 te
IPC Notifications to HMIP	<3
Environmental complaints related to plant operation	O
IPC operator performance rating by HMIP inspections	80%
Unjustifiable sensitive hour HGV movements	None
River effluent consent non-compliance attributable to AO Plant	O

6.7.9 Environmental Management Programme (BS 7750 Clause 4.6)

The initial seven year improvement programme established in 1991 was amended in 1994 to incorporate the requirements of Integrated Pollution Control (IPC). The resulting £4 million capital programme was designed to achieve legislative compliance and control both normal and accidental releases (Solvay Interox Ltd, 1995). Projects had been identified after consideration of IPC authorisations, environmental process hazard reviews and waste minimisation initiatives. They included the installation of a comprehensive river effluent monitoring station to provide continuous monitoring of consent parameters, with alarm features should effluents exceed consent limits (Table 6.13). The Solvay Group, HMIP and the NRA had agreed the programme and regularly monitored progress with its implementation.

Many other ongoing improvement initiatives had not been documented. To ensure all significant effects were managed these needed to be reviewed and monitored. A programme was developed detailing responsibilities, target dates and status of environmental projects (Appendix 2.8). The complexity of operations and the volume of ongoing environmental activity resulted in over 150 initiatives being listed. Ten new projects were established after consideration of the environmental effects assessment (Chapter 7). Progress with environmental projects needed monitoring every six months. This required a substantial resource input because of the volume of projects and the spread of responsibilities for projects across the company. Keeping track of projects, however, was essential to ensure environmental improvement.

Table 6. 13: Summary of IPC improvement programme at Solvay Interox Ltd (from Solvay Interox Ltd, 1995)

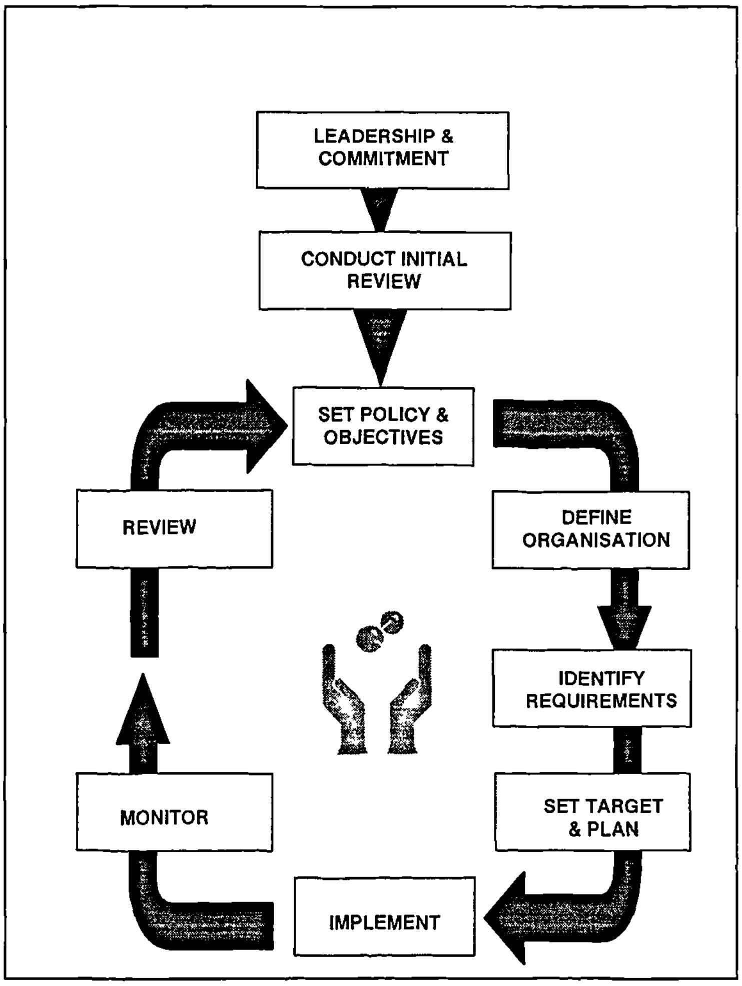
	Environmental Projects	Cost (£k)	Timescale
Prevention and containment of accidental releases:			
1	Scopes from environmental process hazard reviews	1,599	1996/7
2	Bunding sulphuric acid tank on DMW plant	42	1995
3	Bulk sulphuric acid storage for cooling water treatment	7	1996/7
4	Firewater / interceptor ponds	800	1997/8
Response to environmental emergencies:			
5	Emergency response equipment purchase	20	1995
Control of normal environmental releases:			
6	DMW effluent treatment	50	1995/6
7	Percarbonate effluent segregation and treatment	600	1995/6
8	Perborate effluent diversion to sewer	inc in 1.	1995/6
9	Improvements to North West Water pumping station	300	1995/6
10	AO effluent pH control	50	1995
11	Re-design of PAA reactor ventilation system	inc. in 1	1996
Monitoring:			
12	River outfall monitoring station	200	1996
13	Continuous VOC monitoring from AO carbon beds	50	1996
14	Improved overall site monitoring including sewer effluent	130	1996

6.7.10 Environmental Management Manual (BS 7750 Clause 4.7.1)

The draft environmental management manual developed in December 1995 described the EMS elements and summarised responsibilities. In January 1995 the Health, Safety and Environmental Integration Group decided to amalgamate the manual with the existing RCLP manual. This remained an agenda item for the next twelve months and by January 1996 a draft was complete. The format followed the model for integrated health, safety and environmental management systems published by the Chemical Industries Association (1995). It consisted of a cycle of activities similar to BS 7750 but applied to health, safety and environmental management (Figure 6.17).

The manual covered the requirements of BS 7750, the *International Safety Rating System (ISRS), Process Safety Management (PSM), Responsible Care* and the *Solvay Group Policy* (Solvay Interox Ltd, 1996a). Referencing these external standards throughout the document emphasised the importance of compliance.

Figure 6. 17: Model for responsible care management systems (from Chemical Industries Association, 1995)



6.7.11 Documentation (BS 7750 Clause 4.7.2)

It was possible to adopt the existing ISO 9002 procedure for controlling RCLP documentation. As required by the EMS standards documents were assigned an issue number, date and circulation. Those requiring updating were stamped “controlled” in red and copies, for information only not requiring updating, were stamped “uncontrolled”. When a revision was issued previous versions were removed and one copy, stamped “superseded”, kept for reference. A register of all RCLP documentation controlled by the system was maintained to ensure the most up to date versions were available where required.

6.7.12 Operational Control (BS 7750 Clause 4.8)

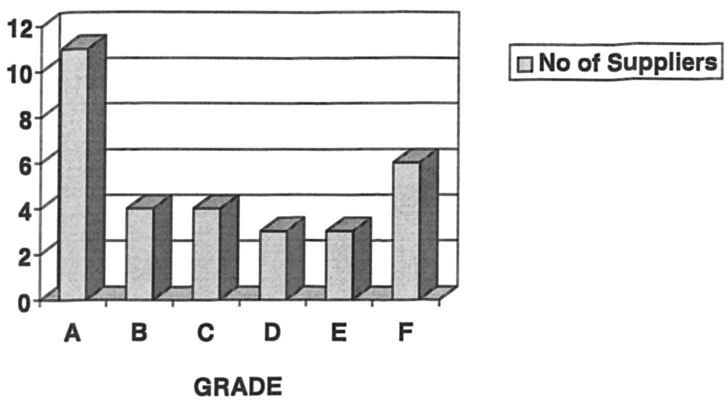
BS 7750 required the existing 400 standard operating procedures (SOPs) to be reviewed and their scope broadened to include environmental control. It was essential that these were written by the manufacturing departments who had a detailed understanding of the process. A guidance procedure was developed to assist them identify and write additional procedures (Table 6.14). Although process personnel were responsible for developing these procedures support and advice was provided by the Environment Group.

In addition to controlling environmental impacts resulting directly from the process BS 7750 also requires the control of indirect effects where this is required by the company's environmental policy. As Solvay Interox's RCLP policy included a commitment to encourage suppliers to apply equivalent health, safety and environmental standards to their own it was necessary to appraise supplier's performance. A supplier assessment questionnaire was established (Appendix 2.10) and sent to approximately 50 suppliers of major raw materials, as these would have the largest environmental effect. Questions were included on management practices, planned improvements, release data and previous prosecutions. Responses were scored from a maximum of 100 and suppliers graded from A to F (Appendix 2.11). Completed questionnaires were received from 37 suppliers and 29% achieved Grade A (Figure 6.18) (Table 6.14). Those who did not respond or sent standard replies were contacted several times and encouraged to complete the questionnaire.

Table 6. 14: Elements to be incorporated into standard operating procedures for BS 7750 at Solvay Interox Ltd

EFFLUENT CONTROL	
Hoses & wash downs	Bund emptying
Steam ejector system operation	Spillage control
Condenser performance	Leak prevention
Fire water control	Storm water control
Dumps to sewer / river	
EFFLUENT TREATMENT	
pH control	Stormwater handling
TPS operational performance	Firewater handling
Flow recorders	Impact of system maintenance
pH monitoring	System overload
TOC monitoring	Off Spec effluent handling
Spillage handling	
EMISSIONS TO AIR	
Carbon beds / scrubbers	Bursting discs
Combustion plant exhaust	Storage and relief vents
Drier exhausts	Relief vents
LEVs	Emergency venting
Tanker loading / off loading	Fugitive releases
WASTE MANAGEMENT	
Process specific waste	General waste eg packaging
Cleaning and maintenance waste	Scrap metals
Off spec product & raw materials	Waste classification ie special / non-special
Special projects	Disposal arrangements & paperwork
Construction waste	Segregation
Demolition waste	
MATERIAL HANDLING & STORAGE	
Labelling and Packaging	Construction materials eg tanks, drums
Bunding	Designated waste areas
Inventories	Drum handling eg palletisation
Segregation	Waste stockpiling
Loading / off loading	Vessel overfill protection
MISCELLANEOUS	
Design & new developments	Distribution

Figure 6. 18: Results of supplier assessments at Solvay Interox Ltd



Those who still did not respond or achieved Grade E (8%) or F (16%) tended to be small manufacturers or distributors of products. As their environmental impact was not as significant as larger companies such as BP and ICI it seemed unreasonable to expect them to have complex control systems in place. In determining whether to maintain their position on the approved supplier list other criteria, such as quality, price and reliability of delivery, also needed to be considered. Company policy regarding acceptable supplier performance required clarification at board level. At the time of the assessment a policy of encouragement through annual assessments of performance and communication was favoured. In the case of new suppliers the existing ISO 9002 assessment process was expanded to include several environmental questions. Responses to these would contribute towards the overall supplier rating and influence future choice of suppliers.

Table 6. 15: Suppliers rated Grade A at Solvay Interox Ltd

Supplier	*Product Supplied*	*Score*
BP Chemicals Ltd	Acetic Acid & Industrial acetic acid	91%
Brunner Mond + Co Ltd	Sodium Carbonate	81%
Ciba Geigy plc	Irganox 1010	89%
Collinda Ltd	Dipiclonic Acid	90%
Courtaulds Chemicals Ltd	Orthosextate	82%
DSM (U.K.) Ltd	Cyclohexanone	98%
Du Pont de Nemours (Nederland) BV	PTMEG (Terathane)	81%
Elf Atochem SA	Sodium Chlorite	88%
Exxon Chemicals Ltd	Aromatic Hydrocarbon	89%
Hoechst U.K. Ltd	Neopentyl Glycol; Di-ethylene Glycol	92%
ICI Chance and Hunt (Distributors)	Topanol	85%
Johnson Matthey plc	Palladium Chloride	82%
RWE-DEA Aktiengesellschaft	Cetyl Alcohol	92%

6.7.13 Verification, Measurement and Testing (BS 7750 Clause 4.8.2)

Several standard operating procedures relating to verification, measurement and testing were already in place. These included weekly checks of river effluent quality and daily visual checks of the outfall. Standard operating procedures were also in place for calibration and testing of quality equipment. BS 7750 required these to be expanded to cover the monitoring of all relevant process characteristics, including air emissions, effluent streams and waste generation. The calibration of monitoring and testing equipment, such as pH meters and flow meters was also required. Guidance on the additional areas to be covered in the standard operating procedures was incorporated into the operational control procedure for implementation by process areas (Chapter 6.7.12).

To monitor annual environmental performance over 100 pieces of data relating to emissions to air, releases to water, waste production and resource consumption were compiled into emission inventories. This information was required by HMIP, the Chemical Industries Association and the Solvay Head Office in Brussels. The EMS led to the development of five new procedures to ensure consistency in performance measurement. They provided instructions on data location, calculations and record keeping (Table 6. 19). A new checklist ensured all the necessary information was collected (Appendix 2.12). Data was used in the calculation of environmental performance indicators, to measure improvements (Table 6.20). This allowed trends in performance to be monitored (Figure 6.18 and Figure 6.19) (Chapter 7).

Figure 6. 19: Extract from emission inventory procedure for releases to water at Solvay Interox Ltd (Solvay Interox Ltd, 1996b)

River Mersey Effluent

Annual releases to the River Mersey are recorded on Form F1 (Appendix 1 of this procedure).

a) Total Flow (m^3/a)

Total flow to the River Mersey is assumed to remain constant at the consented level of 11,000m^3 per day which is equivalent to 4,015 x 10^3 m^3 per annum.

b) Average Parameter Concentrations (mg/l)

Average concentrations C.O.D, H_2O_2, B_20_3, suspended solids and chloride are calculated from the "Effluent Analysis Log Book" kept by the Environment Group (samples are taken once a week by the labs). The pH is quoted as the range between the minimum and maximum analysis values.

c) Corrected C.O.D Concentration (mg/l)

Analysis results for C.O.D are unrepresentative as peroxide present contributes towards the C.O.D reading. A corrected C.O.D measurement can be calculated by subtracting a theoretical proportion representing the additional C.O.D content due to the hydrogen peroxide:

Actual C.O.D (mg/l) = Measured C.O.D (mg/l) - AvOx

Where AvOx (mg/l) = H_2O_2 Concentration (mg/l) x 6/34

d) Average Boron Concentration (mg/l)

Average boron concentration is calculated from the measured average B_2O_2 concentration.

Molecular weight of B_2O_3 = 22 (2B) + 48 (3O) = 70

The B content in B_2O_3 = 22/70

Average B (mg/l) = Average B_20_2(mg/l) x 22/70

Figure 6. 20: Environmental Performance Indicators at Solvay Interox Ltd

Environmental Index
- Total Weighted Release (see Figures 6.11 and 6.12)

Environmental Complaints
- Total Number and Category (ie Noise, Odour, Dust, Traffic, Smoke)

Effluent to River
- Chemical Oxygen Demand (mg/l) (te/a)
- Hydrogen Peroxide (mg/l) (te/a)
- Boron (te/a)

Effluent to Sewer
- Chemical Oxygen Demand from AO Plant and Capa Plant (mg/l) (te/a)
- Suspended Solids from AO Plant and Capa Plant (mg/l) (te/a)
- Total Chemical Oxygen Demand (mg/l) (te/a)

Air Emissions
- VOCs from AO, Capa, Peracetic Acid (te/a)
- Total Site VOCs (te/a)
- SO_2, NO_X, CO_2 and Dust from Boiler House (te/a)
- Dust from Persalts Plant (te/a)
- Total Site Dust (te/a)

Waste Disposals
- Tincal Sludge (te/a)
- AO Tars (te/a)
- Capa Residues (te/a)
- Ash from Boiler House (te/a)
- Laboratory Waste (te/a)
- Total Special Waste (te/a)
- Total Site Waste (te/a)

Lost Time Accidents

Incidents
- Numbers Offsite, Environmental and Total

HGV Movements
- Numbers per Month
- Numbers on Saturdays and Sundays
- Weekly Average in Sensitive Periods
- Total Weekly Average

Figure 6. 21: Annual releases of volatile organic compounds released to air at Solvay Interox Ltd

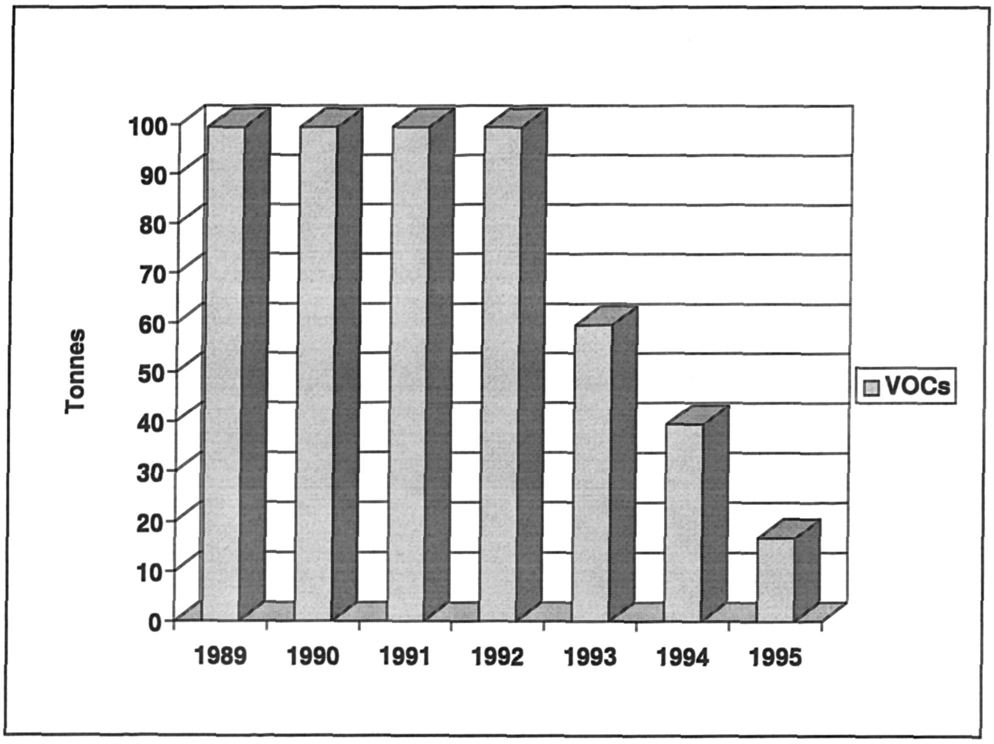
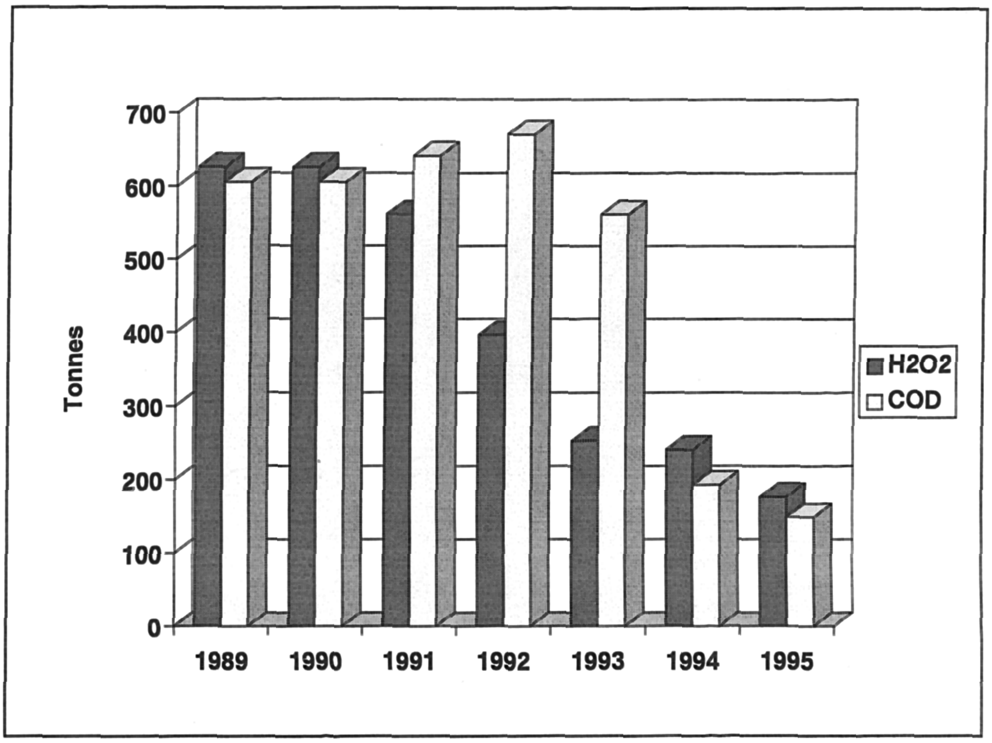


Figure 6. 22: Annual hydrogen peroxide and chemical oxygen demand released to River Mersey at Solvay Interox Ltd



6.7.14 Non-compliance and corrective action (BS 7750 Clause 4.8.4)

Three systems were already in place for recording, investigating and correcting non-conformances prior to BS 7750. Minor quality non-conformances were reported and corrected using *Corrective Action Proposal* forms and major non-conformances using *Corrective Action Request* forms. Health, safety and environmental incidents and near-miss situations were reported and investigated through the Responsible Care & Loss Prevention (RCLP) *Opportunities for Improvement* system. Incident reports, including environmental implications, were compiled into an *Events Weekly* document for discussion at team quality and safety meetings. Non-conformance documentation was initiated by the person identifying the failure, often an auditor, and corrective actions identified and implemented by the Manager responsible.

It was possible to utilise these existing systems for recording environmental non-conformances. Those identified during routine environmental audits were recorded using the existing quality system of *Corrective Action Proposals* and *Corrective Action Requests*. Environmental incidents and near-miss situations were recorded and investigated using the RCLP *Opportunities for Improvement* system.

6.7.15 Environmental Management Records (BS 7750 Clause 4.9)

A critical element of an EMS is the ability to demonstrate that work practices comply with objectives, targets and procedures. Each individual procedure specified the necessary recording requirements and contained examples of forms and registers. These included details of weekly river effluent analysis, monitoring results, customer enquiries, annual release inventories and environmental complaints. The RCLP Management Manual specified that all records must be kept for a minimum of 2 years.

6.7.16 Environmental Management Audits (BS 7750 Clause 4.10)

An internal auditing system was operated for the ISO 9002 system. A schedule specified audit timings and procedures described the stages in the audit process. These included notifying the auditee, compiling an audit checklist, carrying out the audit and reporting findings and non-compliances (Chapter 4). Twenty employees from across the site were externally trained in quality auditing.

In 1993 the Environment Group, with the assistance of a post-graduate from Salford University, delivered a one-day environmental auditing training session to plant operators. Checklists were used to inspect manufacturing plants and identify areas of concern. In addition BS 7750 required an environmental audit schedule and procedure (Solvay Interox Ltd, 1996b). These were both based on the existing ISO 9000 procedure with similar proformas for developing checklists and reporting audit findings. The audit schedule specified that each clause of BS 7750 was to be audited at least every year (Appendix 2.13). In accordance with BS 7750 the frequency of audits depended on their environmental significance with waste management, incident reporting, tanker deliveries and monitoring being audited more frequently.

6.7.17 Management Reviews (BS 7750 Clause 4.11)

The ongoing suitability and effectiveness of the ISO 9000 system was reviewed by senior management at six monthly intervals. The company was therefore familiar with the concept of management reviews. As the EMS was integrated with the RCLP system the existing Health, Safety and Environment Steering Group, initially established to discuss changes to HSE legislation, would review the EMS. It consisted of senior managers plus the Production & Environmental Services Manager from the Executive Committee.

6.8. SUMMARY

Larger companies, especially those heavily regulated under Integrated Pollution Control, will be operating many elements of a formal EMS to meet their legal obligations. An essential first stage for such organisations is a detailed analysis of existing management practices compared to the requirements of the EMS standards. Prior to 1994 Solvay Interox had completed an environmental policy, risk assessments, waste minimisation reviews and was in the process of implementing a substantial environmental improvement programme. Site effluents and atmospheric emissions were routinely monitored and performance measured on an annual basis. Several procedures had been established for controlling accidental releases, waste management and handling external communications.

The review of existing management practices identified a number of weaknesses against the EMS standards. Areas requiring particular attention were the registers of regulations and effects; objectives and targets; management manual; system procedures; internal auditing system and management reviews. In reviewing existing management practices it is important not to overlook the activities of other departments and systems. Companies certified to a quality standard, as was the case for Solvay Interox, will have a documented system in place encompassing a policy, management manual and a set of procedures including those for training, document control, auditing and non-conformances. In some cases companies may also operate formal health and safety systems. This is particularly likely in chemical companies committed to the Chemical Industries Association's Responsible Care principles. Solvay Interox's Responsible Care and Loss Prevention (RCLP) system for health and safety contained a policy statement; a system manual, an incident reporting and investigation system plus an emergency plan.

EMS implementation within tightly regulated industries raises a key point regarding the ease of modifying existing environmental management activities to meet the requirements imposed by the standard. In certain cases it is relatively easy to modify existing documentation as was the case with the policy and several procedures at Solvay Interox. Problems arise where in-house techniques are well established, have a high profile but do not entirely meet the EMS standards. Changing such systems requires substantial effort and can lead to confusion within the workforce. To avoid this situation it is often most efficient to develop parallel systems to address those areas of the standard not currently covered. At Solvay Interox this was the case with the environmental process hazard reviews, waste minimisation reviews and the IPC improvement programme.

Prior to BS 7750 substantial resources had been committed to the site-wide environmental process hazard and waste minimisation reviews. These took over a year to complete and involved large numbers of staff from across the site. The process was successful in identifying risks of accidental releases and opportunities for waste minimisation. However, in isolation these techniques did not fully comply with the environmental effects requirement of the EMS standards. In particular effects arising from normal, past and future operating conditions had not been incorporated. As was the case with less tangible impacts such as nuisance to local residents, supplier and customer activities and other indirect effects. The solution was to develop a parallel methodology to cover those areas not previously considered.

A similar situation, concerning the modification of existing management tools, arose in the establishment of the environmental management programme. The existing £4 million IPC programme, which was well established within the organisation, had been agreed with HMIP and the NRA. As its focus was to meet the requirements of the IPC authorisations it did not address all the significant effects, some of which were significant due to their potential to cause local residents concern. Many other initiatives were ongoing, such as the reduction of HGV movements, but had not been documented. The solution was to formalise parallel programmes addressing these issues plus the new projects identified from the effects assessment (Chapter 7). This led to the identification of numerous projects which would require monitoring to ensure compliance with the EMS standards.

A key decision in EMS implementation, particularly within larger companies, is the extent to which to integrate it with other disciplines. The lack of a clear strategy from the start of the project can compromise progress. This was the case at Solvay Interox where environmental and health and safety systems had developed in parallel with limited co-ordination. The lack of a company strategy regarding systems integration hindered EMS progress as a clear implementation plan could not be established. In many cases documentation established for the EMS later required amending to also incorporate health and safety. In retrospect it would have been more effective to have established combined documentation from the start of the project. This illustrates the need for an early policy decision regarding systems integration. As this can affect the roles and responsibilities of individuals within the company this decision needs to be made at senior management or ideally board level.

In integrating systems it is important to define responsibilities for the combined system. Their absence at Solvay Interox resulted in no clear ownership for the integrated health, safety and environmental documentation. The continuation of this situation would cause problems in terms of system maintenance. A second problem arose due to the shorter timescales and increased urgency of implementing the EMS compared to the health and safety system. A two-year full time position was created for EMS implementation whilst development of the health and safety system formed only a small part of the role of the Safety Manager. Although it was planned to eventually combine health, safety and environmental procedures this was not always possible due to a lack of health and safety resources. To ensure environmental deadlines were met some of the procedures were implemented initially as environmental with the view to incorporating health and safety at a later date.

CHAPTER 7

7.0. CHANGES IN MANAGEMENT PRACTICES & COMPANY CULTURE

7.1. INTRODUCTION

The previous three chapters focused on identifying the requirements of the EMS standards, the approaches being adopted to their implementation in industry and the key issues to be addressed. It is inevitable that adopting a recognised EMS will change management practices and company culture. The extent of change will depend largely on existing company culture. In some cases companies will be familiar with the systematic approach whilst for others the concept will be new. This chapter considers how the publication of the EMS standards and their implementation within industry is changing the approach and focus of environmental management. It draws on data from the experience survey of certified companies, the five detailed case studies and the applied research at Solvay Interox Ltd.

7.2. ENVIRONMENTAL MANAGEMENT BEFORE THE STANDARDS

All organisations operate elements of an EMS although this may not always be recognised. Any company disposing of waste will have a system to ensure its collection and many will have an informal mechanisms to meet legislation (Morris, 1995). All 22 experience survey respondents reported elements of an EMS to be in place prior to their adoption of BS 7750 (Table 7.1). Five companies (23%) were undertaking environmental monitoring, probably because it was required to ensure legislative compliance (Table 7.2). A larger number (45%) had implemented some environmental improvements such as waste minimisation, recycling or energy efficiency initiatives. The environment was only incorporated into documented procedures by 23%. Lindsey Oil Refinery had a procedure for handling environmental complaints and Autosmart included environmental criteria in their product design procedures.

Table 7. 1: Environmental management practices operated by survey participants prior to their adoption of a recognised EMS standard

Company Name	***Existing Environmental Management***
Akzo Nobel Chemicals Ltd	ISO 9002; environmental monitoring.
Alcan Smelting & Power UK	Preparatory review; environmental policy; external audit; management programme; environmental targets.
Anaplast Ltd	Waste control; energy reduction; recycling
Applied Chemicals	Testing and monitoring; waste reduction; legislative compliance.
Arjo Wiggins Fine Papers Ltd	Audit; management review.
Auto-Smart Ltd	Reference in design procedures.
The Beacon Press Ltd	About 70% of BS 7750.
BICC Cables Ltd	Small amount of copper recycling.
BOC Gases Europe	Spill contingency; legislative compliance; waste management procedures.
Carson Office Furniture Systems	Environmental policy; product analysis; supplier probity; legislative compliance; objectives & targets.
Curtis Fine Papers	Informal systems dealing with legislative compliance
Dunlop Precision Rubber	Operational requirements to ensure legislative and regulatory requirements.
Epson Telford Ltd.	Quality management system
Gleaner Oils Ltd	Informal environmental training
Lindsey Oil Refinery Ltd	Gaseous and liquid effluent monitoring; complaint procedure; local liaison committee
NDM Manufacturing	Environmental policy; targets; working groups; environmental committee; environmental coordinators.
P P Payne	Spill containment; waste documentation.
Philips Components	Legal compliance; regular monitoring procedures and routines.
Ricoh UK Products Ltd	Process monitoring; waste recycling; reduction and reuse policies; environmental advisory committee; environmental policy, approximately 60% of records required.
Shields Special Metals Ltd	Environment procedures under ISO 9002 for work practices.
Thomas Swan & Co Ltd	About 70% of BS 7750
Wavin Buildings Products Ltd	Recycling activities; legislative compliance.

Table 7. 2: Percentages of experience survey participants operating particular environmental management practices prior to their EMS

Existing Environmental Management	*Percentage of Companies*
Environmental Policy	18%
Objectives, Targets or Management Programme	14%
Register of Environmental Effects	0%
Register of Environmental Legislation	0%
Environmental Monitoring	23%
Environmental Committee or Management Review	14%
Environmental Management Manual	0%
Environmental Training	5%
Environmental Auditing	9%
Environmental Improvement Initiatives (eg recycling)	45%
Environmental Considerations in Documented Procedures	23%

The comprehensiveness of environmental management practices, prior to the implementation of an EMS standard, varies substantially. Some companies operate simple informal systems to address compliance whilst other have established environmental committees, management programmes and resident liaison groups. Larger or tightly regulated companies are the most likely to operate advanced systems (Table 7.3).

Table 7. 3: Companies with well developed systems prior to the adoption of a recognised EMS standard

Company Name	*No of Employees*	*Part A or Part B**
Alcan Smelting & Power	172	Part A
Carson Office Furniture	160	Part B
Lindsey Oil Refinery	500	Part A
NDM Manufacturing	650	Non-Prescribed
Ricoh UK Products	740	Part A
The Beacon Press Ltd	70	Non-Prescribed

* As defined in the Environmental Protection (Prescribed Processes and Substances) Regulations 1991

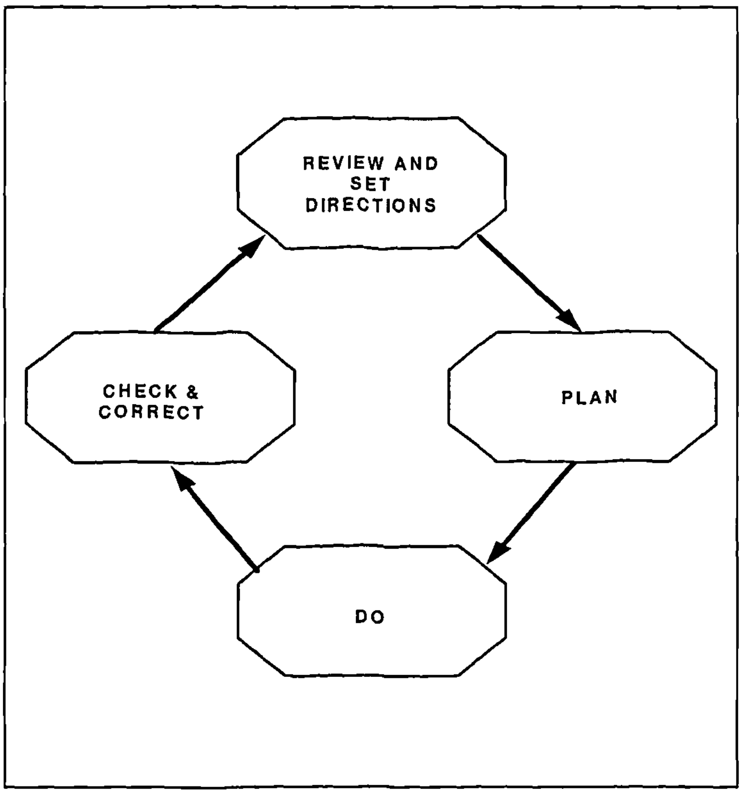
A comprehensive system of documentation was consistently lacking within participating companies. None of the respondents had comprehensive procedures, a management manual, registers of environmental effects and legislation or internal auditing systems. This was also the case at Solvay Interox where extensive resources had been committed to environmental management prior to BS 7750 (Chapter 6).

7.3. THE SYSTEMS CONCEPT

Traditional approaches to environmental management have typically failed to appreciate its interconnections and complexities (Margerum, 1995). Environmental management systems, as specified in the standards, are based on a holistic and dynamic approach. Systems are defined as a set of connected parts functioning as a whole (The Concise Oxford Dictionary). The concept is based on the philosophy that the impact of the system is greater than the sum of individual parts. In comparison to a linear approach a system consists of a complex network of inter-relationships (O'Regan, et al., 1997). This is also true of management systems where individual activities are inter-dependent upon each other (Figure 7.1). A key objective of the external assessor will be to ensure all EMS elements are consistent and a clear link has been established between the policy, significant effects and objectives and targets (Houldin, 1995b) (Peckham, 1995).

In developing an EMS it is important to ensure system elements are consistent and inter-related. No particular element can be effectively established in isolation to the others. The environmental policy must be relevant to the significant environmental effects and provide for the setting of objectives and targets. Responsibilities must be derived from procedures and be consistent throughout system documentation. Employee training must be clearly focused on the policy, individual's responsibilities, significant effects, objectives and targets. Certain members of staff will also need more detailed training on other system elements such as the manual, specific procedures and environmental auditing (Chapter 7.6).

Figure 7. 1: The Dynamic Systematic Approach (adapted from Sutton, 1997)



The significant environmental effects require addressing by the environmental policy statement. Specific commitments to address particular effects must be reflected during their significance assessment. An example would be a commitment to purchase from suppliers meeting specified performance levels which would automatically mean the effects of suppliers must be treated as significant. The effects assessment must also be consistent with the legal requirements as these will influence their importance. In addition the register of regulations is inter-related with the policy. If the policy requires compliance with industry codes of practice these must be incorporated into the register.

The determination of objectives and targets requires consideration of both legal requirements and the significant effects (Chapter 4.2.7). If the effects assessment identifies solid waste as significant a corresponding objective and target would be expected. The management programme is closely linked to objectives and targets as it describes the mechanisms for their achievement (Chapter 4.2.8). The manual describes the management system and therefore interrelates with all the other elements (Chapter 4.2.9). The degree of monitoring and control depends on the policy, the significant effects and the objectives and targets (Chapter 4.2.10). Should the policy contain a commitment to use recycled paper procedures will be required to ensure this is translated into the purchasing decisions. Likewise if a particular atmospheric or liquid release is identified as significant, procedures are required to assess and control the associated impact.

The systematic approach introduces the need for checking compliance to identify opportunities for improvement and implementing preventative and corrective action. This ensures internal consistency and conformity with company policies and procedures in addition to compliance with external regulations and standards. It can also identify wasteful or inappropriate use of energy and raw materials, and shortcomings in the application of technology and the management of wastes (Jones, 1997). The frequency of environmental audits is determined by the environmental significance of the particular activity or department. Activities with the greatest impact require more frequent audits, the in-house effluent treatment plant needing more attention than the warehouse (Powley, 1996) (Chapter 4.2.12). The final activity in the systems loop is the management review process which ensures the ongoing suitability and effectiveness of the entire system.

By identifying the inter-relationships between management activities the EMS standards provide a useful model to assist companies manage their environmental impacts (Sheldon, 1996). They are particularly valuable for those with limited environmental expertise. It is often easier for such organisations to adopt a recognised standard rather than establish their own in-house systems. This is not necessarily the only route to developing a strong and effective system. Prior to their publication many major companies, especially those tightly regulated under legislation, had already established in-house systems meeting their business needs (Morris, 1995). For such organisations the standards provide a valuable bench mark (Sunderland, 1997). By comparing their existing practices with the standards, missing elements and inter-relationships can be identified. This can assist companies pull together their existing environmental management activities into a more organised system (Burdett, 1994). This was one of the main reasons why BP Chemicals made a commitment to registering six of their main European sites to EMAS by the end of

1997. At the Salt End site, near Hull, an in-house EMS was already well established and the site had previously been praised by HMIP for its quality of environmental protection. By adopting EMAS they believed they could improve their existing system and ensure a strong link between policy, plans and activities (Joslin, 1996).

When technologies or organisational structures become complex the tendency is to focus on incremental improvements in limited parts of the system (Sutton, 1997). This approach typically fails to identify the often significant benefits which can be achieved by considering the whole system design (O'Regan, 1997). It is therefore essential that systems are designed with the broadest possible scope. The development of new technologies and products, life-cycle assessments and the upgrading of production processes should all be incorporated (Sutton, 1997) (Chapter 10).

7.4. FORMALISING MANAGEMENT PRACTICES

The EMS standards place a large emphasis on the need for documentation. In addition to policies, manuals and registers extensive procedures and records are required (Chapter 4). This often requires a major change in management practices and is illustrated by the consistent lack of documentation within companies prior to their adoption of an EMS standard (Chapter 7.1).

The large emphasis for documentation has led to fears of excessive bureaucracy (Gleckman, 1997) (Sunderland, 1997) (Environment Business, 1996c) (ENDS 231, 1994). In small and medium sized enterprises (SMEs) this may have originated from their experience with quality management systems which are frequently seen to be no more than paper exercises (Bell, 1997) (Hodge, 1995) (Chapter 1). In larger companies, who are likely to have operated their own informal systems for many years, the additional cost of formality is frequently perceived to be unjustifiable (Sunderland, 1997).

These concerns are justified, as it is inevitable that an EMS will result in some additional documentation. However, this is typically only perceived of as negative by those without an EMS. Only one (5%) of 22 certified companies involved in the survey reported documentation to be a disadvantage. Formalising ad hoc activities through procedures was frequently reported to be an advantage. It guarantees consistency and clarifies delegated responsibilities. Employees become clear of how and when to undertake particular tasks which is important in times of change or absence as new staff immediately understand their responsibilities (Butterworth, 1995).

A comprehensive and effective recording system for environmental incidents, complaints, resource usage and environmental releases is essential for measuring environmental performance and the achievement of objectives and targets. Documentation is also important for auditing as it provides evidence of compliance.

The management manual provides a useful "route map" and starting point for employees or auditors requiring a summary of the system. At Solvay Interox it was beneficial in describing the EMS elements and their inter-relationships. It clarified the activities required to ensure compliance with legislation and company policy requirements. By referencing external criteria, such as those incorporated into BS 7750, ISO 14001, EMAS, legislation and Responsible Care, employees' understanding of the relevance of the system was increased.

The emission inventory procedures documented calculation methods and ensured a standard approach to performance measurement. This was particularly important as data were required by the Environment Agency, the Solvay Group and the Chemical Industries Association. The lack of consistent calculating methods could result in a misleading impression of performance. The procedures were also beneficial by allowing the Senior Environmental Advisor to delegate the task of information collection and performance calculation, which took several months. This allowed his expertise to be more effectively utilised in implementing the environmental improvement programme which was essential to achieve legislative compliance.

The external certification process can be beneficial by ensuring the system is maintained. This was the case at National Power who have successfully certified 13 of their UK sites to one or more of the standards. They believe a primary benefit of certification is the efficiency and discipline imposed by being made to maintain high levels of management which also provides an incentive for keeping the system up to date (Institute of Environmental Management, 1996c).

Whilst there are substantial benefits in establishing EMS documentation it is essential to avoid becoming over bureaucratic (Bell, 1997). The system must be designed to suit the organisation and not the external auditors. It is easy to become too introverted by focusing on the requirements of the standard rather than business needs. Lessons can be learnt from the larger companies, many of which are aware of these concerns and are determined to avoid unnecessary bureaucracy. At BP Chemicals the system must provide real benefit and will not be tolerated if it becomes a bureaucratic exercise (Joslin, 1996). National Power took particular care to design their system for its ease of use for employees and not to make it easy for third party auditors (Institute of Environmental Management, 1996c). The Company is committed to minimising bureaucracy and reduced the duplication of documents by keeping them only where they were needed. They also set a target to reduce paper usage so that their system helped them to reduce bureaucracy rather than adding to it.

7.5. INTEGRATION OF MANAGEMENT DISCIPLINES

Many companies are finding the easiest route to certification is through stand-alone systems. This has caused concern that the EMS standards may discourage integration between systems and departments. Industry is worried that they may eventually need separate systems for quality, safety and environmental conformance each with distinct procedures (Sunderland, 1997) (Faragher, 1996) (King, 1995).

Despite concerns that the EMS standards may discourage the integration of the environment with other business processes there is increasing evidence to the contrary. Many opportunities for systems integration result from the implementation of an EMS (Fishwick, 1996) (Ringer, 1995) (Shillito, 1995a and 1995b). A survey undertaken by the Institute of Environmental Management found that 89% of respondents felt environmental issues were becoming increasingly integrated into overall management (Institute of Environmental Management, 1995). 10% felt that environmental considerations were already being fully integrated with only 2% believing there was no integration at all.

These findings correspond to those obtained from the experience survey of EMS certified companies. Only one company (5%) in each case stated that there had been no integration at all (Table 7.4) (Table 7.5). Integration with quality was reported to be greater (27% scoring 5) than with health and safety (5% scoring 5). This is explained by the larger number of companies with quality systems compared to formal health and safety systems. The quality system standard BS 5750 (now ISO 9000) was first published in 1979 whilst the health and safety standard BS 8800, is still a new concept and was not published until 1996.

Table 7. 4: Perceptions of the extent to which the adoption of a formal EMS increased integration between environmental and quality management

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	5	5	5	41	18	27

Table 7. 5: Perceptions of the extent to which the adoption of a formal EMS increased integration between environmental and health & safety management

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	5	0	18	36	36	5

Responsibility for implementing an EMS is frequently assigned to an existing Quality or Health and Safety Manager (Table 7.6). An organisation's choice of champion influences the degree of integration between management systems. Where EMS responsibility lies with a Quality Manager or a dedicated Environmental Manager the extent of integration with quality was perceived to be greater than with health and safety. In contrast where a Health and Safety Manager is responsible the extent of integration with health and safety and quality was considered to be approximately equal (Table 7.7).

Table 7. 6: The responsibilities of EMS champions within survey participating companies

Responsibilities	***Percentage of Companies***
Environment, Health, Safety & Quality	5%
Environment, Health and Safety	18%
Environment & Quality	32%
Environment Only	23%
Others (eg Technical Manager)	22%

Table 7. 7: Participants perceptions of the extent of integration between environment and other disciplines versus their individual responsibilities

Responsibilities	***Average score***	
	Quality	***Health & Safety***
Environment, Health, Safety & Quality	5.0	5.0
Environment, Health and Safety	3.8	3.8
Environment & Quality	3.7	3.1
Environment Only	2.8	3.4
Others (eg Technical Manager)	2.6	2.6

At Solvay Interox Ltd the EMS was integrated with health and safety but utilised existing quality techniques where appropriate (Chapter 6). Procedures adopted for environmental auditing, training and non-conformances were based on the ISO 9000 system. The decision to develop combined health, safety and environmental documentation promised efficiency through synergy of approach. The existing health and safety manual was amended to cover environmental requirements. This provided a flexible structure which could incorporate new initiatives as they arose. Combined policy statements, manuals and procedures minimised documentation requirements and simplified document control. A further benefit resulted from the addition of health, safety and hazard legislation to the environmental law database. The increased resource requirements were offset by the benefits of a comprehensive source of information and improved understanding of health, safety and hazards and their interactions with environmental legislation.

An additional benefit of systems integration at Solvay Interox Ltd was improved communications between departments and increased team working. Decisions were made by the Responsible Care & Loss Prevention Steering Team consisting of health, safety, hazard and environmental personnel (Chapter 6). The discussion of potential conflicts between disciplines promised cost reduction through the adoption of combined solutions. An additional aim of integration was to prevent efforts being focused on one discipline at the expense of others. This happened in the early 1990's when the pressures of the Environmental Protection Act and IPC forced emphasis to be placed on the environment resulting in decreased health and safety performance.

Implementing organisations have a substantial degree of flexibility regarding the extent to which management system documentation is integrated. Whilst the development of integrated systems is often a long-term goal there are a number of issues to be considered. Firstly, management structure must allow for integration. It is logical for a Quality Manager to develop an integrated quality and environmental system or for a Health and Safety Manager to develop a health, safety and environmental system. Problems arise when an organisation has an independent Environment Manager or department. This was the case at Solvay Interox Ltd were the responsibilities for health, safety, environment and quality lay in separate departments (Chapter 6). This caused problems regarding responsibilities for maintaining combined health, safety and environmental documentation. As a temporary measure, a contractor was assigned responsibility. However, to be successful, in the long-term, responsibilities would need to be clearly defined and re-assigned.

In the development of a combined system, commitment to both disciplines must be equal. If one system is already fully implemented it will be relatively straightforward to amend this to incorporate environmental considerations. Problems arise when two systems are developing in parallel. Progress in one discipline can be compromised by a lack of commitment, resources or urgency in the second. This was the case at Solvay Interox Ltd where there was more pressure to implement an EMS than a formal health and safety system (Chapter 6). Unless commitment to both systems is equal it is often most effective to complete one system prior to integration with the second.

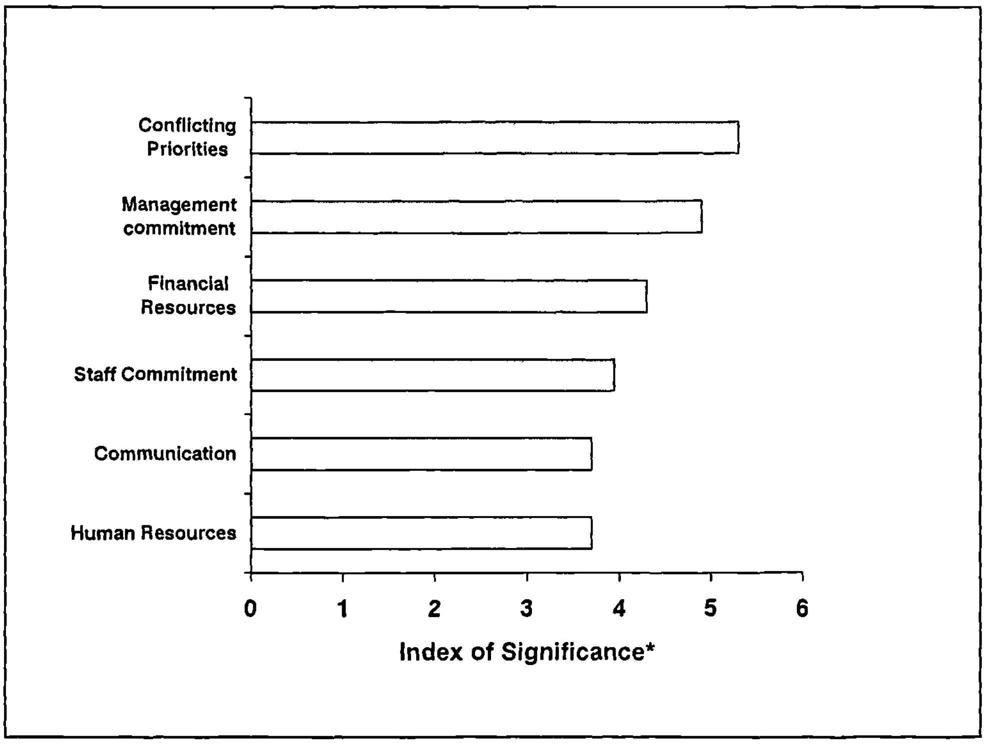
Another concern is that integration can lead to the watering down of environmental considerations (Institute of Environmental Management, 1995c) (Peckham, 1995). Promoting the environment as an extension of quality or health and safety may lessen its priority. Amending existing documentation may be less clear and have less impact than issuing new separate environmental manuals. This illustrates that substantial training is essential on the amendments to existing documents in addition to the new system elements (Chapter 7.6).

A further danger is that integration frequently increases the scope of a manager's responsibilities. A Health and Safety or Quality Manager assigned the responsibility of implementing an EMS is likely to find conflicting priorities a problem. Increased safety incidents or new legislation could easily move the focus away from the environment. In an Institute of Environmental Management survey of members, conflicting priorities were cited as the main barrier to effective environmental management (Figure 7.2). A dedicated Environmental Manager responsible for maintaining the EMS is much less likely to suffer from such problems.

7.6. CHANGING EMPLOYEE CULTURE & AWARENESS

Effective training, communications and employee commitment is essential to EMS success (Crognale, 1997) (Wells, 1997) (Page, 1995). As a prerequisite to certification external assessors need to be convinced of high levels of employee environmental understanding. Improvements in environmental performance are impossible unless all members of an organisation are clear of their role and the benefits of improved performance. Recycling schemes will not be effective unless staff are educated in their use and energy savings will not be achieved without training on good housekeeping such as turning off lights and machines.

Figure 7. 2: Perceived barriers to effective environmental management (from Institute of Environmental Management, 1995c)



In achieving employee commitment, the inevitable resistance to change must be overcome. An EMS requires firmly held beliefs and practices to be tested and frequently changed (Sheldon, 1995a). New methods compete with the evolutionary system that has evolved within the company over many years. Nobody likes to have to learn new routines or change working practices. Change is often treated with suspicion as it has frequently resulted in fewer employment opportunities or a reduction in company benefits (Clough, et al., 1995). Another barrier is the common apathy and inertia of employees towards the environment. It is often perceived as peripheral to everyday activities and unimportant compared to production activities. Without education staff will not see the benefit of sound environmental performance and will question the value of their individual contributions.

To overcome the cultural barriers within an organisation substantial training and awareness raising is required. Existing communication channels, such as company newsletters and notice boards, can assist in this process but formal training sessions and briefings must play an important role. Wells (1997) recommends the provision of general awareness training, procedural training and specialist training as elements of the EMS (Figure 7.3).

Figure 7. 3: Types of environmental training within an EMS (from Wells, 1997)

General	Awareness of: • Global, regional and local environmental issues • Legislation requirements • The role of the company and individuals • The benefits of improved performance • Awareness of the environmental management system
Procedural	Specific skills related to procedures and work instructions. These may be concerned with undertaking a particular operational task or general management activities. Of particular importance is the need for emergency training.
Specialist	Specialist skills such as EMS implementation, legislation, performance monitoring and internal auditing.

All employees require some general awareness training prior to certification. This can range from a short briefing, similar to that at J & J Makin, to several days, as at Contract Chemicals (Chapter 5). At Wavin Building Products all 500 employees attended a 3 hour session (Pers. comm. Underhill, 1996) (Table 7.8).

Table 7. 8: Training per employee undertaken for BS 7750 by participating companies

Company Name	***No of Employees***	***Training per Employee***
Akzo Nobel Chemicals	132	3 hours
Arjo Wiggins Fine Papers	230	3 hours
Contract Chemicals	160	2 days
J & J Makin Converting	75	2 hours
Shields Special Metals	100	1 hour
Wavin Building Products	500	3 hour

In addition to formal training, there are a number of other initiatives which can be effective in improving employee awareness. BICC Cables, employing 350 staff in cable manufacture, found waste recycling and other small scale schemes implemented through "Conservers at Work" made an important contribution to raising awareness (Pers. comm. Horrocks, 1996). There is an immediate visual impression of the meaning of environmental savings which is easily appreciated (Reynolds, 1996). As 60% of the work force of BICC Cables live within a short distance of the factory local environmental initiatives were effective in gaining commitment. An area of land on the site was donated to a local scouts group for conversion into a new football pitch. School pupils, together with a local artist, were invited to paint a mural on site and better housekeeping and waste management improved the site's appearance. These initiatives demonstrated the company was investing in the local community and restored employee pride in their job and the locality (Reynolds, 1995).

Motivation and awareness can also be raised by adopting the principles of Total Quality Management and empowering employees in decision making (Hamilton, 1997) (Hodgson, 1995) (Hocking, 1993). Cego Ltd, an Essex architectural hardware, door and window system and cladding company, made a special effort to involve its 600 employees in established teams. Employees were sufficiently motivated to identify numerous cost saving from a variety of process and material changes (British Standards Institution, 1995a). Renlon Ltd involved staff in developing their own annual departmental targets for fuel consumption, telephone usage and stationery. This was found to be successful in improving motivation by introducing competitiveness between departments (Griffiths, 1995).

Wolstenholme International, employing 260 staff in the manufacture of metal powders, encouraged employee ownership through briefings, specific training for supervisors and training of selected staff in auditing and emergency response (Table 7.9). Environmental Task Groups were established to identify potential environmental improvements in selected areas. Employees were motivated to initiate a voluntary green group to carry out local projects to enhance the firms image in the community (ENDS Report 263, 1996).

Table 7. 9: Staff environmental briefings delivered during EMS implementation at Wolstenholme International (from Garratt, 1998b)

Session 1: December 92	*Session 2: December 93*	*Session 3: June 94*
Global and local environmental issues	Progress in implementing the EMS	Departmental environmental aspects
Using an EMS to control significant effects	Pursuit of certification to BS 7750	Progress to reduce and manage these effects
Commitment to continual environmental improvement	-	Procedures and work instructions

Reward schemes can be beneficial in motivating employees and promoting the financial benefits of improved environmental performance. Autosmart Ltd re-invested savings achieved by their EMS into in-house labelling equipment and new filling equipment including an aerosol facility (Pers. Comm. Munro, 1996). These benefits are easily visualised and demonstrate to employees the financial significance of environmental improvements.

At Solvay Interox Ltd employees had a good understanding of environmental issues prior to the adoption of BS 7750 (Chapter 6). A number of additional initiatives were adopted to ensure awareness of the EMS. The induction procedure and information pack for new employees ensured a basic level of environmental awareness from their first day on site. The policy statement was included in company newsletters and on notice boards across the site. A brief for senior managers to launch the new RCLP manual included a slide show, presentation and discussion session. Each manager was asked to review the document to identify their individual responsibilities and determine their current position against its requirements. Information was cascaded at team meetings and a slide show, publicised by posters, was available on the network. The EMS also required more direct involvement from employees, for example, in the development of operational control procedures. This improved employee recognition and understanding of the critical areas of impact on the environment.

It is essential that any awareness raising campaign is sustainable. If all effort is focused at the beginning of a campaign enthusiasm will soon decrease leading to loss of morale and commitment. A successful campaign must plan a number of initiatives spread throughout the year. Newsletters must be repeated, posters regularly changed and new ideas generated from employees. After certification refresher training will be required at regular intervals to ensure ongoing environmental improvement. Regular evaluations of training success is also of key importance (Wells, 1997). Training needs to be a constantly evolving and improving process consisting of planning, delivering and evaluating the results.

Whilst changing employee culture poses a significant challenge, all companies participating in the survey believed that employee awareness had substantially increased as a result of their EMS. When asked to score from 0 to 5 the extent of improvement 86% scored 4 or 5 (Table 7.10). This illustrates that efforts assigned to awareness raising yield substantial benefits in improving motivation and job satisfaction. Improved employee motivation was reported to be the single most significant EMS benefit within companies participating in the survey (Table 7.11) (Chapter 8).

Table 7. 10: Perceptions of the extent to which employee awareness was improved by the adoption of an EMS within participating companies

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	0	0	5	9	45	41

Table 7. 11: Participants comments regarding the main benefits of implementing an EMS relating to employee motivation

Company Name	***Comments***
Anaplast	• All employees quickly became aware of the part they must play to maintain and achieve the standard
BICC Cables	• Improved motivation of employees
BOC Gasses	• Better trained workforce
Lindsey Oil Refinery	• Staff environmental awareness improved • Management commitment confirmed
Philips Components	• Improved environmental awareness across the site
Ricoh UK Products	• Clear environmental responsibility and accountability • Improved employee awareness
Wavin Building Products	• Improved overall awareness throughout the organisation of environmental issues

7.7. UNDERSTANDING, PLANNING & DECISION MAKING

The holistic nature of a systematic approach requires the re-examination of activities and products. This can substantially improve manager's understanding of the environmental impacts of their company's activities (Page, 1995). P P Payne Ltd, a Nottingham based manufacturer of packaging products with 252 employees, reported their EMS led to a significant improvement in understanding of their manufacturing processes (Pers.comm. Morris, 1996).

When companies were asked to score on a scale of 0 (no improvement) to 5 (substantial improvement) the extent to which their EMS improved understanding of their manufacturing process 90% scored 4 or 5 (Table 7.12). This was consistently the case within companies of various sizes, industrial sectors and process complexities. Even those with well developed systems prior to BS 7750 reported significant improvements in their understanding of environmental impacts.

Table 7. 12: Perceptions of the extent to which the adoption of a formal EMS improved participants understanding of environmental impacts

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	0%	0%	0%	9%	45%	45%

The more polluting industries, prescribed as Part A under the *Environmental Protection Act 1990*, were less likely to score 5 compared with Part B or non-prescribed companies (Table 7.13). A likely explanation is the substantial environmental knowledge required to ensure legislative compliance, prior to the implementation of their formal systems. This was the case at Solvay Interox Ltd where the Environment Group were aware of the majority of significant issues prior to undertaking the effects assessment (Chapter 6). In comparison a less tightly regulated company is unlikely to have such a comprehensive understanding and the adoption of an EMS standard will be more valuable in raising manager's environmental understanding.

Table 7. 13: Perceived changes in understanding of environmental impacts versus process classification under Environmental Protection Act 1990.

	Not at all					Significantly
	0	**1**	**2**	**3**	**4**	**5**
Part A	0%	0%	0%	0%	80%	20%
Part B	0%	0%	0%	29%	14%	57%
Non-Prescribed	0%	0%	0%	0%	50%	50%

The environmental effects assessment provides reassurance that priorities are identified and decisions based on a full assessment of the situation (Joslin, 1996). Many companies participating in the survey reported this consistent approach to managing environmental effects to be advantageous. Perceived improvements included more rigorous action planning (Pers. comm. Stebbing, 1996) and enhanced focus on the impacts of activities, some of which may not have been captured by previous ad hoc practices (Pers. comm. Kirk, 1996). P P Payne found the effects register to be an invaluable tool for managing their environmental impacts (Pers. Comm. Morris, 1996).

Prior to the EMS at Solvay Interox, improvement initiatives had been identified on an informal basis. The all encompassing nature of the effects assessment highlighted a number of issues outside the scope of the improvement programme (Table 7.14). The temperature of the sewer effluent from the caprolactone plant was not monitored although the discharge consent specified a maximum limit. This initiated investigations into the need for routine temperature checks. Also on the caprolactone plant odours from the residue storage tank were identified as significant due to their potential to attract complaints. This led to investigations into the feasibility of high level venting to disperse odours. The impact of office activities, including the use of paper and plastic drinks cups, had not previously been considered important. The establishment of recycling schemes was an easily implemented improvement which would have a substantial beneficial impact on company culture and environmental awareness.

Table 7. 14: New environmental projects identified at Solvay Interox Ltd as a result of the environmental effects assessment

Significant Effect	***Proposed Action***
Temperature of capa sewer effluent	Consider temperature checks
Vapours from capa residue tank	Consider high level venting
Disposal of brine wash waste	Consider fixed installations
Boron in persalts effluent to river	Include in measures and targets
Mercury in boiler house effluent	Include in measures and targets
Cadmium in boiler house effluent	Include in measures and targets
Potential leaking effluent pit (AO)	Further investigation
Halons in fire extinguishes	Review legal requirements
Waste plastic cups	Include in office recycling group agenda
Electricity usage in offices	Include in office recycling group agenda
Heating in offices	Include in office recycling group agenda
Water usage in offices	Include in office recycling group agenda
Paper usage in offices	Include in office recycling group agenda

The effects assessment provides a focus for the EMS and helps in decision making. Meaningful direction can only be achieved after the important issues are properly identified (Powley, 1996). This allows companies to focus on certain areas, so the mechanisms to achieve improvements are sought (Pers. comm. Booth, 1996). Objectives and targets focus effort on the significant issues and help to maintain a high standard of environmental performance (Barwise, 1996). They provide a means of measuring success and improving employee motivation by providing a goal.

The management programme requires objectives and targets to be translated into action by specifying project stages, timescales and responsibilities. This ensures all employees are aware of their individual responsibilities in their achievement. Ricoh (UK) Products also found that the EMS ensured the management programme was traceable to corporate objectives (Pers. comm. Jackson, 1996).

7.8. CONTINUAL ENVIRONMENTAL IMPROVEMENT

The UK Government has accepted that to meet international environmental agreements, including the Montreal Protocol, Agenda 21, the Basle Convention and the Convention on Climate Change, industry will need to commit itself to a reduction in environmental impacts (McKenna, et al., 1996). Perhaps the major factor in the credibility of formal EMSs is how far they succeed in delivering significant environmental improvement (Klaver, et al., 1998) (Powley, 1995). A worthwhile EMS should deliver improvement, but its scale is largely at the discretion of the organisation (Chapter 4).

Companies adopting EMS standards are implementing a broad range of initiatives at various rates of progress (Chapter 5). The lack of consistent environmental performance indicators makes comparisons difficult. Although ISO 14031, containing a framework for environmental performance measurement, is due for publication in 1999 this is unlikely to clarify the situation. The standard is for guidance purposes only and is not intended for use as a specification. The establishment of comparable performance indicators requires those working in a particular industrial sector to research and advocate suitable measures (Welford, 1998a). This would allow comparisons to be made between companies involved in similar industrial activities.

Brico Engineering, a Coventry based manufacturer employing 300 people, virtually halted its landfill of waste, reduced noise pollution and almost eliminated smoke after BS 7750 (British Standards Institution, 1995a). Wolstenholme International, produces bronze and copper powders and employs 260 at its Darwen site. They reduced copper discharges by 60% and emission of VOCs by 75% (Garrett, 1998b) (ENDS Report 263, 1996).

All companies participating in the survey reported that their EMS had led to improvements beyond the requirements of legislation (Table 7.15) (Table 7.16). The most common improvements were reduced waste, increased recycling and reduced energy usage. The installation of containment, to reduce the risk of accidental releases, and improved monitoring were also frequently reported. Fewer companies achieved reductions in releases to water, air emissions or traffic movements. This would be explained by the fact that significant effects in these areas are less common.

Table 7. 15: Reductions in environmental impacts achieved from adopting an EMS standard within participating companies

Environmental Improvement	*Percentage of Companies*
Reduced atmospheric releases	23%
Reduced releases to river	18%
Reduced releases to sewer	9%
Reduced waste production	63%
Increased recycling	63%
Improved monitoring	72%
Reduced traffic	0%
Reduced raw material usage	45%
Reduced energy usage	63%
Reduced water usage	27%
Improved containment	68%

BICC Cables believed that the appearance of the Blackley site had been much improved by the work carried out by the Waste Management Team who improved housekeeping and general site maintenance. Waste is now segregated at source and recycled wherever possible. Pallets are paid for and removed by contractors, the paper mill pays for and removes packaging and a compactor for polyethylene is being investigated.

Table 7. 16: Environmental improvement initiatives at EMS certified companies participating in the survey

Company Name	***Examples of Improvement***
Akzo Nobel Chemicals*	• Installation of on site treatment for waste water • Office paper recycling • Reduction in energy usage by 18% from 1993-1995
Applied Chemicals	• Waste reduction via production scheduling • Reduced water usage for tank washing
Autosmart*	• Energy savings by reduced heating & mixing • Reduced water use by improved filling machines • Recycling packaging
BICC Cables	• Fume extraction • Waste segregation and recycling • Improved housekeeping & general maintenance
Dunlop Precision Rubber	• Introduction of water based tool degreasant • Change in fabric priming to non solvent process • Introduction of energy monitoring process
Epson Telford	• Elimination of chlorinated solvents • Elimination of CFCs in aerosols • Recycling cardboard and paper • Improved bunding of chemical stores
Gleaner Oils Ltd	• Use of diesel cars • Energy savings by reduced temperature of boiler
P P Payne	• Production of recycled tapes • Reduction in VOCs from 268 tonnes in 1994 to 229 tonnes in 1995 (despite a 22% increase in output)
Ricoh UK Products	• Reuse of cooling water • Toner compactor • Expansion of photocopier reconditioning capacity
Shields Special Metals*	• Decommissioning of laboratory • Reducing acid and alkali use • Elimination of landfill of copper nitrate sludge
Thomas Swan & Co*	• Reduction in process vents to atmosphere • Reduced air emissions and odour • Re-routing trade effluent
Wavin Building Products	• Reuse of waste material

* EMAS Registered Companies

Detailed information relating to the environmental performance of EMS certified companies is only publicly available if they are registered to EMAS. The environmental statement requires companies to report on all areas of their performance, including those not subject to improvement. Unfortunately the number of UK companies certified to EMAS is low and detailed information relating to annual environmental performance is difficult to obtain. The lack of consistent performance indicators also adds to the difficulty of comparing individual company's performance. The review of the three EMAS statements produced by the case study companies indicated a wide range in the nature and extent of improvements being achieved in registered companies (Chapter 5). Two other companies involved in the survey, Shields Special Metals and Akzo Nobel Chemicals, also published environmental statements for EMAS.

Shields Special Metals Ltd, who dismantle electromechanical materials for recycling, reported substantial reductions in disposal of special waste and consumption of acids and alkalis (Table 7.17). Discharges to sewer, emissions to atmosphere and generation of copper nitrate sludge were eliminated by decommissioning the laboratory (Shields Special Metals, 1996). As with many environmental improvements it is difficult, however, to determine whether this was undertaken for environmental or other business requirements. Improvements were not experienced in areas not subject to objectives and targets, with electricity, water and fuel consumption increasing between 1994 and 1995.

Akzo Nobel Chemicals in Gillingham reported significant improvements in their environmental performance within their EMAS statement (Table 7.17). They reduced their landfill of general waste from 200 to 147 tonnes (27%) between 1994 and 1995 (Akzo Nobel Chemicals, 1996). The installation of on-site waste treatment facilities is predicted to eliminate 2,000 tonnes per year of special waste. Energy consumption was reduced by 18% in 1994 compared to 1993 and a further 9% in 1995 compared with 1994 (Jordan, 1996). However, as was the case with Shields Special Metals they also reported areas of deteriorating performance. The chemical oxygen demand of their waste water increased by over 100 tonnes per annum due to the on-site treatment of liquid waste previously sent to landfill. Levels of suspended solids also increased between 1994 and 1995 although the 13 tonnes discharged represented only 6% of the maximum consented level. In addition quantities of special waste increased by approximately 250 tonnes which can be explained by increased production (Akzo Nobel Chemicals, 1996).

At Solvay Interox Ltd environmental performance has been steadily improving since 1990. This can be attributed to a continuous process of improving control, increasing employee awareness, changing working practices and improving monitoring. One method of measuring environmental performance, the site waste index, indicated dramatic improvements since 1992 (Figure 7.4). The quantity of substances prescribed for released to air, as identified in the *Environmental Protection (Prescribed Substances and Processes) Regulations 1991*, has also decreased since 1992 (Figure 7.2). Although BS 7750 contributed towards these improvements it cannot be considered to be the main cause as substantial waste minimisation reviews were undertaken prior to the formal system (Chapter 6).

Solvay Interox invested substantial capital expenditure in improving environmental performance. This included the installation of effluent treatment, secondary containment and improved monitoring. An example is the upgrade of the NWW pumping station, to which the Company is contributing £200,000. Installation of secondary treatment will substantially reduce the chemical oxygen demand levels in the company's sewer effluent. Substantial improvements also resulted from the £6 million replacement of the old coal fired boilers, with new high efficiency, low emission boilers (Table 7.18).

Figure 7. 4: Site waste index at Solvay Interox Ltd

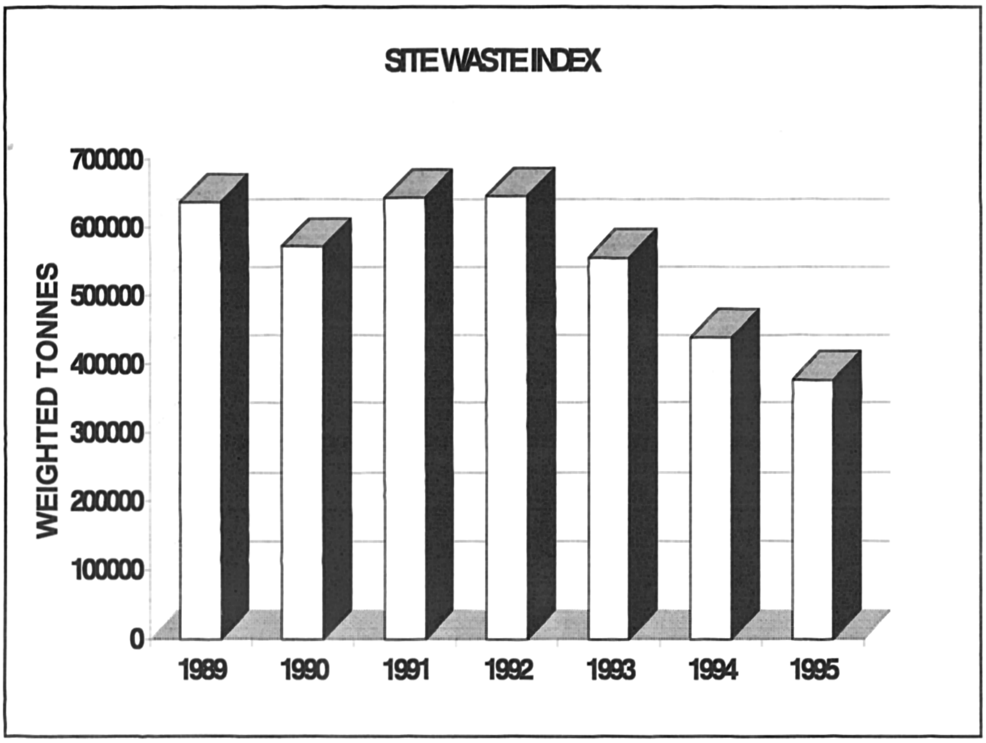


Figure 7. 5: Release of prescribed substances to air at Solvay Interox Ltd

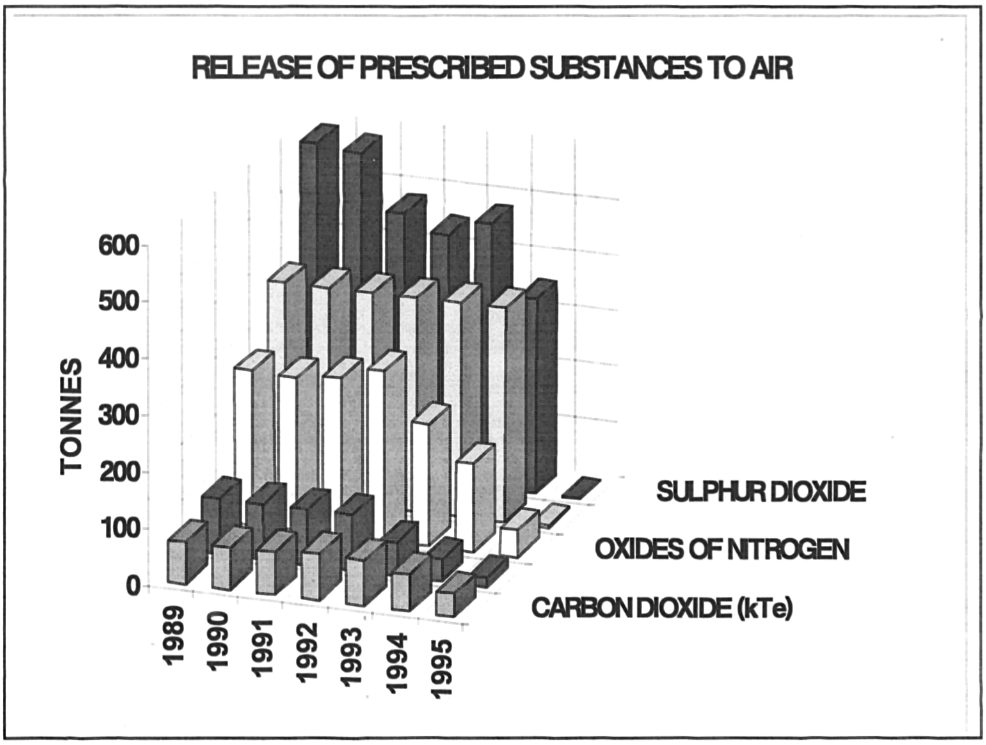


Table 7. 17: Reduction in special waste and resource consumption resulting from the EMS at Shields Special Metals Ltd (from Shields Special Metals, 1996)

Waste Category	*Waste / Resource Consumption*			*Waste / Resource Consumption per tonne of material recycled*		
	1994	*1995*	*Reduction*	*1994 (kg)*	*1995 (kg)*	*Reduction*
Components containing asbestos	18.67 te	2.35 te	87%	1.47 kg	0.25	83%
Components containing mercury	3.11 te	0 te	100%	0.24 kg	0	100%
Components containing PCBs/PCNs	92.02 te	61.28 te	33%	7.22 kg	6.57	9%
Copper nitrate sludge	$13.6m^3$	$13.6m^3$	0%	$1.06 \times 10^{-3} m^3$	$1.45 \times 10^{-3} m^3$	-37%
Inert items	142 te	110 te	22%	11.15 kg	11.80	-6%
Nitric acid consumption	2,575 litre	1,830 litre	29%	202.26 kg	196.42 kg	3%
Sodium hydroxide consumption	3,000 litre	2,000 litre	33%	235.64 kg	214.66 kg	9%
Electricity consumption	37,844 KWh	57,851 KWh	-53%	2972.59 kg	6209.19 kg	-109%
Water consumption	$291\ m^3$	$352m^3$	-21%	$0.02\ m^3$	$0.04\ m^3$	-100%
Vehicle fuel	187,422 litre	193,064 litre	-3%	14.72 litre	20.72 litre	-41%
Diesel forklift truck fuel	8,947 litre	7,400 litre	17%	0.70 litre	0.79 litre	13%

Table 7. 18: Environmental improvements resulting from converting boilers from coal to gas at Solvay Interox Ltd

♦ 93% efficiency versus 80% for old coal fired process
♦ 4000 less heavy goods vehicle movements per year
♦ 500 tonnes less sulphur dioxide (SO_2) gas emissions per year
♦ 200 tonnes less oxides of nitrogen (NOx) gas emission per year
♦ 400 tonnes less dust emissions per year
♦ Over 10,000 tonnes less carbon dioxide (CO_2) per year
♦ 15% improvement in site environmental performance index
♦ Significant reduction in local resident complaints

Continual improvement requires an ongoing process of evaluating effects and implementing improvements. Individual effect's significance will vary with time as legislation, stakeholder's opinions and environmental knowledge changes. By regularly repeating the effects assessment new issues are identified as their importance increases. At Solvay Interox the second assessment, undertaken a year after the first, identified some effects having increased in significance (Table 7.19). This was due to tighter legislation, improved understanding of impacts, increased complaints or increased environmental incidents. In this way the EMS provided a safeguard against the deterioration of environmental performance from the failure to acknowledge changing circumstances.

Ghobadian (1998) argues that companies do not necessarily, or inevitably, pursue a linear approach towards environmental excellence. In fact they can jump from position to position as the various factors determining their behaviour change. This research has demonstrated that companies are motivated to address the environment by external factors such as customer pressure and tightening legislation (Chapter 8). It can be predicted that such factors will also influence the extent to which a company with an EMS seeks to continually improve their performance. Certified companies studied as part of this research have demonstrated a wide variety in terms of the extent to which they seek to continually improve (Chapter 5).

Table 7. 19: Effects increasing in significance between 1995 and 1996 at Solvay Interox Ltd

Description of Effect	*1995*	*1996*	*Explanation*
VOCs from carbon beds	Med/High	High	Tighter legislation
pH of Capa process effluent	Low	High	Increased incidents
Temperature of Capa effluent	Low	High	Changed opinion
Effluent from new distillation plant	-	Med/High	New development
Disposal of brine wash waste	Med	High	Increased incidents
COD of new Capa plant effluent	-	Med/High	New development
Flow rate of persalts effluent	Low	Med/High	Tighter legislation
Hg / Cd in boiler house effluent	Low	Med/High	Changed opinion
Halons in fire extinguishers	Low	Med/High	Tighter legislation
Effects from office activities	Low	Med/High	Changed opinion

7.9. AN EMS AS A STRATEGIC TOOL

Traditionally the focus of industrial environmental management has been legal compliance. EMSs were first developed to help high impact industries with a significant risk of public and legal exposure (Sutton, 1997). This has led to direct pollution, through air emissions, water pollution and waste, typically being treated as the highest priority, even in companies certified to an EMS standard (Sheldon, 1995a) (Table 7.16) (Chapter 5). This largely reflects the current regulatory framework and fear of environmental prosecution.

Longer term issues such as raw material acquisition, design, research and development are also important to an organisation's survival. Today's global issues such as global warming, ozone depletion and natural resource shortages will be the focus of future policy and legislation (Chapter 10). Organisations who anticipate future trends and consider the impacts on their businesses will be better prepared for the future. Those who look to reduce their consumption of solvents, for example, will position their business to ensure its future survival. In comparison those who install expensive abatement equipment may find that emission limits become progressively tighter and abatement equipment increasingly expensive. By treating environmental problems at source a longer term approach is achieved.

EMSs are important in helping industry become more strategic. The Swiss Business Environment Barometer 1997/98 surveyed 250 organisations across Europe and found those with an EMS considered long-term, pro-active, market-oriented strategies to be more important (Baumast, 1998). This is further substantiated by the Institute of Environmental Management's 1996 survey which showed that EMSs are important in helping an organisation take a strategic approach (Institute of Environmental Management, 1996a).

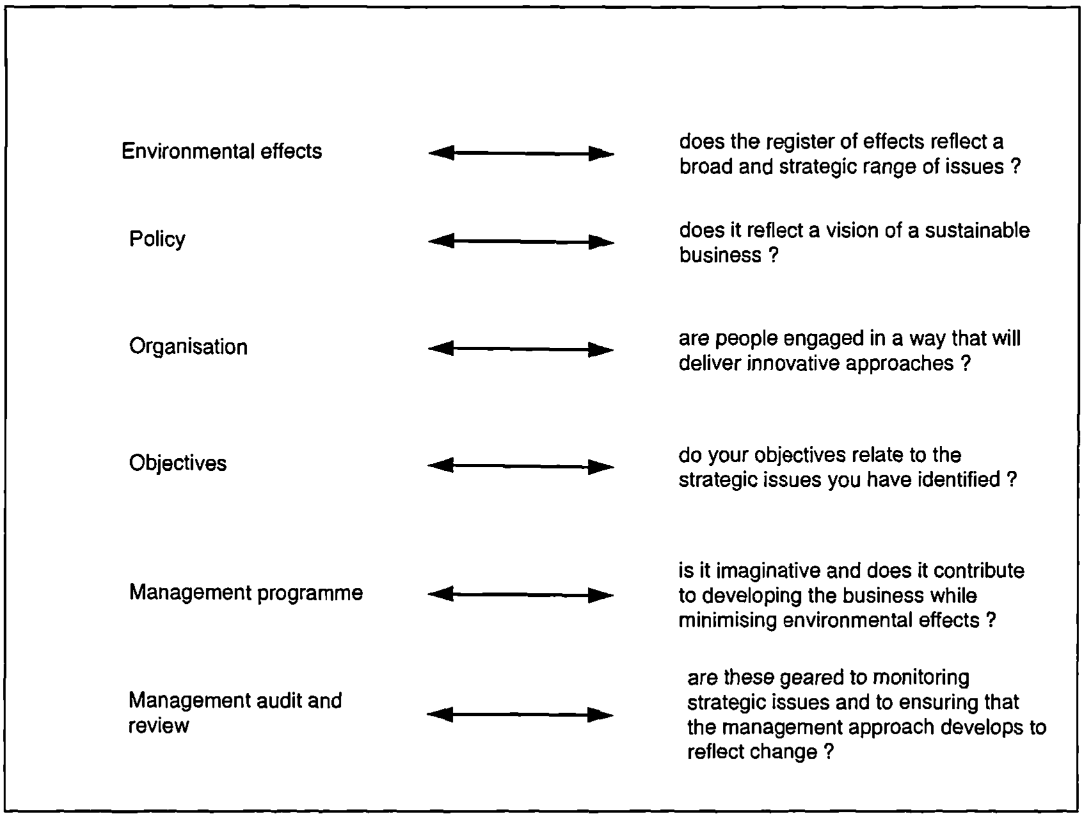
Systems provide regular mechanisms to re-evaluate company strategy and identify emerging environmental issues. The effects assessment, register of regulations and management review all require the company to consider future risks and government policy. The need for continual improvement and the requirement to consider the views of interested parties also have the potential to move environmental management towards a sustainability-seeking orientation (Sutton, 1997). The standards also suggest that life-cycle assessments could be adopted to assist in product design (British Standards Institution, 1996a) although none of the companies participating in the survey had adopted such detailed approaches.

By spreading responsibilities throughout the organisation an EMS can also liberate the environmental manager to spend more time analysing and advising on strategy. National Power's EMS significantly reduced the time spent by the staff at Head Office on environmental auditing. Previously a team spent 5 days auditing each of the 13 sites every two years. As they now have their own internal auditing systems, and are audited every six months by EMS assessors, a simple annual audit lasting one day is sufficient for each site. This has allowed the Group Environmental Co-ordinator's role to become more strategic, concentrating on the commercial issues and longer term legislation rather than short term compliance (Institute of Environmental Management, 1996c).

Whilst EMSs can assist companies in developing a strategic approach having a system in place does not equate to being strategic. Environmental managers need to ensure strategic environmental issues are incorporated into their systems (Figure 7.6) (Chapter 10). Critical to the development of a strategic outlook is knowledge of a constantly shifting agenda so as to anticipate and prepare for change (Institute of

Environmental Management, 1996c). Bench-marking against other countries and competitors can assist in identifying weaknesses in existing management systems. Sweden and Norway, for example, often adopt the toughest environmental criteria. An understanding of their legislative framework can help to ensure future compliance with legislation elsewhere. There are also a number of documents which outline current scientific facts, policies and strategies. The European Environment Agency's state of the environment report *Europe's Environment: The Dobris Assessment:* identifies 56 key environmental issues for Europe (European Environment Agency, 1995). In addition annual reports to *This Common Inheritance: Britain's Environmental Strategy* outline future UK policies and commitments (Department of the Environment, 1990) (Chapter 10).

Figure 7. 6: Developing an EMS as a strategic tool (from the Institute of Environmental Management, 1996b)



7.10. SUMMARY

The adoption of an EMS standard requires some key changes to management practices and company culture. Firstly, it is necessary to embrace a holistic and dynamic approach where EMS components are closely inter-related and dependent upon each other. This differs from traditional environmental management, still operated within the majority of companies without formal systems, where the tendency is to focus on a limited number of unrelated activities. To ensure EMSs deliver year on year improvement in performance it is necessary to adopt a broad scope by considering as many elements as possible in the effects assessment.

By specifying the individual requirements of an EMS the standards can provide a useful model to assist companies with less comprehensive systems to manage their environmental impacts. For those with their own formal in-house systems the standards can strengthen existing systems and improve links between environmental management elements.

It is inevitable that introducing a formal system, meeting the requirements of a recognised standard, will involve increasing documentation. However, certified companies do not perceive this to be a disadvantage. Documented procedures ensure that staff are aware of their responsibilities and are particularly useful during periods of staff absence or turnover. They can also allow managers to liberate their time by facilitating the delegation of tasks throughout the organisation.

Formal systems are beneficial in improving planning and decision making. In companies with limited previous understanding of their environmental impacts adopting a standard can assist in identifying the significant issues. Whilst a formal system may be less valuable in improving understanding for companies with more in-house expertise, it provides reassurance that decision making is based on a full environmental assessment. Issues can also be identified which have previously been overlooked. External certification is beneficial by ensuring the system is updated and new issues identified as they become significant.

One of the major barriers in implementing an EMS is employees resistance to change. Overcoming this requires substantial effort but yields significant benefits. Many of those organisations responding to the survey cited improvements in employee awareness and motivation as the most beneficial outcome of having implemented the system. A variety of mechanisms are being adopted by certified companies to achieve the desired levels of employee environmental awareness. In particular employee involvement in local environmental improvement projects, such as landscaping or conservation, can be particularly beneficial.

A key test of the success of EMSs is the extent to which they are successful in improving environmental performance. The survey results illustrated a substantial range in the nature and level of improvement sought. Detailed data on environmental performance is difficult to obtain but can be found by reviewing environmental statements produced for EMAS registration. These indicate that whilst certified companies can frequently demonstrate significant improvements in some areas this does not typically occur in all areas of activities.

An EMS can assist companies in developing a more strategic approach (Baumast, 1998) (Sutton, 1997). Consideration of issues of future importance can be incorporated into the effects assessment, register of regulations and the management review. By tackling these issues earlier companies can avoid future problems and costs by predicting the focus of UK and EC legislation (Chapter 10).

CHAPTER 8

8.0. EMS DRIVERS AND BENEFITS

8.1. INTRODUCTION

Companies adopting the EMS standards and seeking external certification are motivated by various reasons. Their perceptions regarding the extent to which their organisation may benefit will have played a critical part in their decision to adopt a systematic approach. Due to the recent nature of the standards there remains a lack of comprehensive data on which to base these decisions. This is leading to uncertainty within industry and causing many companies to delay their decision until more substantial evidence is available (Chapter 2). It is essential that the experiences of certified companies are evaluated to assist others in making an informed decision regarding whether a formal EMS is the most appropriate option for their organisation.

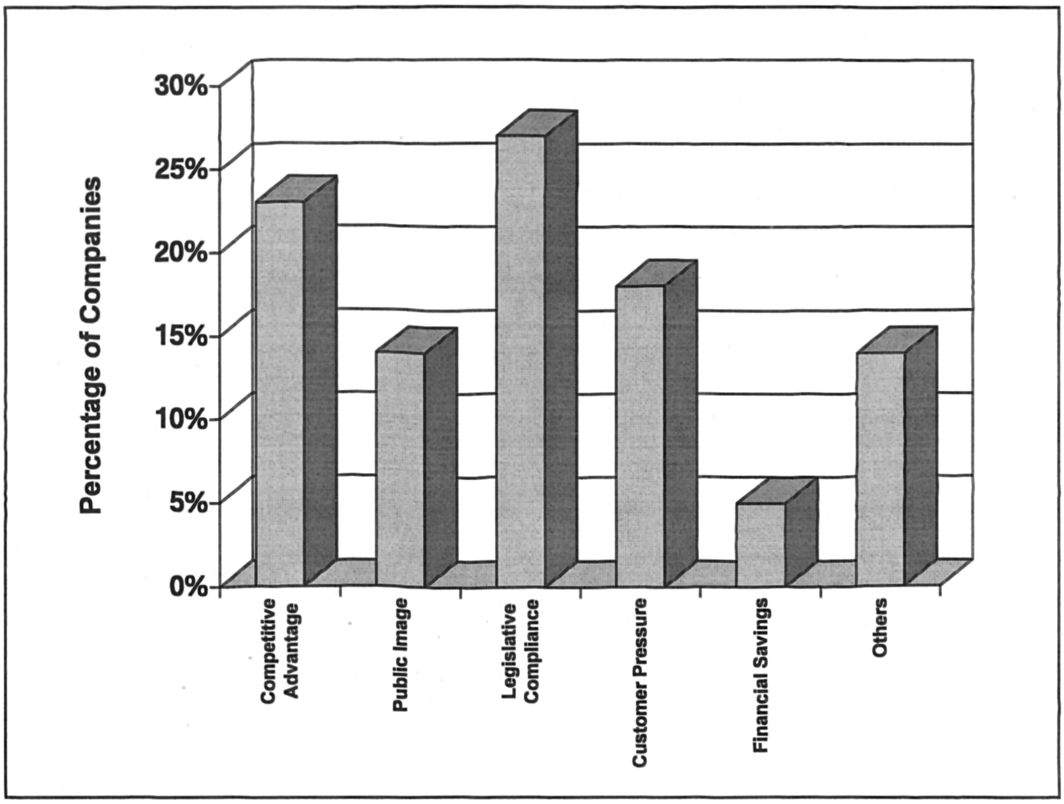
This chapter identifies and evaluates the benefits of adopting an EMS standard. Evidence is drawn from all four phases of the research including the desk study, the experience survey, the five detailed case-studies, and the applied research at Solvay Interox Ltd. Improvements in operational efficiency, competitive advantage, public image, legal compliance, supplier performance and access to capital, investment and insurance are considered. The extent to which the benefits vary between organisations is analysed by consideration of the impacts of independent and moderating variables (Chapter 3). Independent variables requiring consideration include company size, industrial sector, nature of environmental effects, degree of regulation, location and the markets in which the company operates. Potentially moderating variables include the company's starting position; their driver for implementation; the particular standard adopted; the extent of integration with other systems and the degree of employee training and involvement.

8.2. EMS DRIVERS

The survey of certified companies indicated the main drivers for EMS implementation were legislative compliance (29%) and competitive advantage (24%) (Figure 8.1). The desire to achieve financial savings or improved public image were considered less important. Several companies were motivated by pressure from their parent company. Epson Telford, owned by a Japanese company, implemented their system as a pilot for group wide implementation of ISO 14001.

These findings are consistent with those of previous research (Ghobadian, et al.,1998) (McKenna, et al., 1996). A survey of 84 top UK companies carried out by consultants Arthur D Little found external factors such as legal compliance (69%) and competitive advantage (41%) were considered to be more important than internal improvements in process efficiency (31%) (ENDS Report 252b, 1996) (McKenna, et al., 1996).

Figure 8. 1: Motivating factors for EMS implementation



Legislative compliance was particularly important for companies prescribed as Part A, under the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991*. Three of the four Part A companies (75%) reported legislative compliance as the main driving factor. It was also the main motivating factor for chemical companies, reflecting their tighter regulation (Table 8.1). In comparison, small and medium sized enterprises (SMEs), which tend to be less tightly regulated, were mainly motivated by the desire to achieve a competitive advantage. This is particularly important as they are often suppliers to larger organisations, who are often the earliest adopters of the EMS standards (Business and the Environment, 1997).

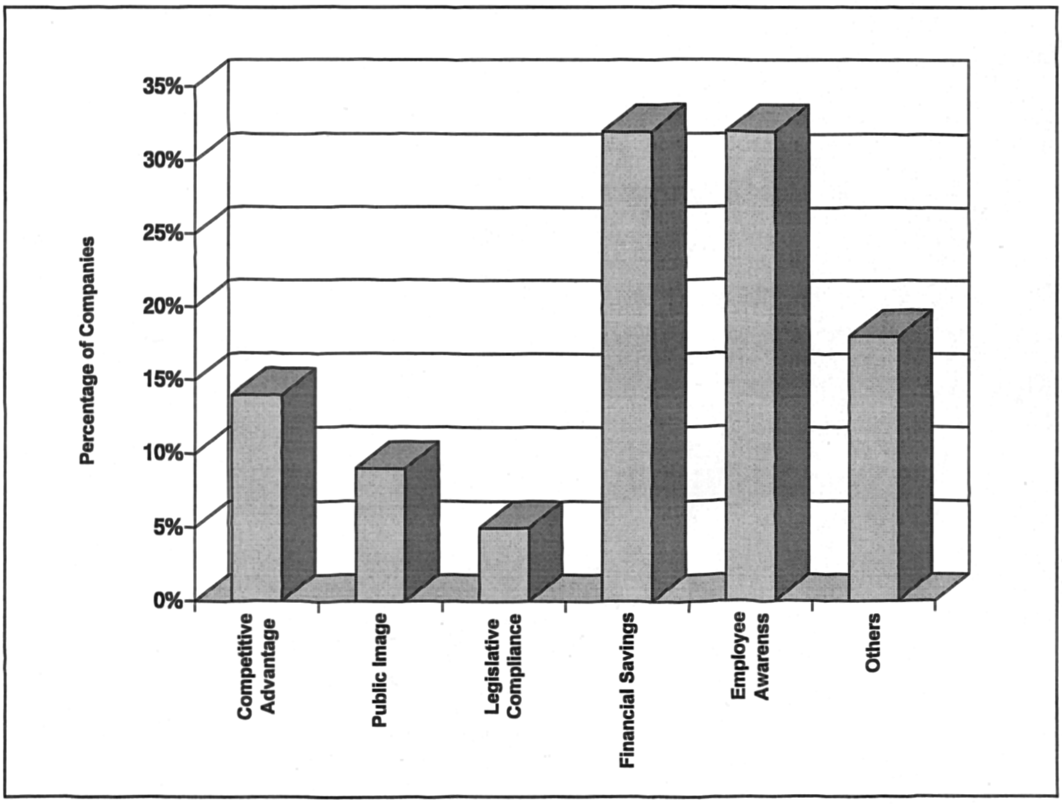
Table 8. 1: Main EMS drivers versus industrial sector within participating companies

Industrial Sector	***Number of companies vs motivation***					
	Competitive advantage	Public image	Legislative compliance	Customer pressure	Financial	Other
Chemicals			3		1	
Metal products	1	1	1			
Paper products and printing	2	1				
Electricity, gas and water supply				1		
Wood and wood products					1	
Rubber / plastic products		1				1
Electrical and optical equipment						1
Refined petroleum products			1			
Other machinery and equipment			2	1		1

8.2.1 EMS DRIVERS VERUS BENEFITS

At the time of the survey, approximately a year after certification, participating companies reported cost savings and improved employee motivation to be the most significant benefits (Figure 8.2). This conflicts with their reasons for initially adopting the standard, which were mainly to achieve legislative compliance or competitive advantage (Figure 8.1). This illustrates that prior to implementation companies often underestimate an EMS's potential to reduce costs and improve employee motivation. Those reporting employee awareness to be one of the most significant benefits had consistently involved them during implementation and undertaken substantial training exercises (Chapter 7). In SMEs improvements in competitive advantage were reported to be equally as important as cost savings (27%), with employee motivation being less significant (18%). This can be explained by the generally more effective communication present within smaller companies, which often manifests itself in higher motivation levels.

Figure 8. 2: Main benefits reported by companies participating in the survey



Similar results were found by SGS Yarsley in their 1996 survey of 500 organisations across France, Germany and the Netherlands. The main driving factors were external forces such as regulatory compliance, customer pressure and improved market share (ENDS Report 261, 1996) (Environment Business, 1996a) (SGS Yarsely, 1996) (Table 8.2). After certification these were of least importance and the clearest benefit was improved staff awareness followed by reduced pollution, legislative compliance, reduced risks and waste, and finally better working conditions. This clearly suggests that organisations frequently underestimate the long term impact of an EMS on motivating employees and improving operational efficiency.

Table 8. 2: Driving factors for EMS implementation (SGS Yarsley, 1996)

Motivating Factor	*Percentage of Companies*
Compliance with legislative requirements	81%
Improved market share	80%
Customer pressure	78%
Public recognition	64%

8.3. COST SAVINGS & EFFICIENCY IMPROVEMENTS

It is well established that environmental initiatives can result in financial savings through waste minimisation, reduced raw material consumption and improved energy efficiency (Environmental Business, 1996a) (Alleid Colloids, et al., 1995) (Hill, et al., 1994 and 1995) (Aspects International, et al., 1994) (Gray, et al.,1993). These initiatives have the potential to substantially affect profitability as waste costs both to produce and during disposal. Cost savings represent an on-going annual contribution to profit (Little, et al., 1992).

Since the publication of the EMS standards a large number of certified companies have published data on cost savings. Layezee Beds, Wolstenholme International, Design for Distribution, Birds Eye Walls and Vauxhall Motors all published savings from their EMS in excess of £100,000 per annum. Birds Eye Wall's ice cream factory in Gloucester, employing 1,000 staff on its 84 acre site, saved £250,000 per annum (ENDS Report 264b, 1997). Vauxhall motors, with over 4,000 employees at their site in Ellesmere Port, saved £120,000 in electricity in six months in addition to £43,000 through reducing landfill waste (Healy, 1995). National Power turned around its £200,000 annual bill for general waste disposal into a profit of £26,000. A member of staff was assigned responsibility for waste minimisation on site. This resulted in investment in crushers for drums and fluorescent light bulbs, recycling waste oils and the purchase of a waste compactor. Used materials are re-sold wherever possible and contractors have been asked to remove the waste they generate whilst on site (ENDS Report 247, 1995).

The review of published literature indicates that savings are not limited to larger organisations. Renlon Ltd is an example of a small company gaining significant savings from their EMS (Hill, et al., 1995). They have a turnover of £6 million and employ approximately 60 people in the business of property preservation through pest control. The initial review and effects analysis achieved savings of £22,000 per annum. Returning chemical drums for re-use reduced special waste disposal by £1000 per annum. Replacing their transport fleet with diesel vehicles and the establishment of an energy efficiency programme gave annual savings of £17,000 a year. In addition the more effective control of printing and stationery using recycled paper, saved over £4,000 annually.

In December 1996 the Department of the Environment published case studies from EMAS registered companies (Table 8.3) (Department of the Environment, 1996b). Layezee beds, a member of the Silent Night Group, employs 350 staff and manufacturers 7,000 beds a week, at its West Yorkshire site. The company was one of the first to gain certification to BS 7750 and EMAS. The introduction of their EMS resulted in financial savings of more than £250,000 per year in waste reduction, energy conservation and the recycling of vehicle washings (Hillary, 1995). Design to Distribution (D2D), a wholly owned subsidiary of ICL, are one of Europe's leading electronics manufacturing businesses. They design, manufacture and test base and assembled circuit boards at their plant in Kidsgrove, Staffordshire. Their CFC eradication programme, completed in 1991, is now saving over £250,000 per annum and the move to videoconferencing has reduced mileage by 750,000 per annum (Environmental Excellence, 1995). Since adopting BS 7750 they have achieved financial savings of £290,000 per annum on process chemicals alone, giving a payback on the £1 million investment in new capital equipment in 3 years (ENDS Report 242, 1995).

***Table 8. 3*: Financial savings achieved through EMAS (Department of the Environment, 1996d)**

Company Name	***No of Employees***	***Business Activity***	***Quantification of Savings***
Loudwater	< 250	Greeting card manufacture	£20,000
Woodcote Industries	230	Engineering and forging	£250,000
Layezee Beds	350	Bed manufacture	£250,000
Design to Distribution	> 250	Electronics	£3 million

The emprical data collected from the experience survey of 22 certified companies found that in 77% of cases an EMS results in financial savings. In 45%, companies were able to estimate the value of these savings (Table 8.4). At the time of the survey savings ranged from £30,000 (Carson Office Furniture, 160 employees) to £500,000 per annum (BICC Cables, 350 employees) (Table 8.5). Due to a lack of comprehensive environmental accounting systems, these may be an underestimation in some cases as they include only the more significant savings rather than those resulting from every improvement.

***Table 8. 4*: Extent to which EMS led to financial savings in participating companies**

Response	***Percentage of Companies***	***No of Companies***
Financial Savings Achieved	77%	17
Financial Savings Achieved & Quantified	45%	10
No Financial Savings	23%	5

The main variable influencing the value of savings achieved is company size. Those employing over 250 staff averaged annual savings of £170,000, with a maximum of £500,000. In comparison SMEs achieved an average annual savings of £60,000 with a maximum of £100,000. These results are consistent with those found by a programme undertaken by the Rover Group to implement BS 7750 and EMAS with six of its automotive parts suppliers. They also found that savings in smaller companies ranged from £60,000 to £100,000 per annum (Business in the Environment, 1997) (Rover Group, 1994).

Table 8. 5: Sources & Quantification of Financial Savings from EMSs

Company Name	**Source of Savings**	**Savings (/ year)**	**No of Employees**
Akzo Nobel Chemicals	• Reduced water usage • Reduced energy usage • Office paper recycling • Process improvements	£80,000	132
Applied Chemicals	• Waste reduction techniques • Energy and natural resource minimisation	£100,000	150
BICC Cables	• Waste minimisation	£500,000	350
Carson Office Furniture	• Waste minimisation	£30,000	160
Epson Telford	• Paper recycling (£105k/a) • Returning pallets (£24k/a)	£130,000	1,700
NDM Manufacturing	• Waste reductions • Energy savings	£50,000	650
P P Payne	• Waste reduction (£13k) • Disposal costs (£7k) • Others (£30k)	£50,000	252
Philips Components	• Energy reduction • Water reduction • Reduced waste disposal.	£150,000	400
Ricoh Products	• Reduced toner waste (£30k) • Water usage reduction (£45k) • Energy reduction (£40k) • More reconditioning (£100k)	£100-200,000	740
Shields Special Metals	• Decommissioning of labs • Reduced acid / alkali use • Landfill of Cu nitrate sludge	£35,000	100

Four companies (23%), reported that no savings had been experienced within the first year. There are three reasons why this may be the case. The first is that limited data is available on waste and resource costs. In such organisations it is necessary to establish a monitoring system before it is possible to identify and implement cost saving opportunities. The second reason is that comprehesive waste minimisation surveys have already been undertaken. The adoption of an EMS standard may not therefore immediately identify further savings. This was reported to be the case at Anaplast Ltd, who felt all savings had been achieved prior to BS 7750. The third explanation is that there is minimal scope within the organisation. This would be the case in a small company, who perhaps only spends £1000 a year on energy and have their waste collected weekly by the council. A 10% reduction in energy consumption will only result in savings of £100 per annum. This illustrates that substantial financial savings are most feasible in companies with high resource consumption and waste disposal costs (Chapter 10). In addition savings will be particularly apparent in companies who have not previously considered waste minimisation where there will be ample opportunities for improvement.

The detailed case study research found substantial variety in the cost savings achieved. The greatest improvements were achieved at BICC Cables and Autosmart Ltd. BICC Cables, employing 350 staff in the manufacture of telecommunication cables, achieved annual savings of £500,000 through the introduction of waste minimisation and cable recycling. Autosmart Ltd, employing 55 workers in the manufacture of water-based cleaning chemicals, reported increased efficiency to be the most significant benefit of their EMS. Savings were achieved by reviewing existing procedures with an improved understanding of environmental impacts (Pers. comm. Munro, 1996). Experiments found that certain products could be manufactured cold as opposed to hot, yielding savings in energy consumption. Effluent disposal costs were renegotiated and effluent volumes reduced by the introduction of formal washdown procedures. Savings were re-invested into the company and contributed towards preventing a price increase in the last three years (Robinson, 1996).

Table 8. 6**: **Re-investment of savings at Autosmart Ltd achieved through their EMS

Investment	***Added Benefits***
Redesign of the manufacturing facilities	Reduced effluent and spillages
Purchase of in-house labelling facility	New export markets
	Reduced heating of storage buildings
Purchase of aerosols filling equipment	Reduced contractor costs
Improved chemical storage	Reduced liabilities

In 1997 Contract Chemicals was succesful in reducing water consumption by 8%, equivalent to over £10,000, and anticipated electricity savings of 900MWh, equivalent to approximately £60,000 (Contract Chemicals, 1997). In 1996 J & J Makin achieved annual savings of £50,000 by eliminating the use of heating oil and reducing electricity consumption by 33% and gas by 70% from consolidating all activities in one building. However, since then no further programmes had been established for waste minimisation and limited employee training had been provided (Chapter 5). Thomas Swan felt their system had led to partial savings but could not estimate these in financial terms. This can be explained by the large influence of tightening legislation on their decision to adopt an EMS. Their system was largely compliance focused and substantial emphasis was paid to risk minimisation.

A number of factors contributed towards BICC Cables' and Autosmart's success in achieving cost savings. Both companies were motivated by the desire to achieve a competitive advantage rather than to reduce liabilities or improve public image. This enabled them to focus on areas which would result in cost savings or improved market position. As environmental management was new to both of them there was substantial scope to save. Their environmental commitment was illustrated by their choice of a senior manager, with significant knowledge of the business, as EMS champions. These individuals demonstrated considerable enthusiasm and ability to motivate others. Their responsibilities included Total Quality Management and substantial effort was committed to employee training and involvement (Chapter 6). Environmental management was integrated with an existing ISO 9000 system and assumed a high profile within the organisation.

At Solvay Interox Ltd substantial waste minimisation reviews, prior to the implementation of the EMS, had identified potential savings in excess of £1 million per annum. Improvements yielding annual savings of £272,420 were implemented during 1994 and 1995 (Table 8.7). This illustrates that substantial savings can be achieved without a full EMS (ENDS Report 255a, 1996) (Hill, et al.,1994 and 1995) (ENDS Report 217, 1993). Alleid Colloids in Bradford worked with HMIP on their high profile "3Es" project looking at emissions, efficiencies and economics. They demonstrated annual savings of over £400,000 at little capital cost (ENDS 255a, 1996) (Allied Colloids, et al., 1995). Many regional waste minimisation projects such as the Aire & Calder Project, Project Catalyst, Merseyside Waste Demonstration Project achieved similar results. Project Catalyst, the largest waste minimisation project in the UK, involved 14 participating companies from a wide range of industries. It was funded by the Department of Trade and Industry and the BOC Foundation and delivered by Aspects International, March Consulting and WS Atkins. During the 16 months potential savings totalling £8.9 million a year were identified across participating companies. Savings of over £2.3 million were implemented before the end of the project (Aspects International, et al., 1994).

Table 8. 7: Financial savings achieved at Solvay Interox Ltd through waste minimisation

Plant	***Source of Savings***	***Annual Savings (£)***
AO	Reduction in disposal costs by conversion of AO Tars to sewer.	£7,000
AO	Reduction in labour and raw material usage by improved filter cleaning.	£48,240
AO	Reduced hydrogen usage by continuous addition of catalyst.	£22,680
AO	Increased ratio of well water to mains water usage	£15,000
Boilers	Reduced mains water usage on compressors	£81,000
Persalts	Conversion of scrubber from water to process liquor	£20,000
Capa	Filter cleaning modifications	£58,500
Capa	Improved cooling of stripper / fractionator	£20,000
		£272,420

Although financial savings are possible in isolation, waste minimisation forms a critical part of an EMS. The main benefit of a full system is the ongoing process of identifying improvements. The effects assessment and objectives and targets provide a formal process for continually identifying cost savings. Certification to an EMS standard will ensure waste minimisation is not a one-off exercise.

As environmental performance improves it can be predicted that traditional efficiency gains will become harder to achieve and less spectacular. Companies may reach a stage whereby the majority of low cost savings have already been achieved. This was reported to be the case by the Rover Group, based on their experiences of EMS implementation in six of their suppliers. It was more difficult for companies with good environmental performance to make additional improvements without considerable capital investment (Business and the Environment, 1997). Such expenditure must be linked to cost-benefit analysis and will depend on capital availability within the organisation. In the future, the feasibility of certain projects may improve as waste disposal and resources costs increase. An example is the landfill tax introduced in 1996 which greatly increased waste disposal costs and provided an additional incentive to reduce waste at source (Chapter 10).

The more strategic companies are realising that although traditional efficiency gains may become harder to achieve the development of a longer-term approach will lead to future savings. As discussed in the previous chapter an EMS can assist companies in developing a more strategic outlook. As external costs in terms of detriment to the environment form the basis of future international and EC policy companies considering the impacts of such policies on their businesses will become more competitive in the future. Examples include incorporating environmental life-cycle into design procedures and redesigning products and processes (ENDS Report 254b, 1996) (Chapter 10).

8.4. COMPETITIVE ADVANTAGE

Educated customers are increasingly encouraging their suppliers to improve their environmental performance. This has led to environmental criteria beginning to be built into procurement requirements. In 1991 B & Q took the lead by requiring that all suppliers demonstrate environmental commitment through a documented policy and only use timber from managed forests (Knight, 1995 and 1996). Each supplier completes a detailed questionnaire used to grade their performance from A to F. This depends on the nature of timber and packaging used, the existence of supplier audits, the import of products from developing countries and the use of hazardous chemicals. Suppliers Graded F were required to achieve a Grade C by July 1994 and Grades D and E by November 1994. Failure to meet these deadlines led to 14 suppliers being removed from B & Q's approved supplier list.

Since 1991 many other companies, including British Gas, British Telecommunications, The Rover Group, Jaguar and IBM have begun to make similar demands on their suppliers. Through the use of a generic purchasing standard British Telecommunications built environmental considerations into their tendering process for products and services. Environmental performance, together with product reliability, quality and functionality, is used to choose suppliers. In 1993 an Environmental Purchasing Panel, consisting of industrialists, environmentalists and academics from across Europe, was established to advise on environmental issues relevant to procurement (British Telecom, 1996). Their focus in 1995-6, due to continued public concern, was the procurement of paper and print. All suppliers are required to submit details on forest management practices, energy consumption, de-inking processes and emissions to air and water. The specifications were reviewed in 1995/6 to require suppliers to provide more information on potential eco-toxic effects of effluents and to tighten their limits for emissions to water and air. The next stage for BT is to make procurement specifications relating to other products and services more stringent.

A certified EMS can provide an easier answer to customers' enquiries regarding environmental performance. In some cases certification is necessary to meet their expectations and secure new contacts. Inaction may reduce market share by excluding companies from approved supplier lists. This will give competitors responding more rapidly to customer pressure an advantage. In 1997 the Rover Group told their suppliers they were expected to achieve ISO 14001 or EMAS by the end of 1998 (Business and the Environment, 1997). In April 1998, IBM wrote to over 900 suppliers specifying their commitment to purchasing from environmentally responsible companies and asking them to achieve certification to the standard (ENDS Report 280, 1998). These represent two of many companies placing such demands on their suppliers.

An EMS can improve competitive advantage by encouraging organisations to develop less environmentally damaging products. This was the case for several companies responding to the Institute of Environmental Management's 1996 survey of members (Institute of Environmental Management, 1996c). In light of recent water shortages a company involved in the manufacture of car cleaning products realised they needed to look for alternative products and services to increase their market share. They created new opportunities from negative situations. Another company manufacturing equipment for the oil and gas industries for over 100 years realised that there were limitations in the longer term to their existing market place. The environment gave them the chance to develop a new market by diversifying products whilst still capitalising on existing skills.

It is difficult to directly attribute increased sales with improved environmental performance as many other factors are involved. Increases in market share are likely to be attributable to a wide variety of factors, one of which may be the existence of an EMS. Loudwater Litho, a Watford-based printer, was the first small company in the UK to achieve registration under EMAS. They found the ability to prove environmental credentials resulted in the company securing many new contracts, particularly with blue-chip companies who would not have previously considered them. In the first 18 months following registration turnover doubled to nearly £5 million (Department of the Environment, 1996b). Tioxide's Grimsby plant is finding their EMS helps sales of pigment to its Scandinavian Markets (ETBPP, 1998) (Garrett, 1998a). Thomas Swan & Co reported that at least two additional contracts for manufacture of speciality chemicals were won, in part due to their certified EMS (Garrett, 1998a).

The emprical data from the survey indicated that 45% of companies believed their EMS resulted in a competitive advantage during the first year after certification. Autosmart Ltd, who export to Scandinavia, Australia, Ireland and Europe achieved significant improvements in market position through training their sales force to communicate their environmental commitment to customers. When a Swedish company, Johnny Lance, was looking to the UK for a supplier they won the contract because of their BS 7750 certification. Their substantial internal efficiency improvements contributed to preventing a price increase in three years resulting in domestic sales increasing by 20% and exports by 120% (Robinson, et al.,1998) (Business and the Environment, 1997). They also realised they could transfer their improved vehicle washing procedures to customers and achieve a marketing advantage. By switching to a cold-spray device and reducing application and washing times by using a higher concentration of chemical they could demonstrate savings of £19,000 per annum to one customer. None of their competitors provided the same level of service and this helped secure the customer's account (Robinson, et al., 1998).

Shields Special Metals considered the main benefit of their EMS was the ability to secure contracts with major plcs. The company has a long-term contract with BT to safely dismantle electro-mechanical materials, to ensure the safe disposal of hazardous materials (eg PCBs) and to recover precious metals and other materials for recycling. Their commitment to BS 7750 originated from the Managing Director, Gordon Shields, who recognised the need to differentiate the company from the less responsible scrap metal merchants (Clark, 1995). Certification led to them being included in BT's qualified supplier list. They were highly commended in their Environmental Supplier of the Year Award in their first year of entry and became winners the following year (Shields Special Metals Ltd, 1996).

The ability to demonstrate a high level of environmental performance, by certification to an EMS standard, is particularly important for companies exporting to Europe. European companies are taking the lead in EMAS registration and therefore require high standards from their suppliers. Epson Telford Ltd, who employ 1,700 staff in the manufacture of computer printers, reported certification had significantly helped to meet the requirements of their German customers.

Customers at Solvay Interox had been enquiring about environmental performance since 1992. Enquiries relating specifically to the adoption of an EMS standard have ranged from 1 to 4 a year (Table 8.8). One EMS certified customer, Thomas Swan Ltd, visited to undertake an environmental audit. A questionnaire was completed covering a range of issues. Commitment to an EMS standard contributed towards the achievement of a Grade A in the assessment. Although it is difficult to exactly measure improvements in competitive position should the existence of an EMS result in a 1% increase in turnover, for example, this would increase revenue by £70,000 a year.

***Table 8. 8*: Number of environmental enquiries received from customers at Solvay Interox Ltd**

Year	***Environmental Enquiries***	***Enquiries Regarding EMS Certification***
1992	1	1
1993	6	4
1994	1	1
1995	2	2
1996	4	4

The extent to which an EMS improves competitive advantage depends on the markets in which an organisation operates. At present companies supplying corporate organisations, who themselves are likely to be the first to gain EMS certification, are more likely to enhance their market position. This is also true of those supplying countries with high environmental standards, such as Germany and Scandinavia. Pressure from customers is also influenced by industrial sector. Those associated with a negative image, such as the paper, wood or automobile industry, are more likely to experience supply chain pressure. This is likely to spread to other sectors as the uptake of ISO 14001 becomes more widespread. Companies responding more rapidly to the environmental challenge will experience an enhanced competitive advantage in the future.

8.5. IMPROVED PUBLIC RELATIONS

EMS certification can help to demonstrate to the general public, as well as customers, commitment to the environment. It provides an answer to public pressure for independent evidence on a company's environmental performance. EMAS is particularly likely to improve public image through the publication of the externally validated environmental reports. This gives an organisation increased credibility and allows improvements to be demonstrated in the context of previous mediocre performance.

The experience survey indicates improved public image to be an important benefit of EMS implementation. 82% of participating companies scored the improvement to be 3 or above on a scale of 0 (no improvement) to 5 (substantial improvement) (Table 8.9). Improvements to public image were considered to be particularly important in SMEs with 92% of participating companies scoring 3 or above. This illustrates that improved public image is significant for a wide range of industrial sectors and is not limited to those high impact industries associated with a traditionally negative public perception.

Dunlop Precision Rubber experienced some of the biggest gains from implementing an EMS in improved public relations. The company became better perceived by its local communities and employees became increasingly reassured by the national recognition regarding the company's environmental commitment (King, 1995b). Shields Special Metals Ltd were invited to present to the Department of the Environment and Ministry of Defence on integrating the environment into purchasing after the introduction and certification of their EMS. They also presented to a workshop on Environmental Issues with British Telecommunications (Shields Special Metals Ltd, 1996).

Table 8. 9: ***Perceptions of the extent to which EMS improved public image***

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	0	9	9	32	32	18

Improvements in public image can be achieved by a variety of mechanisms. BICC Cables, initiated several projects to strengthen links with the local community. These included the donation of an area of land to the local scouts group for use as a football pitch and the painting of a mural on site by local schools (Chapter 5). The site's profile as an environmental exemplar was believed to have escalated amongst the workforce. This resulted in them hosting the BICC Cables European Environmental Forum. Representatives from BICC plants gathered from across Europe and were openly impressed by the quality of environmental management at Blackley (Reynolds, 1996).

Applied Chemicals improved their public image by hosting visits from various overseas delegates including groups from Korea and Japan (Counsell, et al., 1995). The EMS also led to involvement with the local community through the Coventry Groundwork Trust and initiatives with local schools.

Tallent Engineering joined a collaborative programme with local further education colleges and industry. They pooled resources to develop ideas and a starter pack for cost effective environmental management. A video and sample EMS procedures were made available to other companies in the area (Environment Business Magazine, 1996).

Solvay Interox's experiences with EMS implementation featured at a Teaching Company Directorate Conference on *Environmental Issues* in Belfast. They also hosted a visit for the DTI-sponsored initiative, *Inside North West Enterprise*. Lectures to the Environmental Resources M.Sc. Course at Salford University and a course for smaller companies, *Environmental Management Matters,* helped promote Solvay as an environmentally responsible company. The policy statement was included in the environmental report circulated to local residents, customers and in response to enquiries from interested parties.

By reassuring local residents and pressure groups an EMS can be beneficical in increasing the likelihood of successful planning applications (Environment Business, 1996c). At Solvay Interox local residents opposed an application for planning permission for a new Caprolactone Plant because of fear of increased traffic movement. To obtain planning permission they agreed to limit HGV movements to prevailing levels. Commitment to an EMS standard demonstrated that full assessments of the environmental effects, including those expected from the new Caprolactone Plant, had been completed. It provided reassurance by demonstrating a programme was in place to continuously improve performance.

The EMS standards ensure complaints are recorded, investigated and actions taken to prevent reoccurrence. Any environmental effect attracting complaints needs to be identified as significant and programmes established to minimise its impact. This was the case at Ciba Clayton, in Manchester, where complaints regarding these issues significantly reduced in 1995, the year they gained certification to BS 7750 (Table 8.10).

Table 8. 10: Environmental complaints at Ciba Clayton (from Ciba Clayton, 1996)

Complaint Category	***1991***	***1992***	***1993***	***1994***	***1995***
Aqueous pollution	1	2	3	4	1
Particulate emissions	11	8	6	5	2
Gaseous emissions	4	9	3	2	1
Land pollution	6	1	0	1	0
TOTAL	**22**	**20**	**12**	**12**	**4**

Care is required in using the number of complaints as a performance indicator. Initially an EMS may increase recorded complaints due to improved recording procedures. They should therefore only be used to measure performance once effective recording systems are established. At Akzo Nobel Chemicals, complaints remained approximately constant after implementation of their EMS. In 1994, 3 complaints were received regarding noise compared to 4 in 1995, the year after certification. These were due to the one-off demolition of several buildings to allow for a new road.

At Solvay Interox the number of complaints recorded increased dramatically between 1993 and 1995 (Figure 8.3). Of the 32 recorded in 1995 over 80% were attributed to three particular issues, odours associated with effluent released from a local pumping station, traffic movements and intermittent noise from the dryers on the Persalts Plant (Table 8.11). Significant effort was focused on rectifying these concerns. An odour control unit was purchased and installed at the pumping station and £40,000 was presented to North West Water to assist in upgrading the station. A new silencer was fitted to one of the dryers on the Persalts Plant and ongoing noise complaints were investigated.

***Figure 8. 3*: Number of environmental complaints per year at Solvay Interox Ltd**

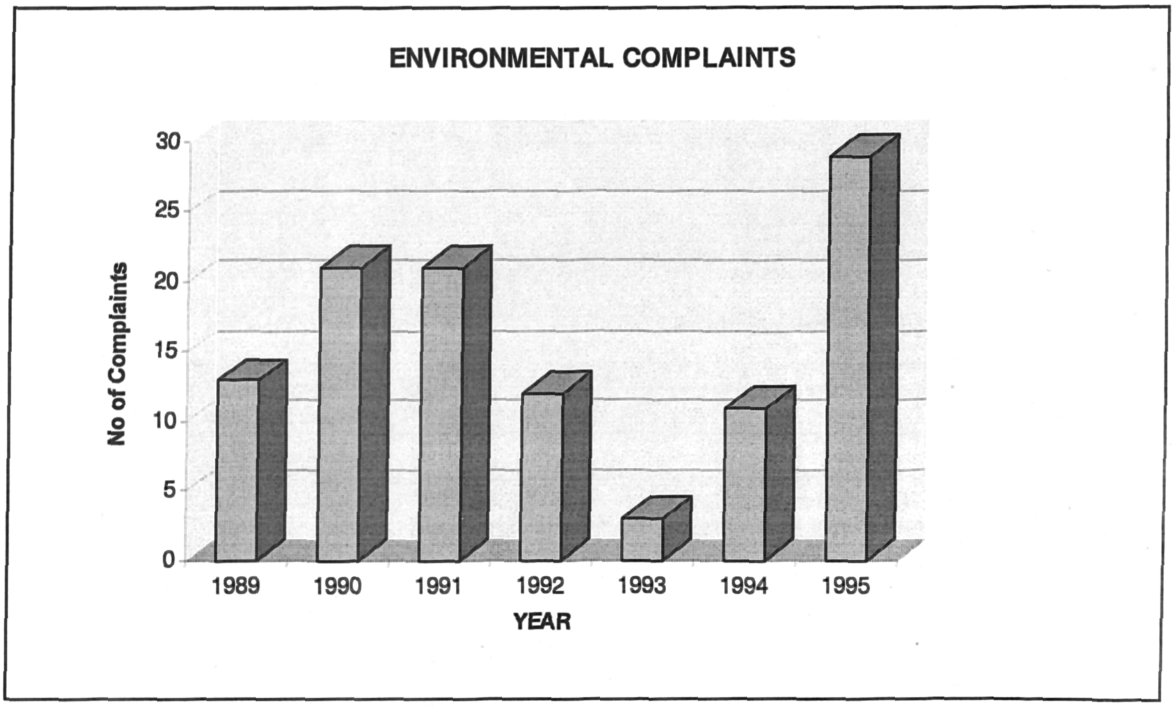


***Table 8. 11*: Environmental complaints received in 1995 by Solvay Interox**

Complaint Category	*Percentage of Complaints in 1995*
Noise	22%
Odour	37%
Traffic	28%
Miscellaneous	13%

8.6. LEGAL COMPLIANCE & RISK REDUCTION

The main EMS driver in heavily regulated industries, such as chemicals and pharmaceuticals, is often to comply with legislation (Morris, 1995). In the USA fines and civil damages can be sufficient to make a company bankrupt. The Exxon Valdez disaster cost Exxon over $6 billion in clean-up costs, penalties and damages (Hill, et al., 1996). Whilst UK liability regimes are less onerous, the EC's Polluter Pays Principle is leading to greater fines and clean-up costs (Table 8.11).

Maximum fines under the Environmental Protection Act 1990 are £20,000 in a Local Magistrates Courts and unlimited in the Crown Courts. In July 1998 ICI Chemicals and Polymers were fined £300,000 plus costs of £51,000 after pleading guilty to breaching their IPC authorisation resulting from a spill of 147 tonnes of chloroform (ENDS Report 278, 1998). The fine was the second largest ever imposed for an environmental offence in the UK. In 1990 Shell UK Ltd were fined £1 million in the Crown Court following release of oil into the River Mersey. This was exceeded by the fine imposed on Milford Haven Port Authority in January 1999 of £4million plus costs of £825,000 for causing 72,000 tonnes of oil to spill from the Sea Empress off the coast of Pembrokeshire (ENDS Report 288, 1999).

An additional threat is that directors can be held personally liable, under section 157 of the Environmental Protection Act 1990. Where a company is proved to have committed an offence with the consent of or by neglect on the part of any director, manager, secretary or other similar officer that individual is guilty and liable to appropriate punishment (Little, et al., 1992). Maximum penalties are 2 years imprisonment for most breaches of the Act and 5 years for unlawful dumping of special wastes. Since the Environment Agency was launched in April 1996 nine individuals have been jailed for environment related offences (Lee, 1998). Such severe fines can be significant motivators for senior mangers. Threat of personal prosecution has prompted board members to implement an EMS (Clough, et al.,1995).

*Table 8. 12: **Penalties resulting from breaches of environmental legislation (ENDS Reports 1996-7)***

Company	***Description***	***Penalty***	***Clean-up Costs***	***Total Cost***
Frank Allen Scrap Metal Merchant	Asbestos pollution of site and surrounding areas.	3 months in prison	N/A	N/A
Ford Motor Company	Release of pollution from an underground pipeline into controlled waters.	£10,000	£11,400	£21,400
David Distin Builders	Burning of building waste by the side of the M4 motorway.	£13,500 £9000[1]	£1,550 £350[1]	£15,050 £9,350[1]
ICI Chemicals	18 tonnes of vinylidene chloride into Weston Canal.	£34,000	£6,500	£40,500
Holiday Dyes & Chemicals	Explosion of a tank of methyl-nitro-phenol.	£50,000	£63,000	£113,00 0
Tolent Construction	Generation of unacceptable noise levels during construction.	£6,000	None	£6,000
Recyclable Metal Services	Failure to obtain a waste management licence and storage of waste on unlicensed land.	£50,000	£1,200	£51,200
Creighton's Toiletries	Breach of Duty of Care Regulations and Special Waste Regulations when disposing of ammonia and acid drums.	£10,000	None	£10,000
Castle Cement	Pollution of River Ribble	£6,500	None	£6,500[2]
Akzo Nobel	Discharge of white paint to sewer at levels above discharge consent.	£2,000	£600	£2,600[3]
Rover Group	Pollution of Elmdon Park Lake with trichloroethylene.	£4,000	£500	£4,500[3]
Alexander Drew	Pollution of River Roch and Spodden.	£5,000	£488	£5,488

1 Personal fine on company director
2 The existence of an EMS and reporting procedures were cited as mitigating circumstances which resulted in reduction of the fine from £80,000 to £6,500
3 Company certified to BS 7750 / ISO 14001

An EMS can significantly reduce litigation, fines and legal costs (Morris, 1995). The requirement for a register of regulations was included as companies frequently do not know or fully appreciate the legislative framework they should be working within (Powley, 1996). The process of identifying and documenting legal requirements is beneficial in improving their understanding. The majority of those participating in the survey perceived this to have significantly improved, 82% scored 3 or above (Table 8.13).

Table 8. 13: Perceptions of the extent to which understanding of legislation was improved by the EMS

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	0%	9%	9%	36%	32%	14%

The degree of improvement in understanding of legal requirements resulting from an EMS will depend on a company's starting position. Where a dedicated environmental specialist has been with the company for some time an EMS may not necessarily further their understanding. At Solvay Interox, due to the high level of in-house expertise, improvements in legal understanding were not substantial. The main advantage was to ensure a consistent mechanism to identify and record future legislative changes. The database of regulatory, legislative and policy requirements improved understanding of future legislation by identifying several areas which had previously been overlooked. The implications of the Montreal Protocol stimulated a study of the use of refrigerants and fire extinguishes on site. No CFCs were identified but several other chemicals used were due to be phased out as a result of the protocol's requirements. This prompted consideration of alternatives and ensured the company was prepared for future developments. Brico Engineering, a Coventry based manufacturer with 300 employees, reported that through BS 7750 they felt confident they would be able to respond to future legislation (Mike Head, Quality Director) (British Standards Institution, 1995a).

The effects assessment identifies problems which may cause a breach of legislation. Formal procedures are required to control activities which could have a detrimental impact, thereby reducing human error. A key measure of EMS success is the extent to which control is improved and the likelihood of accidents reduced. The disciplines required help anticipate threats and risks in a proactive way.

An internal audit at a company involved in the handling of chemicals identified an incomplete drainage plan. Ground sealed for chemical storage, drained to a disused mine shaft rather than the site effluent treatment plant. Corrective action was taken to prevent a major chemical spill which would have caused severe groundwater pollution (Hill, et al.,1996).

At Birds Eye Wall's ice cream factory in Gloucester the use of ammonia, used in industrial refrigeration units, was identified to be a risk. One of the first actions resulting from the EMS was to paint red all site drains which discharged to surface water courses and thereby reduce the risk of chemicals being discharged to a wrong drain (ENDS Report 264b, 1997).

Improvements to legal compliance were considered to be significant by 45% of companies participating in the survey (Table 8.14). This was particularly relevant for those prescribed as Part A for regulation under Integrated Pollution Control, with 80% scoring 3 or above compared to 35% of non-prescribed or Part B processes.

Table 8. 14: Perceptions of the extent to which regulatory compliance was improved by the EMS

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	14%	18%	23%	18%	23%	4%

In the majority of cases, environmental incidents significantly reduced as a result of the EMS (Table 8.15). 68% improved their containment facilities, hence reducing the risk of chemical spills. Shields Special Metals Ltd improved their drainage map to detail surface and foul drains. They differentiated between drains by colour coding. Drain interceptors were regularly inspected, cleaned and serviced. In addition mats and seals were purchased to protect drains and contain spills (Shields Special Metals Ltd, 1996).

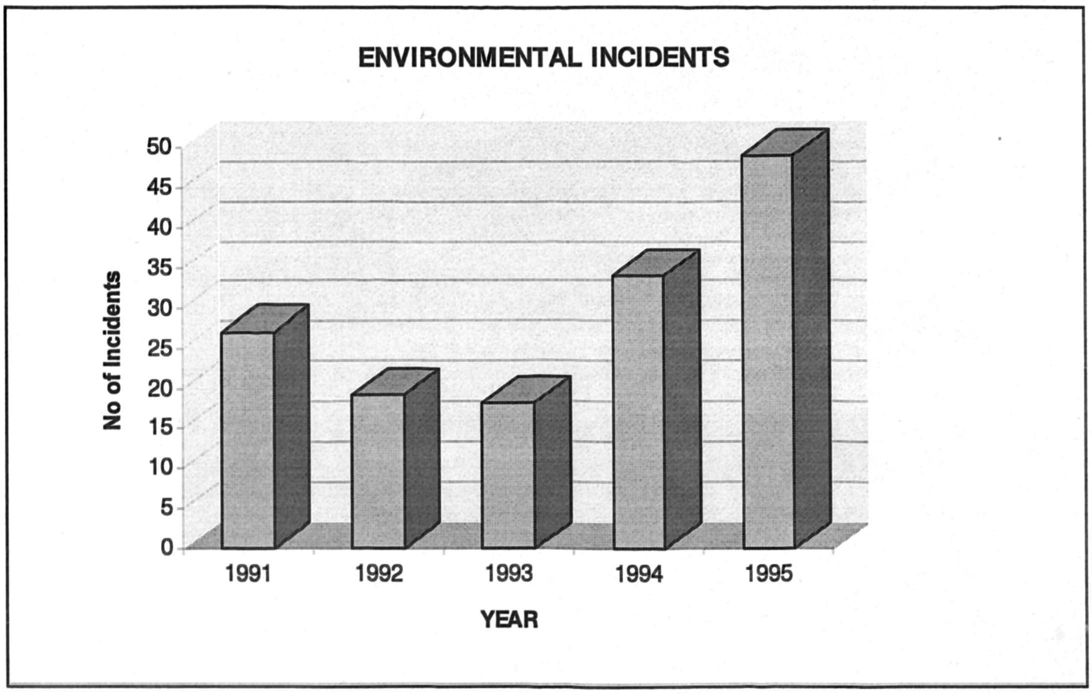
***Table 8. 15*: Extent to which EMSs reduce environmental incidents**

	Percentage of Companies
Reduced incidents	54%
No reduction in incidents	23%
Not sure	23%

As the risk of prosecution is an area of concern for larger more tightly regulated industries those with limited inherent environmental risks, such as those who store small volumes of chemicals without significant environmental releases, are unlikely to benefit substantially from reduced liabilities.

The increase in recorded environmental incidents at Solvay Interox in 1994 and 1995 cannot be assumed to be a reflection of worsening environmental performance (Figure 8.4). The introduction of the *Accidental Releases Procedure* (1994) provided a formal mechanism for recording accidents and implementing mitigating actions. Improvements in the recording system may explain the increase in incidents. Prosecution had been avoided since the early 1990's when the Company was fined twice within the space of two years for accidental releases to the Manchester Ship Canal and the River Mersey. The last prosecution, occurring in 1992, resulted in accidental release of chemicals from the AO Plant into the Ship Canal. Total costs were calculated to be £70,000, including a £12,000 fine, clean-up costs and management time in dealing with the emergency response. Should the EMS, through improved procedures, prevent one major incident a year, in 10 years it would save over £500,000.

Figure 8. 4: Number of environmental incidents at Solvay Interox Ltd



Should an incident occur, the existence of an EMS can help convince prosecutors it was unforeseeable, not caused by neglect and that procedures are in place to prevent incidents re-occuring. In New Zealand a High Court decision in 1993 ruled that one factor relevant to sentencing was the extent to which the defendent had an internal compliance programme in place (Morris, 1995). Under the UK's Water Resources Act 1991 fines can be reduced if an organisation can demonstrate they did not knowingly permit pollution to occur. In the future it may be impossible to mount a successful defence in a liability case without being able to demonstrate the existence of effective systems (Hill, et al., 1996). In October 1997 Castle Cement, an ISO 14001 certified company, were fined £6,500 after pleading guilty to breaches of the Environmental Protection Act 1990 and the Water Resources Act 1991. Mitigating circumstances were taken into account by the court, who noted that the company had taken steps to prevent breaches by introducing a new reporting system, and that a gas cleaning system was being implemented. The judge stated the fine could have been £80,000 if such strong mitigating factors had not been installed (Environment Business, 1997).

By demonstrating that self-regulation is effective, the widespread adoption of the EMS standards would give industry a stronger argument against the enactment of future legislation (Sheldon, 1996 and 1995a). All companies participating in the survey reported their EMS to have led to improvements beyond the requirements of legislation, in particular reduced waste, increased recycling and energy efficiency. Such voluntary improvement may help convince regulators that legislation in these areas is unnecessary. The desire for less regulatory oversight has been a major driving factor for EMS implementation in the chemical industry (ENDS Report 254a, 1996). The standards represent an opportunity for moving the regulatory approach away from command, control and punish to self-responsibility and co-operation with regulatory bodies (ENDS Report 254a, 1996). The majority of companies participating in the survey indicated their relationships with regulators to have significantly improved, with 73% scoring 3 or above (Table 8.16). By increasing their confidence the frequency of inspections and associated charges can be reduced, as was the case for Carson Office Furniture and Shields Special Metals.

***Table 8. 16**: Perceptions of the extent to which relationships with regulators were improved by the EMS*

	Not at all					Significantly
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	9	9	9	9	55	9

National legal frameworks vary in their ability to recognise industrial self regulation initiatives and therefore it will remain with individual countries as to how closely legal enforcement will be influenced by EMS certification (Sheldon, 1996). In Victoria and Queensland, Australia, the existence of an EMS is one of the requirements for an accredited licence that can ultimately lead to reduced inspection fees (Ridgeway, 1997). The UK's Environment Agency is investigating methodologies for determining inspection frequency and charges for companies regulated under Integrated Pollution Control. The Operator Performance Risk Appraisal (OPRA) was launched on a pilot basis in 1995. It requires inspectors to assess a company's performance against seven key indicators, one of which is the existence of an auditable EMS (Table 8.17). Performance in each area is scored from 1 - 5 (1 worst, 5 best) and multiplied by a weighting factor reflecting its importance. A certified EMS should substantially increase the score in each category.

In February 1997 the Government asked the Environment Agency to prepare guidelines for reducing IPC regulation for ISO 14001 or EMAS companies. They agreed that there is considerable overlap between IPC and formal environmental management systems (ENDS Report 265a, 1997). The Government hopes more companies will be encouraged to seek certification if they are required to provide data to regulators less frequently and receive fewer inspection visits. The Agency is currently consulting with the Confederation of British Industry (CBI) and the Chemical Industries Association (CIA) to investigate how OPRA could be used to reduce the regulation of EMS certified companies.

Table 8. 17: Operator Performance Risk Appraisal (OPRA) system developed by HMIP (from HMIP, 1996)

CRITERIA	*FACTOR*
Compliance with limits and adequacy of records	5
Knowledge of authorisation requirements and implementation	3
Plant maintenance and operation	3
Management and training	2
Procedures and instructions	1
Frequency of incidents and justified complaints	3
Auditable environmental management systems	3

The decision regarding whether to reduce regulatory oversight for certified companies will depend on the extent to which EMSs ensure continued compliance. If breaches of legislation are identified during routine surveillance visits, certification bodies are required to notify senior management and ensure that they inform their regulators, when required by an authorisation (European Accreditation of Certification, 1996). Regulators are required to notify the Competent Body of breaches at EMAS registered sites. They can be suspended until mechanisms have been implemented to prevent reoccurrence. The decision regarding suspension raises difficulties for both the Environment Agency and the Competent Body. Neither organisation will want to discourage companies from seeking certification by threatening loss of registration.

The Environment Agency have stated that they will not normally notify the Competent Body about trivial, short-lived, quickly rectified, non recurring breaches (Duncan, 1996). They will only be informed where it was necessary to issue an enforcement notice or to prosecute in connection with a significant breach of an authorisation.

Whilst EMAS requires legal compliance and ISO 14001 requires a commitment to comply, breaches of legislation have not resulted in the removal of EMAS or ISO 14001 certificates. An environmental statement from Shields Special Metals Ltd, certified to both standards, reported zinc and nickel in their sewer effluent to be greater than consented levels. Because of the relatively small volumes discharged no penalties were imposed (Shields Special Metals, 1996). Ciba Clayton, who are also certified to BS 7750 and EMAS, reported more serious breaches during 1995 (Ciba Clayton, 1996). The most serious incident occurred when 7.5 tonnes of black liquid dyestuff was lost to drain due to operator error. North West Water and the National Rivers Authority were immediately informed and the liquid was diverted into storm tanks to be released later under controlled conditions. A further incident involved dust from a cleaning operation resulting in spots of colour on a nearby car. On another occasion lime dust escaped from a poor connection on a discharging tanker. Particulates and ammonia were released from drains near the perimeter wall.

In February 1997 the Rover Group became the first BS 7750 holder to be fined for a pollution incident. The release of 500 litres of chlorinated solvent killed at least 200 fish and resulted in the closure of an emenity lake in Solihull (ENDS Report 265b, 1996). The company spent £700,000 cleaning up the spill and on measures to prevent a reoccurrence. They were also fined £4,000 with £500 costs. Akzo Nobel Chemicals, who hold ISO 14001 and EMAS, stated in their 1996 Environmental Report that discharge levels had exceeded their consent four times during the year (Akzo Nobel, 1996). On two occasions their sewer outlet was out of consent due to high flow. On the other two, their outlet to river exceeded consent on chemical oxygen demand (COD). As the levels were only marginally over consent, no further action was taken by the regulatory bodies. A more serious incident in April 1997 resulted in a fine for illegal discharge of paint waste from its Darwen works in Lancashire. They were prosecuted £2,000 with £1,700 under the Water Resources Act 1991 and another £2,000 with £600 costs under the Water Industry Act 1991 (ENDS Report 267b, 1997).

If companies are not deregistered following such prosecutions and the Environment Agency is not sufficiently confident to introduce lighter regulation for certified companies others may be discouraged from gaining certification (Lange, 1996).

8.7. IMPROVED SUPPLIER ENVIRONMENTAL PERFORMANCE

The EMS standards require an evaluation of indirect environmental effects, including supply-chain activities (Chapter 4). This has led to the common misconception that an in-depth evaluation of each supplier's environmental performance is required. Unlike the quality standard, ISO 9000, there is no such explicit requirement in the EMS standards (Powley, 1996). Supplier assessments are only needed if the environmental impacts of their activities assume a high significance in comparison to other effects. However, the more forward thinking companies are realising benefits from improved supplier performance. In many organisations purchasing represents in excess of 50% of expenditure and may exceed 90% in assembly orientated manufacturing firms (Green, et al., 1996). Corporate organisations, including B & Q, the Body Shop, the Rover Group and British Telecom, are recognising that poor supplier environmental performance could pose a threat to their public image and the long term viability of their suppliers. B & Q believe the use of suppliers with sound environmental performance will improve their public image and competitive advantage (Knight, 1996). Suppliers who are responsive to customer demands and comply with legislation are more likely to be competitive and secure in the market place.

An EMS frequently results in companies addressing their suppliers' performance. At Design for Distribution (D2D) material costs comprised 80-90% of total manufacturing costs (ENDS Report 242, 1995). They believed minimising problems in the supply chain would help hold down the cost of the finished product. Environmental criteria were incorporated into their vendor accreditation process and suppliers with an EMS have their performance checked annually. Those judged to have no environmental awareness had their supplier position with D2D reviewed as a matter of urgency. Their philosophy is to work with suppliers and only if they constantly fail to improve are they eliminated from vendor lists (Hamilton, 1995). This approach was successful in increasing the proportion with an environmental policy from 50% in 1993 to over 90% in 1994. Over half now intend to apply for certification.

Data from the survey of certified companies found 95% to have assessed their supplier's performance. 59% indicated this had influenced choice of suppliers and 23% intended to ask their suppliers to become certified to an EMS standard. The extent to which relationships with suppliers had improved varied between organisations (Table 8.18). This will depend on the approach adopted to the assessments and the degree of personal contact.

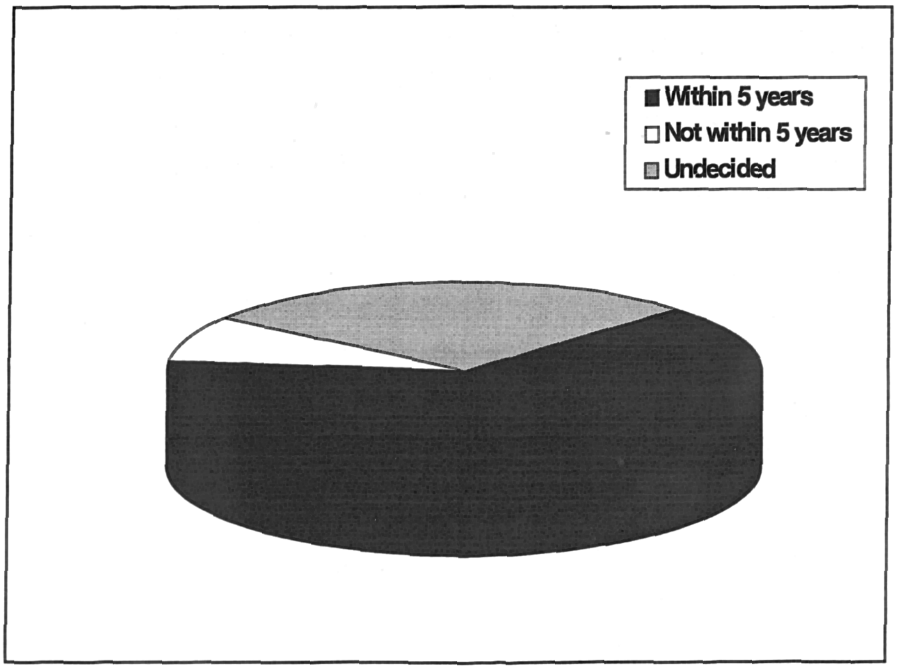
Table 8. 18: Perceptions of the extent to which relationships with suppliers were improved by the EMS

	Not at all				Significantly	
Score	**0**	**1**	**2**	**3**	**4**	**5**
% of Companies	9	23	23	36	9	0

Solvay Interox opted for a philosophy of encouraging suppliers to improve, rather than demanding specific standards. Their performance would be evaluated regularly and feedback provided on areas requiring improvement. This approach had the potential to improve competitive advantage as some suppliers were also potential customers. Encouraging them would help to improve the public image of the chemical industry and so benefit this negatively perceived industrial sector.

The supplier assessments provided an opportunity to bench-mark against other chemical companies. In their own assessment Solvay Interox would have achieved a Grade B, placing them in the top 40% of those assessed. The questionnaire provided valuable information regarding the extent to which other companies, including competitors, were adopting systems (Figure 8.5). Of the 37 assessed 63% either had established or were developing a formal EMS. 3% were already certified and 61% intended to gain certification within 5 years. 8% did not intend to seek certification and 26% were still undecided (Figure 8.6). The majority of those not seeking certification were smaller companies involved in activities with low environmental impacts, such as storage and distribution.

Figure 8. 5: Status of Solvay Interox suppliers regarding EMS certification



It is essential that purchasers are sensitive to the needs of their suppliers. SMEs, in particular, could lose business due to a lack of resources to meet stringent requirements imposed by customers (Smith, 1994). Demanding suppliers to achieve EMS certification may not be the best approach in facilitating environmental improvement. Companies forced to implement an EMS are unlikely to focus on their business needs. Parallels can be made with the adoption of quality standards in the 1980s. The publication of BS 5750, and later ISO 9000, led to the perception that a certificate to ISO 9000 was synonymous with a quality company. As customers wanted to buy quality products, ISO 9000 became a requirement to supply. In many cases certification did not improve product quality and companies implementing the standard to meet customers' requirements experienced minimal long-term benefit (Davies, 1993). B & Q, one of the most active organisations in greening its supply chain, has moved away from requiring suppliers to achieve certification. They do not consider it to be evidence of good environmental performance (Green, et al., 1996). Instead they have developed their own supplier rating system and have been auditing suppliers since 1991.

Supply chain pressure is a powerful mechanism for encouraging the adoption of environmental best practice. In 1991 only 8% of B&Q's suppliers had an environmental policy whereas by 1995, after significant pressure had been exerted, this had risen to around 90% (Vogt, 1996). Research undertaken by CROMTEC at UMIST identified critical success factors for achieving improved supplier performance (Table 8.19). Environmental criteria need to be effectively communicated to front line buyers and fully integrated with other purchasing standards (pers. comm. Morton, 1998). A consistent approach is required for communicating with suppliers. The establishment of long-term relationships rather than the threat of substitution is often most effective (Green, et al., 1996) (Business in the Environment, 1993). Collaborative approaches allow both customers and suppliers to benefit and can lead to the close integration of operational systems.

Table 8. 19: Principles of buying into the environment (from Green, et al.,1996)

1	Understand the business reasons	Examine the implications of legislation, market opportunities and pressures, supply chain risk, community needs.
2	Know your environment	Understand: environmental responsibilities, policies and issues, improvement targets and programmes.
3	Understanding your supply chain	Rank key suppliers based on environmental issues and risks. Develop environmental purchasing policy and processes.
4	Adopt a partnership style	Communicate openly and clearly. Explore areas of co-operation for mutual benefits.
5	Collect only information needed.	Identify key questions and define information needs. Select suitable collection methods.
6	Validate supplier's performance.	Select, where necessary, a suitable method to validate information and management systems.
7	Set a suitable timetable for improvement.	Discuss and agree improvement targets with environmental managers and suppliers.

8.8. REDUCED INSURANCE PREMIUMS

The *Environmental Protection Act 1990* is based on the principle that the polluter pays the cost of reducing the risk of environmental contamination or remediating environmental damage. In practice it is usually the insurers who pay the cost of damages through public liability insurance, which covers financial claims by third parties sometimes by the process of law. Claims are settled on the basis of resulting environmental harm (Kirk, 1996). Public liability policies cover sudden and accidental occurrences but in 1991, as a result of tightening legislation, the Association of British

Insurers made it impossible to gain cover for gradual pollution (Kirk, 1996). The Cambridge Water Company sued Eastern Counties Leather plc, a tanning company, for unknowingly polluting aquifers with solvents. The water company lost the use of an borehole and were awarded £1.6 million in damages. This decision was subsequently reversed in favour of Eastern Counties Leather by the House of Lords in December 1993 as the pollution was unforeseen. If not, it would have set an important precedent for Counties Leather's insurance company which may have been liable to pay the cost of damages (Crosbie, et al., 1995).

Since 1991, public liability policies cover for damages resulting from incidents occurring any time during the policy period, regardless of the time of the claim. This allows retrospective claims and the growing number of claims from old policies for compensation for industrial related disease, such as asbestosis, and long-term pollution are causing the insurance industry to limit claims and levels of cover (Kirk, 1996).

In the European Union and the USA a limited number of plans, known as environmental impairment policies, will cover damages resulting from gradual pollution but they are costly and the excess payable is substantial. By September 1995 no more than 100 policies had been issued on this basis in the UK (Crosbie, et al., 1995). European reinsurers are currently moving to exclude any type of pollution cover from public liability policies (Rickman, 1996). Should this become the case, pollution cover would only be available separately, resulting in the rapid development of environmental impairment liability policies.

Environmental management systems have the potential to assist insurers in assessing their client's environmental risks. A certified system indicates an organisation is in touch with business developments; aims to keep ahead of competition; has tight environmental control and reduced pollution incidents. Certification should therefore represent a lower risk for insurers and lower the cost of premiums.

However, few insurers conduct comprehensive assessments of environmental risk to assist in deciding to underwrite liability costs (Hodge, 1995). Major hazard sites may receive some attention but SMEs are often neglected. This is largely due to the traditional use of consultants to undertake environmental risk assessments. This incurs high costs for the insurers. In the future, as companies are forced to seek environmental impairment policies, they are likely to face rigorous investigations to determine the limit of indemnity and the cost of premiums (Little, et al., 1992).

1995 the *United Nations Environment Programme Statement of Environmental Commitment by the Insurance Industry* was signed by 70 insurance companies from 25 countries. It commits signatories to incorporate environmental considerations into their internal and external business activities. In July 1997, the *Insurance Industry Initiative for the Environment,* consisting of 35 senior officials from leading firms, was launched (Business in the Environment, 1997b). It established two working groups, one on climate change and one on asset management.

The Loss Prevention Council (LPC) advises UK insurers and their clients on a wide range of issues affecting their industry. Their objective is to improve risk management by addressing risk related scientific, technical and environmental factors. They are currently developing an environmental risk assessment tool for use by insurers in their underwriting process. This includes a research project, with Imperial College, studying the interactions of EMS and insurance. The proposed methodology is based on questionnaires and checklists for five hierarichal levels which relate to the polluting nature of a site (Table 8.20). Most companies would be assessed at Levels 1, 2 or 3 with higher levels being reserved for those with particular environmental problems or those especially tightly regulated. Companies with certified EMSs generally get a good rating in the overall assessment, which should guarantee approval for insurance (Hodge, 1995).

***Table 8. 20*: Proposed risk assessment model for assessing insurance risks developed by the Loss Prevention Council (from Hodge, 1995)**

Level 1	Simple questionnaire sent by post to identify class of industry on site. Sites in a potentially polluting class go to Level 2.
Level 2	Simple site questionnaire sent by post investigating more aspects of the company's activities. More problematic sites go to Level 3.
Level 3	A more complex questionnaire followed by a visit by an insurer with further checklists. Sites with particular problems go to Level 4.
Level 4	An insurance surveyor or environmental risk consultant would visit the site and perform a specialist survey. This stage is likely to incorporate some element of measurement or sampling if contaminated land is involved.
Level 5	This stage would only apply to those sites subject to special scrutiny, for example CIMAH sites. External consultants are likely to have already been involved in developing the sites safety case and much further work may not be necessary.

Some individual insurers, including ECS Underwriting and the Willis Corroon Group, have indicated an EMS would result in lower premiums (McKenna, et al., 1996). A proposed risk assessment methodology, developed by the Willis Corroon Group, involves establishing environmental control factors and environmental threat factors (Rickman, 1997). Guidance is provided for scoring each factor, which is broken down into individual elements. These include consideration of the policy statement, definition of environmental responsibilities and the existence of EMAS or ISO 14001 certification. An overall environmental control score (EC) and an environmental threat score (ET) are calculated from the sum of the individual components (Table 8.21).

***Table 8. 21*: Control and threat factors used for assessing environmental risk for insurance purposes by the Willis Corron Group (from Rickman, 1996)**

Control Factors	
EMS	20
Authorisations	20
Emissions to Air	20
Liquid Discharge	20
Waste Management	20
MAXIMUM SCORE	**100**

Threat Factors	
Hazardous Materials	10
Contaminated Land	10
Water Environment	10
Waste	10
Nuisance	10
MAXIMUM SCORE	**50**

An environmental quality rating (EQR) is then obtained by subtracting the environmental threat score from the environmental control score.

Environmental Quality Rating (EQR) = EC - ET

To obtain an environmental liability rating, used to determine insurance premiums, the environmental quality rating is subtracted from 100. Should this approach be implemented by the Willis Corroon Group the existence of an EMS would increase the environmental control score by 20 points, leading to reduced insurance premiums.

Environmental Liability Rating (ELR) = 100 - EQR

The important issue for insurers is whether an EMS ensures risks are managed responsibly (Kirk, 1996). The recent prosecution of two certified companies, Rover and Akzo Nobel, is likely to raise some concern. The consensus is that an EMS itself cannot guarantee sound environmental performance. Other factors such as site history, location, geology, ground water vulnerability and the risk of gradual pollution also need to be considered.

Environmental risk assessment for insurance purposes is at an early stage and few certified companies can demonstrate reduced premiums. A large construction company convinced their insurers to accept a single external audit rather than to demand audits of all twelve sites (Hill, et al.,1995). This substantially reduced the costs of reassuring insurers and obtaining environmental insurance. Dunlop Ltd was the only company participating in the survey to report reduced premiums. This resulted from preventative procedural actions which were put in place as part of the EMS.

The risk assessment methodologies being developed by the insurance industry will mean that certified companies will benefit from reduced premiums. The Loss Prevention Council (LPC) has expressed some concern regarding the likely implications on SMEs as they are less likely to have an EMS, due to a lack of resources and in-house expertise. The LPC is currently collaborating with Business in the Environment on a research project to investigate this problem and suggest a solution (Business in the Environment, 1997b).

8.9. ACCESS TO CAPITAL & INVESTMENT

A company's position on the environment is increasingly influencing access to capital and investment. Banks are becoming concerned over security of loans and potential lender liability. Awareness among investors of the importance of ethical and environmental matters is growing. Certification to a recognised standard, may help convince banks and investment institutions that the environment should be taken seriously and that the risk of liability can be reduced.

Pressure on industry from banks arises largely from their commercial concerns over their own exposures. Should the business to which they lend have serious environmental problems, resulting in high fines or clean-up costs, loan repayment may become difficult. If a company goes into liquidation the bank may become the owner of the property and risk becoming liable for clean-up costs. This scenario first arose in the United States over the remediation of contaminated land. Banks whose loans were secured on land which turned out to be contaminated, found themselves owners of significant liabilities (Gray, et al., 1993). This encouraged them to review their lending policies to take account of the environmental risks associated with potential borrowers. A survey of US banks undertaken in 1991 showed that 63% had rejected loan applications and 46% had discontinued loans because of fear of environmental liability (Financial Times, 1991). These issues have since moved to Europe as a result of contaminated land legislation, civil liability from waste and the polluter pays principle. It is still unclear how EC law will act in these areas but there is no doubt that banks are becoming increasingly aware of potential environmental liabilities.

In the UK the National Westminster Bank have taken the lead in incorporating environmental criteria into banking policy. In 1991 they established an environmental management unit and were invited to form the *United Nations Environment Programme Advisory Committee on Banking and the Environment.* Natwest, along with the Deutsche Bank, Royal Bank of Canada, Hong Kong & Shanghai Banking Corporation and Westpak Banking Corporation, were instrumental in producing the *Statement by Banks on Environment and Sustainable Development* (UNEP, 1992). It contains 20 commitments covering sustainable development, environmental management and public awareness. Customers are required to comply with all applicable local, national and international environmental regulations. Environmental risks must form part of a normal credit risk assessment and environmental impact assessments should be applied where appropriate. Sound environmental practices are to be considered one of the key factors demonstrating effective corporate management. The statement has since been signed by 63 banks worldwide including the UK's Co-operative Bank, Lloyd's TSB and The Royal Bank of Scotland.

UK bank's commitment to integrating the environment with mainstream business was stated at the British Bankers Association conference in July 1997. This coincided with a leaflet on best environmental practice, to be promoted by banks to their customers (Business in the Environment, 1997a). National Westminster and the Co-operative Bank have published high profile reports relating to their ethical and environmental policies. This includes the Co-operative Bank's 1998 *Partnership Report* and Natwest's annual report on *Environmental Sense makes Business Sense.* Other banks including Lloyd's TSB, Barclays, Royal Bank of Scotland and Midland provide environmental policies and information packs upon request (Coulson, et al.,1998).

It is extremely rare for UK companies to be refused access to loans purely as a result of poor environmental performance or high liabilities. Lloyd's TSB have never refused access to funding on these grounds alone (Pers. comm. Monks, 1998). Companies seeking finance are being questioned on their environmental policy and management practices as part of the lending evaluation. Those engaged in environmental activities are likely to benefit from quick and easy loan provision, reduced costs of loan negotiation and more favourable loan conditions (Coulson, et al.,1998). As legislation becomes tighter and fines increase, companies seeking loans will be increasingly subject to stringent environmental requirements. In the future the existence of a certified EMS may become a prerequisite for securing loans.

The motivation of banks and insurers to encourage sound environmental management is easily understood but this is less clear for investment institutions. Ethical investment funds were first launched in the USA in the early 1970s. In the UK such funds became prominent with the launch of the Friends Provident Stewardship Trust in 1984. Environmental investment originated with the formation of the Merlin Ecology Fund in 1988, following the upsurge in environmental awareness of the 1980s. By the mid 1990s over £50 billion was invested in UK funds taking account of environmental factors (ACBE, 1993). By the early 1990s many ethical funds were active in the UK (Figure 8.6).

***Figure 8. 6**: UK ethical and environmental investment funds in order of emphasis on the environment (from Gray, et al., 1993)*

- **Merlin Jupiter Ecology Fund**
- **Clerical Medical Evergreen**
- **HFS Green Chip Fund**
- **TBS Environmental Investor Fund**
- **CIS Environmental Trust**
- **Eagle Star Environmental Opportunities**
- **Abbey (Life) Ethical**
- **All Churches Amity Fund**
- **NM Schroder Conscience Fund**
- **Acorn Ethical Fund**
- **Friends Provident Stewardship Income Trust**
- **Friends Provident Stewardship Unit Trust**
- **Friends Provident Stewardship North American Trust**
- **Scottish Equitable Ethical Unit Trust**
- **Target Global Opportunities**
- **Sovereign Ethical Fund**
- **Buckmaster Fellowship Trust**
- **Fidelity Famous Names**

Pressure groups have been instrumental in the rapid growth of green investment funds. Numerous campaigns have been launched to encourage financial institutions to invest in companies with higher environmental standards. Friends of the Earth focused a campaign on shareholders in RTZ, the UK based mining company, proposing a mine in Madagascar. In 1993, a coalition of pressure groups sent a briefing document to 275 UK fund managers advising against buying shares in the floatation of Barito Pacific, one of the world's biggest makers of plywood. A year later Greenpeace issued a similar document during the flotation in Amersdam of EVC, a Belgian based PVC manufacturer (Financial Times, 1995).

Green investment portfolios represent a significant, and growing, proportion of the market. Their performance is often good but evidence is largely inconclusive due to their relatively recent nature. A major problem regarding green investment is the lack of reliable data on which investment managers can base decisions. The most frequently used source of information is annual reports which contain limited detailed information (Gray, et al., 1993). This has led to investment managers seeking alternative sources of information. Public registers, introduced by the *Environmental Protection Act 1990*, are proving useful in detailing previous problems with legal compliance. In 1992 Norwich Union issued a environmental assessment questionnaire to companies in which they invested.

Few trusts exert direct influence on the companies in which they invest. The inclusion of environmental criteria in decision making is still largely limited to a few dedicated funds. As investor's awareness increases and more environmental information becomes publicly available this is likely to change and there is little doubt that companies will find themselves under increasingly close scrutiny.

Companies able to demonstrate high environmental performance (Figure 8.7) are likely to be included in ethical investment portfolios. Investment managers are likely to welcome the EMS standards for providing external certification of good environmental management. This will provide additional information for fund managers when deciding about investment.

A speciality chemicals manufacturer based in the South of England, exports a significant proportion of its production. When it came to securing investment for a management buy out and subsequent flotation, their certified EMS was used to demonstrate that environmental risks were well managed. This gave confidence to investors and access to Green Investment Funds (Garrett, 1998a).

Evidence of increased access to capital or investment resulting from an EMS is difficult to obtain as environmental considerations in banking policy are embryonic. None of the 22 certified companies involved in the experience survey reported improved access to funding within the first year of certification. However, Solvay Interox felt the existence of an EMS would enhance the site's future likelihood of obtaining capital investment from the Solvay Group (pers. comm. MacDonagh, 1996).

***Figure 8. 7**: The most popular "green" UK companies for investment trusts and reasons for selection (from Gray, et al., 1993)*

British Gas	Greenhouse effect
Halma	Pollution control
Body Shop	Animal and habitat welfare
Powerscreen	Recycling
Tesco	Recycling, ozone layer, transport, healthy eating
Argyll Group	Healthy eating, recycling
Simon Engineering	Pollution control, recycling
Ocean Group	Energy conservation, pollution control, sensitive land use
Sutcliffe Speakman	Pollution control, recycling
Allied Colloids	Pollution control
Attwoods	Pollution control
Bespack	Ozone layer, pollution
Freeman Group	Energy conservation
Marks and Spencer	Healthy eating, energy conservation, recycling
Sainsbury	Healthy eating, energy conservation, recycling
Shanks & McEwan	Pollution control, recycling
Whatman Reeve	Recycling

8.10. SUMMARY

The most important drivers for EMS implementation are legislation and the desire to achieve a competitive advantage. Legal compliance is particularly important for industries tightly regulated under Integrated Pollution Control. In comparison, SMEs who are typically less tightly regulated, are mainly motivated by competitive advantage. Although these issues are effective in driving EMS implementation, following certification they are rarely considered to be the most important benefit of having adopted the system. In contrast, certified companies find cost savings and improved employee motivation to be more significant. These benefits are frequently overlooked by organisations during their decision regarding whether to adopt an EMS.

The results of the survey found participants were experiencing substantial cost savings from their systems. The value of savings depends on company size and waste disposal and resource costs but average £170,000 per annum within larger organisations and £60,000 in SMEs. Comprehensive data relating to savings is often difficult to obtain due to the lack of recording systems of the financial benefits of improved environmental performance. The majority of companies can only estimate savings based on examples of major projects. To enable EMS value to be determined it is essential that companies establish systems for monitoring the financial implications of their environmental activities.

Larger organisations are increasingly demanding high environmental standards from their suppliers. EMS certification can ensure their requirements are met and enhance competitive advantage and market position. Several certified companies have demonstrated how new contracts can be won purely through the possession of an EMS (Garrett, 1998a) (Robinson, 1998) (Department of the Environment, 1996d) (Shields Special Metals, 1996). It can also help in encouraging the development of new and modified products to improve competitive position. The ability to demonstrate a high level of environmental performance is particularly important for those companies supplying leaders in the environmental field or exporting to countries with high EMS uptake. This was the case for Autosmart Ltd who exported to countries within Scandinavia.

The findings of the survey indicated that the majority of certified companies are experiencing significant improvements in their public image. They are frequently invited to present at key events thereby promoting their company as environmentally responsible. Many companies have become involved in local community initiatives including scout groups, schools, colleges and environmental organisations such as the Groundwork Trust. Involvement in such activities can have a dramatic indirect benefit by improving employee pride and motivation.

Companies breaching the law are being punished through increasing fines, clean-up costs and in some cases personal imprisonment (Table 8.12). In the majority of cases an EMS improves understanding of legislation, and is most significant in improving compliance in the more tightly regulated companies. Smaller companies generally consider themselves to be complying with the law prior to their adoption of the standard. Although the survey found a significant number of certified companies to be benefitting from reduced environmental incidents an EMS does not ensure legal compliance. In several cases ISO 14001 and EMAS companies have been prosecuted for environmental incidents (ENDS Report 265b, 1996 and 267b, 1997). Whilst certification does not necessarily prevent prosecution if the existence of an EMS is cited as a mitigating factor in court it can substantially reduce fines.

The EMS standards are effective in encouraging voluntary environmental improvement beyond the requirements of legislation. Their widespread adoption would give industry a stronger position to oppose tighter regulation. The Environment Agency is currently investigating methodologies for reducing regulation of IPC companies certified to an EMS standard (HMIP, 1996). This would give those considering an EMS an added incentive for seeking external certification.

Supply chain pressure for environmental improvement is set to grow with increased uptake of the standards. The survey indicated that the majority of certified companies assess their supplier's environmental performance and in many cases this has influenced their supplier choice. A smaller but significant number intend to ask their suppliers to become EMS certified themselves. Collaborative approaches to encouraging suppliers to improve are most effective as they enable environmental initiatives to be focussed on the individual company's needs (Green, et al., 1996). This is essential to ensure SMEs are able to meet their larger customer's requirements.

The existence of an EMS has the potential to alleviate the concerns of insurers, banks and investment companies and result in easier access to insurance and finance. A number of insurers are developing risk assessment techniques for use in determining premiums (Hodge, 1995) (Rickman, 1997). Banks and financial insitutions are also becoming increasingly concerned over environmental liabilities (Coulson, et al., 1998) (Pers. comm. Monks, 1998). The operation of an effective EMS will reassure stakeholders and demonstrate control of environmental risks.

CHAPTER 9

9.0. RESOURCE IMPLICATIONS ASSOCIATED WITH A FORMAL EMS

9.1. INTRODUCTION

The resource implications of a formal EMS are both human and financial. Human resources are required to implement and maintain the system, whilst financial resources may be required for consultancy, capital expenditure and certification charges. Industrial perceptions of high costs associated with an EMS pose a major barrier to the adoption of the standards (Chapter 2). This has arisen in part from the experiences of the BS 7750 pilot trial, where some companies found that 1,000 staff days were required for the initial environment review (Hill, et al., 1995). Actual costs are often unknown, illustrating the need for greater clarity regarding the likely resources required to implement a system and achieve external certification.

9.2. STAFF-COSTS OF IMPLEMENTING AN EMS

Companies participating in the survey took from 5 months to 3 years to achieve certification to BS 7750, with an average of 18 months (Table 9.1). These findings are consistent with a slightly later survey undertaken in October 1996 by the BS 7750 / EMAS Users Group. They found the commitment required for certification ranged from 8 months to 4 years, with an average of 2 years (Baxter, 1997). As a large proportion of companies involved in both surveys, 41% in the case of the author's, were amongst the first in the UK to be awarded certificates these long timescales may have been expanded due to the lack of accredited certification bodies. Some companies may have operated fully implemented systems prior to this but were unable to seek external certification. Involvement in the BS 7750 pilot trial may also have increased the time spent implementing the standard. This ran for a period of 24 months between 1992 and 1994 and participating companies would not have been able to seek certification until April 1995.

The time taken to achieve certification will be influenced by the degree of pressure on the company. As limited pressure was exerted by customers on their suppliers during the standard's early operation this will explain the sometimes long timescales involved. The resource availability within the company will also influence the speed of implementation. This will vary greatly depending on the manager's other commitments. In some cases, a manager will be exclusively working on the EMS whilst in others it will only be a part of their responsibilities. Where a manager is given flexibility in implementing the system and not pressured to achieve certification the longer it is likely to take.

The lack of established accounting systems for recording the financial implications of environmental initiatives meant that only 63% of surveyed companies were able to estimate the human resources required to implement their EMS. A wide range of resource requirements were reported, ranging from 107 to 681 days, with an average of 333 days (Table 9.1). A period of 12 staff months, 264 days, was sufficient for 65% of participants. In 73% of cases company personnel worked on the EMS during their normal work programme and no additional human resource costs were incurred. The others recruited an additional member of staff, often through a graduate placement scheme.

These results are consistent with the later survey of 30 registered companies undertaken by the BS 7750 / EMAS users group. These ranged from 40 days, where an existing EMS was in place, to 1500 days, with an average of 306 days (Baxter, 1997). The first experiences with ISO 14001 in Germany reported similar human resource requirements. In June 1997 a survey of 73 companies found that in 70% of cases 12 person months were required (Kuhner, 1998).

To convert human resource time into a financial value both salaries and overheads must be considered. Environment Business (1997) surveyed salary levels and found the average for an industrial Manager or Director responsible for the environment was £23,100 per annum. This is equivalent to £100 per day assuming an average of 226 working days a year. According to the Department of Trade & Industry the full cost of employing a member of staff, including overhead costs, is approximately 2 x salary levels. The true cost of staff-time can therefore be reasonably estimated at £200 per day. The human costs of implementing an EMS to the standard of BS 7750, therefore ranged from £21,400 to £136,200, with an average of £66,586 (Table 9.1).

Table 9. 1: Staff time and associated cost of implementing an EMS within participating companies

Company Name	*No of Employees*	*Staff Time[1] (Days)*	*Staff Cost[2] (£)*
Auto-Smart Ltd	55	113	£22,600
BOC Gases Europe	60	227	£45,400
BICC Cables	350	200	£40,000
Akzo Nobel Chemicals Ltd	132	681	£136,200
Applied Chemicals	150	400	£80,000
Carson Office Furniture	160	400	£80,000
Alcan Smelting & Power UK	172	266	£53,200
Arjo Wiggins Fine Papers Ltd	230	681	£136,200
P P Payne	252	107	£21,400
Curtis Fine Papers	350	333	£66,600
Philips Components	400	200	£40,000
Lindsey Oil Refinery Ltd	500	454	£90,800
Wavin Buildings Products Ltd	500	120	£24,000
Ricoh (UK) Products Ltd	740	306	£61,200
Epson Telford Ltd	1,700	373	£74,600

1 Assuming 226 working days a year
2 Assuming £200 a day for management time costs

Relationships between company size and personnel costs are not linear (Figure 9.1). Resource requirements vary greatly, even between companies of a similar size. Arjo Wiggins Fine Papers and P P Payne are both of similar size but required 681 days and 107 days respectively to achieve BS 7750 certification. The large variability in the times required to achieve certification results from many factors in addition to company size. These include the starting position of the company; the complexity of the manufacturing process; the severity of environmental impacts; the experience and seniority of the champion and degree of regulation (Chapter 3). An analysis of the results shows no particular trends or identifies conclusive causal relationships. Companies requiring a high resource commitment, over 400 days, included those from several industrial sectors and different company size (Table 9.2). All five companies had elements of an EMS already in place and assigned a senior manager to be responsible for implementation.

Figure 9. 1: Staff- time required to implement an EMS versus company size

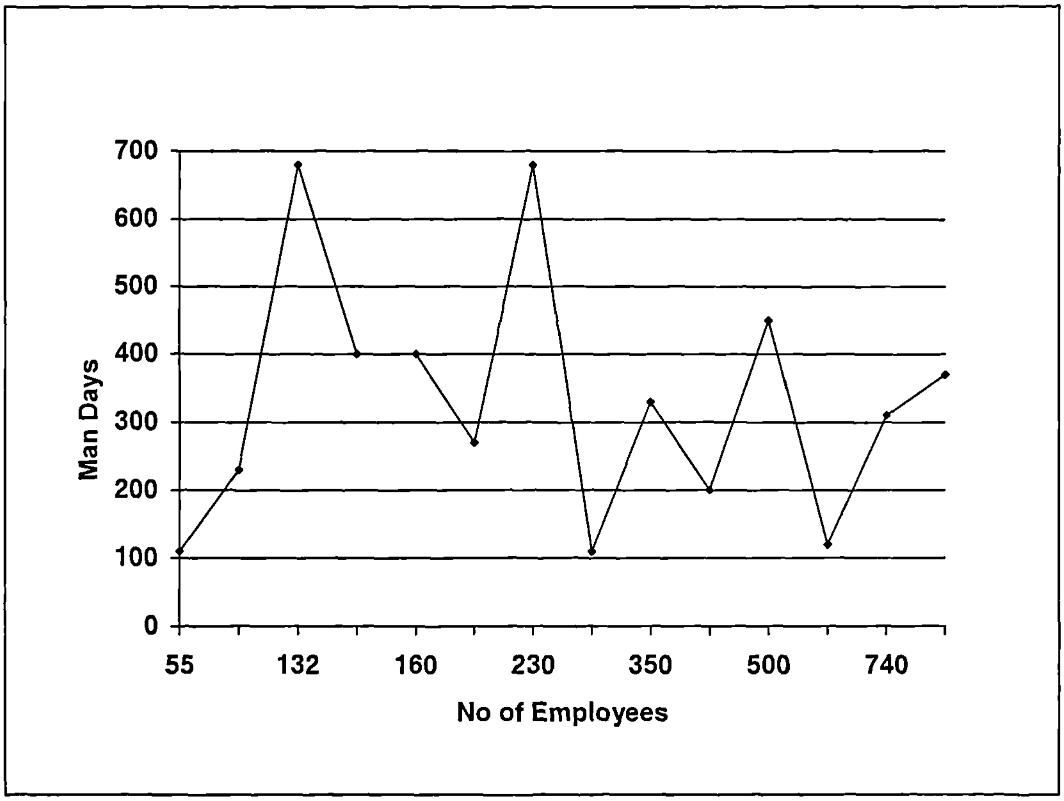


Table 9. 2: Companies spending 400 person days or more on EMS implementation within participating companies

Company	Sector	Size	Part A / B	Champion Responsibility	Starting Point
Akzo Nobel	Chemical	130	None	Technical	Monitoring
Arjo Papers	Paper	230	None	Environmental	Audit & Review
Lindsey Oil Refinery	Oil Refinery	500	Part A	HSE Advisor	Monitoring / Complaint Procedures / Resident Liaison Committee.
Applied Chemicals	Chemical	150	None	HSE Advisor	Monitoring / Legal Compliance
Carson Furniture	Furniture	160	Part B	Quality	Policy / Legal Compliance / Objectives and Targets

SMEs often required more commitment than larger companies (Table 9.3). Wavin Building Products with 500 employees, took significantly less human resource commitment than Akzo Nobel Chemicals, Applied Chemicals and Carson Office Furniture, all with approximately 150 employees. This may reflect the better developed systems and greater expertise already present within larger companies.

Table 9. 3: Staff time of implementing an EMS versus company size within participating companies

No of employees	*Implementation Time Range (staff-days)*	*Implementation Time Average (staff-days)*
< 250 employees	114 - 681	424
> 250 employees	107 - 454	265

The more polluting IPC regulated companies, prescribed as Part A under the *Environmental Protection (Prescribed Processes and Substances) Regulations 1991,* on average required less commitment than non-prescribed companies (Table 9.4). This may be explained by their advanced starting position. Such companies will have acquired certain elements of an EMS such as release monitoring, operational control and improvement programmes to meet their legal obligations.

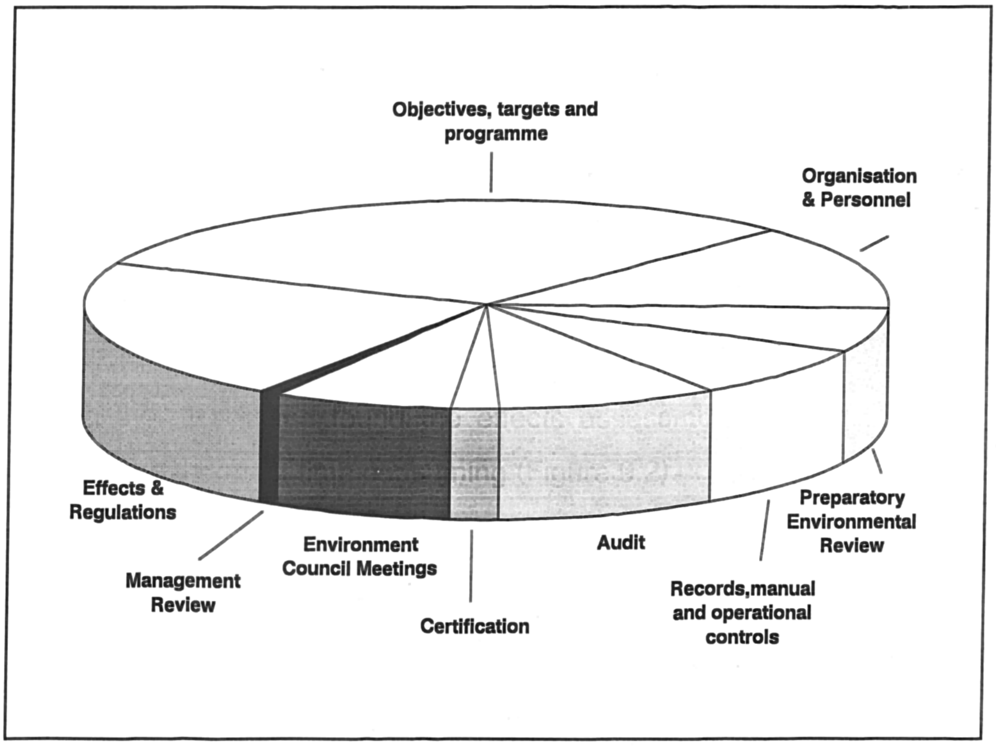
Table 9. 4: Staff-time of implementing an EMS versus process classification under Environmental Protection Act 1990 within participating companies.

Process Classification	*Implementation Time Range (staff-days)*	*Implementation Time Average (staff-days)*
Part A	227 - 454	313
Part B	107 - 400	260
Non-prescribed	114 - 681	394

The environmental effects assessment was found to be the most time consuming element by 50% of participating companies. The development of documented procedures was also reported to be resource intensive. Similar findings were reported by the Rover Group based on their survey of six automotive parts suppliers. They found the initial environmental review, including the identification of environmental effects and legislative requirements, was the most resource intensive. This took 20 to 50 days for a manufacturing site with up to 200 employees (Business in the Environment, 1997).

Wolstenholme International, employing 260 staff in the manufacture of metal powders, is one of the few companies to have developed accounting systems to monitor the value of their EMS (Chapter 10). They analysed the human costs associated with implementing their EMS and found the effects assessment, objectives, targets and programmes to be the most time consuming (Figure 9.2).

Figure 9. 2: Breakdown of internal staff costs for EMS implementation at Wolstenholme International Ltd (from ETBPP, 1996b)



At Solvay Interox Ltd it took 530 staff days (2.5 staff years) to implement the EMS (Table 9.5). Salary costs were reduced through the DTI funded Teaching Company Scheme which provides 50% of the costs of a graduate for two years. The company contribution towards the cost of the project, which included graduate salaries, training and supervision from the university, was approximately £15,000 per year or £67 per day. Overhead costs have not been included as the project was a fixed term contract and graduates were employed through Salford University. The total cost of employing the graduate was therefore equivalent to £29,145. In addition senior management input of approximately 60 days was required, equivalent to £12,000 allowing £200 a day for salary and overheads. The total human resource costs were therefore in the region of £41,145, equivalent to 0.06% of the annual turnover and 0.03% of the annual spending on environmental protection. This does not include the costs of EMS elements established prior to September 1994 or activities which cannot be directly attributed to BS 7750. The salaries of the five members of the Environment Group have not been included as they were employed prior to the start of the EMS project (Chapter 6).

Solvay Interox found the most resource intensive EMS elements to be operational control procedures (85 days), the environmental effects assessment (45 days), the development of the integrated HSE manual (30 days) and the supplier assessments (25 days). The 85 days spent on operational control do not include any associated activities required by the individual process areas developing their standard operating procedures. This is an ongoing process requiring modification as operating conditions and plant equipment changes. The development of a strategy for integration of business management systems took 25 days and the integrated RCLP manual 30 days. This commitment also contributed to the improvement of the health and safety system and was not directly required for the EMS. Integration was resource intensive but would ultimately reduce the time required to maintain the systems.

The survey results demonstrated its possible to complete implementation in 6 to 12 months, with a minimum resource input of approximately 100 days, or an average of 300 days. Greater timescales are likely to reflect a manager's lack of environmental knowledge and poor understanding of the standard's requirements. Companies are frequently overly concerned about the detail required in registers and fail to focus on the key issues. The five case studies indicated that systems are frequently simplified after certification to focus on fewer issues (Chapter 5). Contract Chemicals found implementation at their Knowsley site to be more resource intensive than predicted. Originally they estimated 9 months but actually spent 27 months, 3 times longer than expected. The development of complex unwieldy registers, which were later simplified, contributed to the delay in achieving certification. Human resources can be minimised by keeping documentation simple and focusing on the 10-15 most significant issues, prioritising measures with the potential to result in cost savings (Hill, et al., 1995). Time invested at the beginning of the project to build awareness will facilitate the implementation process. Staff to be involved in operating the system should be involved at an early stage and contribute to its development.

Table 9. 5: Staff costs of implementing an EMS at Solvay Interox Ltd

Element of EMS	*Staff Days*	*Cost[2] (£)*
BS 7750 & EMAS Requirements Review	10	670
Strategy for Integration with ISRS / ISO 9000	25	1675
Determination of EMS Project Stages	5	335
Management Manual	30	2010
Environmental Policy	20	1340
Environmental Effects Assessment	45+10[1]	3015
Register of Regulations	10	670
Procedure for New Legislation	15	1005
Training Procedures	20	1340
Supplier Environmental Assessments	10+15[1]	670
Review of Software for EMSs	20	1340
Environmental Auditing Procedures	20	1340
Review Contractor Procedures	10	670
Objectives, Targets & Programmes Procedure	20	1340
Environmental Programme	10[3]	670
Issue of Procedures	10	670
Operational Control	85[4]	5695
Awareness Raising Activities	50	3350
External Public Relations	20	1340
Senior Management Input[5]	60	12,000
TOTAL	**520**	**£41,145**

KEY

[1] M.Sc student placement (at no cost to Solvay Interox Ltd)
[2] Assuming graduate costs of £67 a day through Teaching Company Scheme
[3] Not including time spent implementing the capital improvement programme
[4] Not including procedures which would have been developed regardless of EMS
[5] Assuming £200 a day to cover senior management salary and overhead costs

Multi-site companies can reduce costs by developing documentation centrally. At British Coal Opencast (BCO) the total internal human resource requirements to introduce a national EMS covering over 50 operating sites were approximately 333 days. In addition 13-20 days were required by each site for the effects assessment, targets and programme plus 400 staff-days for employee training (Hill, et al., 1995). This totals 6 staff years for 50 sites, or 34 staff-days per site which is cost effective when compared to the survey results of an average of 333 days.

9.3. CONSULTANCY FEES

External consultants were employed to assist with EMS implementation by 50% of participating companies. SMEs were more likely to use consultants with 73% seeking external assistance, compared to 27% of larger companies. The three willing to disclose fees paid from £600 to £1,500, with an average of £1,000 per company. The survey undertaken by the BS 7750 / EMAS Users Group reported higher consultancy costs. Over 50% used consultants charging from £207 to £500 per day (Baxter, 1997). Consultants were employed for 1 to 100 days, averaging 23 days, over the implementation period. Total costs ranged from £400 to £29,000, with an average of £6,800. SMEs paid more modest fees, ranging from £2,800 to £3,500.

Grants towards consultancy fees were available to SMEs between April 1995 and September 1998 through the Government's Small Company Environmental and Energy Management Assistance Scheme (SCEEMAS) (Figure 9.3). Subsidy was provided in three stages allowing companies flexibility in the timescale of implementation. Stages 1 and 2 allowed companies wishing to meet BS 7750 / ISO 14001 to claim back 40% of consultants charges. The third stage provided 50% of consultants costs for developing the verified statement required for EMAS. In addition companies progressing to this stage would benefit from a 10% refund from the first two stages. To be eligible companies had to be involved in manufacturing; employ fewer than 250 people; be less than 25% owned by another business and have an annual turnover of less than £32 million or an annual balance sheet of less than £21 million. The scheme was withdrawn in September 1998 due to lack of uptake. In its three years of operation it received only 270 applications, and resulted in 13 SMEs becoming EMAS registered (DETR, 1998a).

Figure 9. 3: Grant Assistance Available through SCEEMAS for SMEs

STAGE 1	**Environmental Review** Establishing a register of environmental effects, drawing up a policy with objectives and targets to ensure legal compliance and continual improvement in performance.	40% Grant
STAGE 2	**Management System** Documentation of procedures, monitoring and internal audit of the site which meets the requirements of EMAS and / or BS 7750	40% Grant
STAGE 3	**Environmental Statement** A report on the site's environmental performance, which has been independently validated by an accredited verifier.	50% Grant + 10% from stages 1 & "

9.4. CAPITAL EXPENDITURE

Capital expenditure to fulfil identified provision for environmental protection was required by 81% of survey respondents. It was most commonly needed to improve storage facilities and spillage response (Table 9.6). P P Payne installed drain inspection and pressure testing and Ricoh (UK) Products installed chiller units, energy saving devices and a toner compactor. At Akzo Nobel expenditure ranged from £333,000 for a waste water treatment plant, which would reduce effluent charges paid to North West Water plc, to low cost improvements to storage facilities and emergency planning.

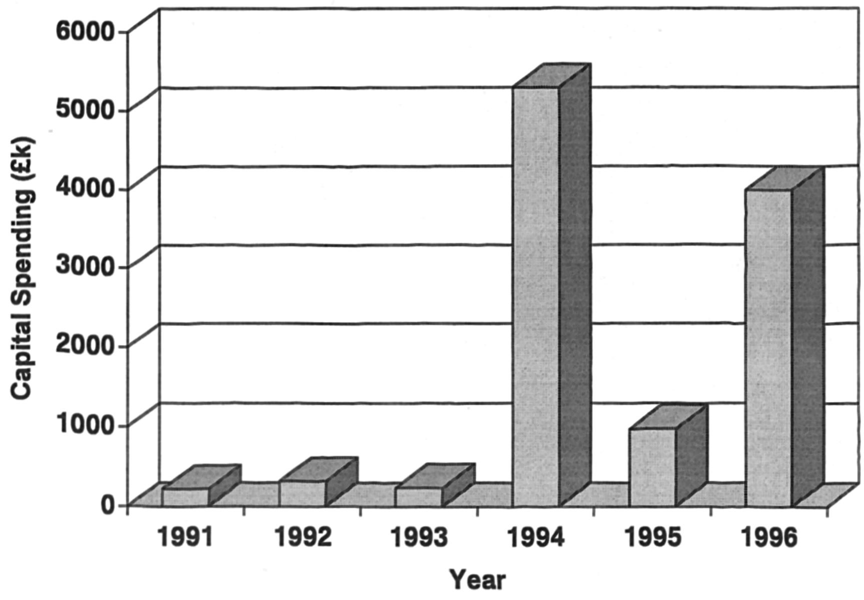
The majority of capital expenditure was required to reduce liabilities or meet conditions imposed by IPC or LAAPC authorisations. It cannot therefore be directly attributed to the EMS. Beyond legal compliance the EMS standards do not require any capital expenditure. British Coal Opencast spent only £2,000 per site which covered the costs of printing manuals, external training and consultancy (Hill, et al., 1995). Organisations voluntarily introducing new environmental technologies usually apply rigorous cost benefit analysis to determine their financial feasibility (Chapter 10).

Table 9. 6: Capital expenditure required for EMS certification at participating companies

Company Name	***No of Employees***	***Cost***	***Explanation***
Arjo Wiggins Fine Papers	230	Not available	Re-routing pipework to reduce risk of spills
Auto-Smart	55	£20,000	Concrete, bunding and a shut-off drain valve
BICC Cables	350	Not available	Extraction units and noise reduction booths
Carson Office Furniture	160	£10,000	Environmental protection
Curtis Fine Papers	350	£250,000/a	Environmental protection
Epson Telford	1,700	£50,000 /a	Environmental protection
Gleaner Oils	130	Not available	Bunding tanks, spill kits for vehicles etc
NDM Manufacturing	650	Not available	Bunding and spillage equipment
P P Payne	252	£6,000	Containment, bunding, drain inspection, pressure testing
Ricoh (UK) Products	740	Not available	Chiller units, energy saving devices, toner compactor.

The EMS at Solvay Interox Ltd did not require any additional expenditure. Substantial resources had been committed to ensuring legal compliance. In 1994, £1.5 million was spent on environmental protection and a further £4 million was budgeted for the period 1995 to 1997 (Figure 9.4). The replacement of coal-fired boilers with new high efficiency, low emission boilers required an additional £6 million. This would ultimately result in cost savings and ensure future environmental emission standards were achieved.

Figure 9. 4: Spending on environmental protection at Solvay Interox



9.5. EMS CERTIFICATION FEES

Charges to third party registration bodies will be required for those organisations seeking external certification to ISO 14001. To minimise these costs the NACCB introduced criteria allowing greater reliance on the internal auditing system (NACCB 1994a). Certification charges are still high with one of the major certification bodies, the British Standards Institution, charging £1000 for registration, covering the initial visit and questionnaire. The final cost is likely to be in the order of £2000-£5000 per company (Hill, et al., 1995).

The survey undertaken by the BS 7750 / EMAS User's Group found certification fees substantially varied. Daily rates ranged from £400 to £1240, averaging £585. Full assessments took between 2 and 21 working days, with an average of 7.2 days. Total costs ranged from £1,100 to £8,757, with an average of £3,745. SMEs paid from £1,100 to £3,500, with an average of £2,200. Following certification, companies had two surveillance visits a year from their certification body. These visits ranged from 1-

3 working days and cost from £775 - £1550, with an average cost of £950 per company.

Although certification fees are significantly less than the internal personnel costs of implementation they still represent a significant cost, especially for SMEs. As 95% of companies in the UK employ fewer than 20 people these high charges will discourage a large proportion of companies from adopting the standards. In a similar way to BS 5750 such companies will only seek external certification if demanded by their customers (Hall, 1995). To encourage EMS implementation in SMEs certification bodies must be prepared to offer affordable rates.

9.6. STAFF COSTS OF MAINTAINING AN EMS

Following certification, the resources required to maintain an EMS should not be underestimated. Ongoing requirements include the implementation of management programmes, record keeping, auditing, management reviews and document revision and control. Business in the Environment predicted this would take small companies 10 days and IPC regulated firms 70 days a year, with costs ranging from £2,000 to £7,000, depending on the size and nature of the company (McKenna, et al.,1996). These are underestimated compared to the actual time spent by those involved in the survey of 22 certified companies. 50% were able to quantify annual maintenance costs and 82% found 150 days per annum to be adequate. Commitment required ranged from 27 to 553 staff days, with an average of 138 days (Table 9.8). This is less than half the resources required during the implementation period and equates to £5,400 to £110,000 per annum, averaging £27,600. These results are comparable with those found by the BS 7750 / EMAS User's Group where annual days, including internal audit and review meetings, averaged 154 days (Baxter, 1997).

Table 9. 7: Staff- time and associated costs of maintaining an EMS

Company Name	*No of Employees*	*Management Time (Days) **	*Cost# / year*
Auto-Smart Ltd[3]	55	33	£6,600
Applied Chemicals[3]	150	40	£8,000
Anaplast Ltd[2]	170	113	£22,600
Alcan Smelting & Power UK[1]	172	27	£5,400
Arjo Wiggins Fine Papers Ltd[3]	230	66	£13,200
P P Payne[2]	252	156	£31,200
BICC Cables Ltd[2]	350	48	£9,600
Curtis Fine Papers[2]	350	53	£10,600
Lindsey Oil Refinery Ltd[1]	500	56	£11,200
Ricoh (UK) Products Ltd[1]	740	533	£106,600
Epson Telford Ltd[3]	1,700	400	£80,000

KEY:

* Assuming 226 days a year at 7.5 hours a day
# Assuming a daily costs of £200 to cover salary and overheads
1 Process regulated by Integrated Pollution Control
2 Process regulated by LAAPC
3 Non-prescribed process

The time required to maintain an EMS generally increases with company size (Figure 9.5). SMEs required an average of 60 staff days per annum compared with 208 for larger companies (Table 9.8). The time required to maintain the EMS dramatically increased for companies employing over 500 staff, with Ricoh (UK) Products and Epson Telford both requiring over 500 days per annum. This can be explained by the fact that the company's size warranted full time environmental staff who also called on the others for their input.

In a similar way to implementation time a great variety was seen between similar sized companies. Alcan Smelting and Power and Anaplast, both with 172 employees, estimated maintenance requirements of 27 and 113 days per annum respectively (Table 9.7). This reflects the many factors influencing resource requirements such as complexity of operations, severity of environmental effects, requirements of legislation and environmental risk associated with the company's operations.

Figure 9. 5: Staff-time to maintain an EMS versus company size

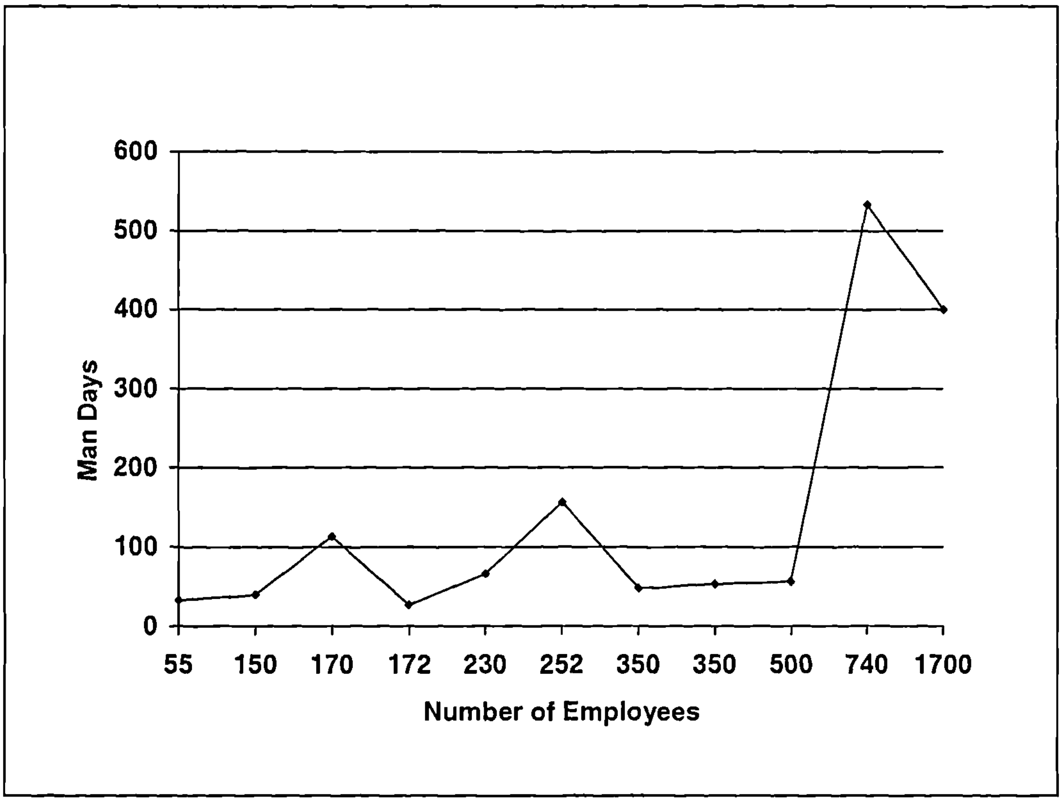


Table 9. 8: Staff-time of maintaining an EMS versus company size

No of employees	*Maintenance Time Range (staff-days)*	*Maintenance Time Average (staff-days)*
< 250 employees	27 - 133	60
> 250 employees	48 - 533	208

Companies prescribed as Part A for regulation under IPC required substantially more time to maintain their systems compared with non-prescribed or Part B processes (Table 9.9). This is the reverse of implementation time which on average was less for these companies, probably because of their advanced starting position. This will have no impact on maintenance time which appears to increase in proportion to the size and complexity of environmental effects. In addition IPC regulated companies are more likely to employ dedicated environmental managers.

Table 9. 9: Staff-time of maintaining an EMS versus process classification

Process Classification ***(EPA 1990)***	***Average Management Time (staff-days)***
Part A	205
Part B	93
Non-prescribed	134

At Solvay Interox, the time required to maintain those EMS elements not in place prior to the project was estimated to be 107 days per annum, equating to approximately £21,400. This amounted to only 21% of the costs of implementation. The majority of environmental concern was not directly attributable to the decision to adopt an EMS standard. Environmental training costs were absorbed as part of the ongoing training provided to employees. Any additional training requirements were incorporated within these sessions. Had there not been such well developed systems in place prior to BS 7750 implementation of the standard would have further increased annual maintenance requirements.

9.7. COSTS OF IMPLEMENTING EMAS

It is difficult to isolate the costs of implementing EMAS as the majority of registered companies seek BS 7750 / ISO 14001 certification first then upgrade to EMAS. This is a relatively straightforward process requiring the production and validation of the publicly available environmental statement. For those companies without an existing EMS the survey of nineteen small companies undertaken by Business in the Environment in November 1995, predicted the time required to achieve registration to EMAS to be anything from 40 and 260 staff days (Business in the Environment, 1996).

Table 9. 10: Staff-time of maintaining new EMS elements at Solvay Interox Ltd

Element of EMS	*Man Days*	*Cost** *(£)*
Update Effects Assessment	1	200
Monitor Progress towards Performance Targets	2	400
Update Annual Performance Targets	2	400
Monitor Progress towards Programme	5	1000
Update Objectives & Programme	2	400
Update Register of Regulations	1	200
Developing Audit Schedule	1	200
Auditing	50	10000
Management Review Meetings	8	1600
Review Manual & EMS Procedures	10	2000
Review S.O.Ps	20	4000
Supplier Assessments	5	1000
TOTAL	**107**	**21,400**

* Assuming a cost of £200 day of management time.

More comprehensive data is available from Germany where the number of registered EMAS sites is significantly greater than in the UK. Herbert Klemisch, of the Klaus Novy Institut in Cologne, evaluated the experiences of three small wood-working shops gaining registration in 1996 (Table 9.11). Human resources required ranged from 22 to 54 days (Business in the Environment, 1997). This appears modest when compared to the average of 333 days required in the UK for ISO 14001 / BS 7750 implementation. It can be explained by their extremely small size and simple operations. Their heavy use of consultants will have also substantially reduced internal costs. The financial costs of producing the environmental statement ranged from £1,300 to £3,400. Fees paid to verification bodies for the registration process varied from £1,700 to £3,400.

Table 9. 11: EMAS costs in three wood-working shops in Germany (Business in the Environment, 1997)

Company	***A***	***B***	***C***
Number of Employees	30	14	Unknown
Turnover	£1.4 mill	£0.8 mill	£0.6 mill
Manager Resources (staff-days)	27	27	19
Employee Resources (staff-days)	27	9	3
Consultants Costs	£26,700	£4,600	£2,300
Environmental Statement Costs	£3,400	£1,300	£1,300
Verification Costs	£3,400	£1,700	n.a.
Overall Costs	**£45,800**	**£16,000**	**£11,400**

[1] Assuming an exchange rate of $1.6 to £1

The UK survey by the BS 7750 / EMAS User's Group found resource requirements for EMAS to range from 2 - 100 working days, with an average of 36 days. The company requiring 100 days was not certified to BS 7750 and had progressed directly to EMAS. As the majority of the remainder had implemented BS 7750 prior to EMAS the reported costs relate primarily to the production of the environmental statement. The verification process lasted from 2-8 days, with an average of 4 working days. Verification bodies charged on average £545 a day and the total fees paid for verification ranged from £1000 to £4408, with an average of £1,900 (Baxter, 1997). Information provided by four of the first companies in the UK to become registered to EMAS illustrates that the staff time required to prepare the environmental statement can range from 2-3 days, for a simple statement of a small company, to 2 people full time for 2 months where substantial data collection and analysis is required (Table 9.12).

Table 9. 12: Staff-time required to prepare an environmental statement for EMAS (from Institute of Environmental Management, 1995a)

Company Name	No Employees	Statement Preparation Time
Akzo Nobel	135	2-3 staff days
Ciba Clayton	500	2 people on and off for 6-8 weeks
National Power (Drax)	620	5 staff days
Design to Distribution	188	2 people full time for 2 months

9.8. SUMMARY

The most significant resource implication of achieving EMS certification is the staff time required during the implementation period. Companies amongst the first to achieve certification to BS 7750 reported substantial variations in the human resources required. These ranged from 107 to 681 days, with an average of 333 days, equating to approximately £67,000 per company. These high costs are likely to reflect the steep learning curve during the initial years of the standards' operation. In addition timescales are likely to have been extended by participation in the BS 7750 pilot trial which ran for two years before it was finalised.

Although the resources required to implement a recognised EMS are significant the majority of companies are able to achieve certification through the utilisation of existing employees. A significant number also employ external consultants, particularly during the initial stages of implementation. Additional costs associated directly with certification are the third party registration fees, which average £4,000 per company. Capital expenditure is frequently indirectly required to ensure legal compliance. This cannot be directly attributable to the EMS as it is usually required to minimise liabilities and would have been needed to meet legal requirements. Typical requirements are for improved storage facilities and emergency response equipment.

Companies seeking registration to EMAS are usually already registered to BS 7750 or ISO 14001. The additional costs relate principally to the management time required to develop the public environmental statement and the validation fees paid to external verifiers. Preparation of the statement can take up to 100 working days, depending on the complexity of the company and availability of environmental performance data. Fees paid to verifiers for validation of the report cost on average £2,000.

The experiences of certified companies illustrate that EMS implementation is feasible within 6 to 12 months, a resource input of 100 to 300 days, and certification fees of £2,000 to £4,000. The exact resources required depend on many factors including the base-line position, nature of activities, complexity of operations and choice of project champion. Companies taking substantially longer than 300 days are likely to be overly concerned about the detail required to meet the assessor's requirements. The exception is those with complex processes with significant problems concerning legal compliance which need to be addressed prior to certification.

Following certification, the resources required to operate an EMS are dramatically reduced compared to the implementation period. They relate mainly to human resource costs and average 138 days or £27,600 per annum. To maintain certification annual surveillance fees of approximately £2000 must be paid to certification bodies.

CHAPTER 10

10.0. MEASURING THE VALUE OF AN EMS

10.1. INTRODUCTION

To demonstrate to stakeholders, especially shareholders, the value of environmental management it is important that companies regularly publish reports detailing their progress. Environmental accounting systems allow environmental objectives and targets to be linked with specific financial outcomes. This will ensure resources are made available where they provide the most benefit in both financial and environmental terms (British Standards Institution, 1996d). Whilst business is subject to mandatory financial auditing and reporting the position is much less developed for environmental accounting (DETR, 1998b) (ACBE, 1997). Businesses reporting on the value of their environmental management activities usually do so by quantifying physical impacts or outputs, such as the quantity of waste produced or resources consumed. Comparisons made on an annual basis measure changing environmental performance. Financial savings can be calculated by converting any reductions in waste or resource consumption into monetary terms. A common weakness of this approach is that the costs incurred during the achievement of environmental improvements are not included. To measure the true value of environmental activity accounting systems are needed which compare environmental expenditure with the resulting income. Ideally this would quantify the financial implications of the reported physical performance measures and give details of matters such as fines and prosecutions (ACBE, 1997). The collection of such data is beneficial in supporting the business case for environmental improvement, demonstrating the true cost of environmental legislation and helping in environmental decision making. There are, however, a number of problems in applying traditional cost benefit analysis to environmental initiatives. The costs are often unknown and many of the benefits are difficult, if not impossible, to accurately monetise (Baxter, 1997) (Holland, 1997). There is ongoing debate between academic institutions, accountants and city analysts about how environmental issues should be treated for accounting purposes.

This chapter reviews current best practice in environmental accounting and investigates mechanisms for measuring EMS value. Lessons are learnt from techniques previously adopted for measuring the performance of quality management systems. Finally the factors influencing EMS value are identified to assist organisations in determining whether a certified system is the most appropriate option.

10.2. LESSONS FROM QUALITY MANAGEMENT SYSTEMS

In considering mechanisms for measuring EMS value it is useful to examine previous research in the field of quality systems. Research on the impact of quality management programmes on business performance is based on the concept of quality costing (Dale, et al.,1995). These include money spent in attempting to achieve 100% customer satisfaction and the money wasted through failures (Musgrove, et al., 1991). Surveys in Western companies over the past 40 years have found that quality costs account for between 5% and 40% of turnover or between 3% to 50% of profit, expressed as a percentage of turnover. They are often at least as large as, and in most cases at least twice as large as, gross profits on turnover (Parker, 1995).

The most widely accepted model for categorising and analysing quality costs is the prevention, appraisal and failure model. It has been in use for 20 years and was first formulated by the American Society for Quality Control and later adopted by the British Standards Institution (Musgrove, et al., 1991). Quality costs are categorised into the cost of conformance and the cost of non-conformance. Conformance costs are the voluntary costs of achieving the desired quality level. They include those incurred in prevention and appraisal. Costs of non-conformance are the involuntary costs of failing to achieve the desired quality level and include internal and external failures (Table 10.1).

Taguchi's "Loss to Society Model" introduced the concept of incorporating the total loss to society generated by the shortcomings of a product (Musgrove, et al., 1991). This could be the loss of failing to improve a product or that caused by harmful side effects. Taguchi provides examples of savings imparted to society through the manufacture of a shirt requiring half the washing of a traditional shirt. This saves society half the cost of laundry bills and also produces environmental benefits in terms of savings in energy, reduced release of detergents and less noise.

Table 10. 1: Examples of Quality Costs (from Parker, 1995)

Prevention: ♦ training ♦ quality management system ♦ test equipment design ♦ quality cost reduction programme ♦ vendor appraisal ♦ business improvement teams	***Appraisal:*** ♦ design reviews ♦ field trials ♦ inspection ♦ review of publicity material ♦ checking cost bookings ♦ staff appraisal
Internal failures: ♦ scrap ♦ downgrading ♦ redrafting test routines ♦ retyping invoices ♦ debugging tested software ♦ correcting manual proofs ♦ stock-outs	***External failures:*** ♦ warranty credits ♦ complaint investigations ♦ replacement costs ♦ product liability claims ♦ discounts on poor installations ♦ redesign because of incompatibility

The concepts introduced by quality costing can be applied to environmental improvement programmes and EMS implementation. The first stage is to identify types of environmental costs. As in quality they can be classified into conformance costs including training, staff time, investments, plus non-conformance costs including the costs of inaction, such as waste, fines and clean-up costs (Table 10.2).

Table 10. 2: Examples of Environmental Costs

Prevention:	*Appraisal:*
♦ training ♦ environmental management system ♦ environmental protection equipment ♦ environmental programme ♦ supplier assessments ♦ environmental teams	♦ monitoring costs ♦ performance measurement ♦ inspection ♦ Environment Agency fees ♦ Water Company fees
Internal failures	*External failures*
♦ waste product ♦ waste raw materials ♦ waste energy ♦ waste water ♦ waste disposal costs	♦ complaint investigations ♦ incident / accident investigations ♦ clean-up costs ♦ prosecutions ♦ cost of missed business opportunity

In 1994 a review of the *Financial Aspects of Environmental Reporting* by the Association of Chartered Certified Accountants (ACCA) found few companies had attempted to produce comprehensive environmental accounts (Bennett, 1996). By 1997 it was estimated there were 300-400 companies world wide producing environmental reports (Brown, 1997). Compared to other areas of accounting research, environmental accounting issues have received little attention in academic journals (Stanwick, et al.,1998). By 1998 the UK top 100 companies all reported on environmental matters with one fifth producing separate environmental reports (DETR, 1998) (DETR, 1998b). This practice, however, is largely limited to major corporate organisations with only half of the next 250 companies publishing information about their environmental performance. Although guidelines for environmental reporting have been established by the Advisory Committee on Business and the Environment (ACBE), the United Nations Environment Programme (UNEP) and the Association of Chartered Certified Accountants (ACCA) only 11% of companies used them in developing their reporting structures (DETR, 1998b). This means the quantity, quality and detail of information provided by companies varies substantially which makes comparisons between organisations difficult. Their quality consistently fails to meet the expectations of stakeholders especially in terms of quantification and benchmarking (Brown, 1997). In 1994, a study undertaken by UNEP and Sustainability reviewed the environmental reports of 100 pioneers in the field, marking them against a 5-stage model (Brown, 1997). Of those studied 39% were classed as Stage 1 or 2, producing newsletters, videos or short statements in annual reports or one-off environmental reports. Stage 5, requiring comprehensive reporting on a range of sustainability issues with multi-way stakeholder engagement, was not attained by any companies and only 5% reached Stage 4.

The concept of environmental reporting and accounting is better developed in the United States. The US Environmental Protection Agency has developed a framework for internal total cost accounting (TCA) involving tiers ascending in degrees of comprehensiveness (Table 10.3).

Table 10. 3: Tiers of environmental costs in US Environment Protection Agency Model

Tier 0	Direct costs only
Tier 1	Direct costs and indirect costs
Tier 2	Tiers 0 and 1, plus legal liability costs
Tier 3	Tiers 0 to 2, plus intangible costs and benefits

Tier 0 - direct costs

These are the visible costs of environmental activity or inactivity which even a simple costing system will report. They are immediately identifiable with the product or process.

Tier 1 - indirect costs

Tier 1 costs are those which are indirectly allocated to a particular product or processes. Those included in this group depend on the sophistication of the accounting system. They may include costs such as energy, waste management and disposal cost which are not tracked to specific products or processes.

Tier 2 - legal liability costs

Tier 2 incorporates costs which may arise in the future. These may be fines and penalties for non-compliance imposed under criminal law or claims on the company from third parties under civil law. They are harder to quantify than direct and indirect costs as they depend on probabilities.

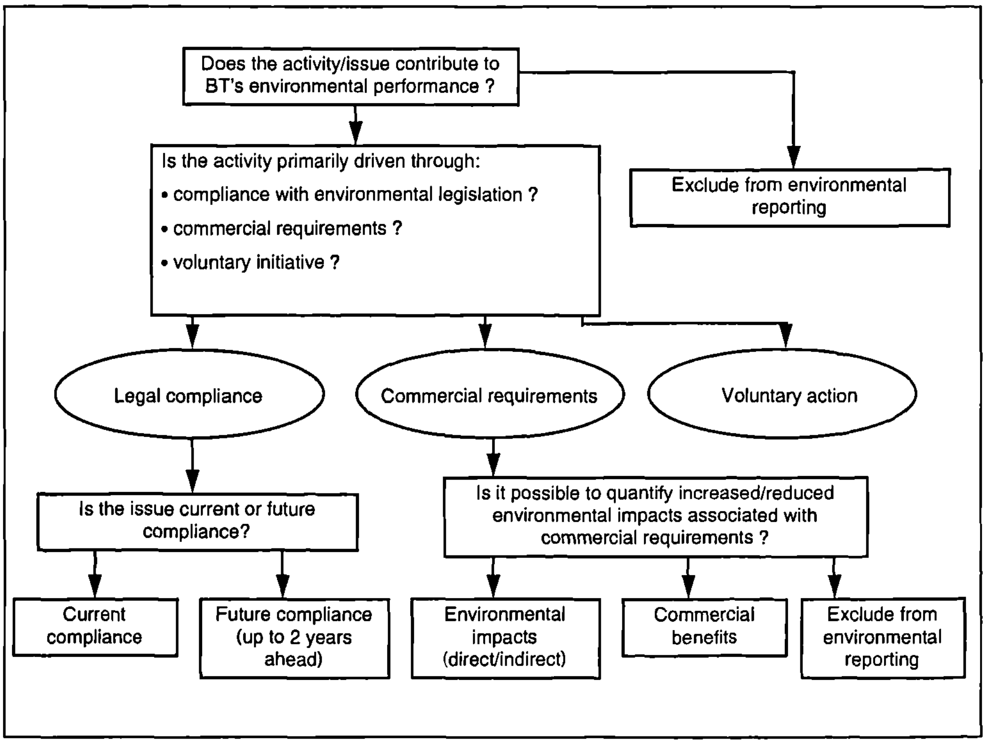
Tier 3 - intangible costs

Intangible costs are those which result from improved environmental performance but which are not easily quantified, such as improved public image with customers and stakeholders and increased staff morale. They may also include externalities such as the true cost to society of environmental damage, for example in deterioration of health.

A North American study, commissioned by British Telecom, interviewed larger companies and found awareness of the TCA framework but few who had sought to quantify even tier 1 or 2 costs and benefits (Bennett, 1996). None of those interviewed had attempted to include tier 3 costs. A common problem is the lack of an agreed systematic framework for defining, evaluating and reporting information. A major difficulty arises in classifying expenditures which are carried out for business as well as environmental reasons. British Telecom, which received international recognition for their approach to environmental reporting, devised a framework for identifying which costs to account for. Activities or issues related to their environmental policy; compliance with environmental legislation; a recognised external environmental issue or accepted good environmental practice were included (Figure 10.1).

The weakness with this approach was its inclusion of most of BT's commercial activities. A significant percentage of the costs or savings included were associated with purely commercial decisions or activities which had not resulted from environmental considerations. A second set of tests identified those issues or activities relevant to environmental performance (Table 10.4). This framework was applied to all issues including fuel and energy, wastes, procurement, emissions to air, product stewardship, local impacts and environmental management.

Figure 10. 1: BT's framework for identifying issues to be incorporated in environmental accounts (from Lane, 1996)



In North America, Baxter Healthcare and Monsanto are recognised leaders in the field of environmental reporting and cost accounting (Gray, 1997) (Barwise, 1996) (Bennett, 1996) (Deloite Touche Tohmatsu, 1994). Monsanto, a large US chemical company, reported externally on environmental costs for a number of years. They quantify operating costs, capital investment, staff costs, land remediation, environmental research and development and recoveries (Table 10.5). Operating costs include those of running pollution control equipment, including depreciation, disposing of wastes and obtaining licences and permits. Capital expenditure is included where the project has environmental benefits but which are not justified by conventional commercial criteria. This excludes investment in cost effective pollution control equipment. Staff costs are included, if at least half their total time is spent on environmental issues. Recoveries include any financial savings resulting from improved environmental performance such as avoided waste disposal costs. The 1994 accounts revealed that environmental costs significantly outweigh the recoveries although the savings were believed to be an underestimation as not all Monsanto units record this information.

Table 10. 4: BT's Definition of environment-related environmental performance data (from Lane, 1996)

Evaluation Criteria	Environmental performance criteria				Driver				Contributory Factors	
Activity / Issue: *Waste Management*	Legal compliance	BT policy	External pressure	Industry good practice	*Compliance*	Commercial	Commercial & Environmental	Voluntary	Direct	Indirect
Audits of main waste contractors / waste disposal facilitates	✓	✓	✓	✓	✓			✓	• Cost of management / consultancy time • Cost of Association membership	
Waste paper collection and recycling		✓	✓	✓				✓	• Cost / income from waste paper • Costs of waste segregation, collection and storage	• Level of commercial activity • Quantity of paper purchased • Efficiency of paper use • Efficiency of paper collection • Contractual conditions with waste paper merchant
Drinks-can recycling		✓	✓	✓				✓	• Costs of can collection and storage • Cost of waste disposal	• Emissions from can collection / recycling • Cost savings to can manufacturers and drinks producers
Cable recovery programme	✓	✓		✓		✓	✓		• Income from metals recovery • Cost of waste disposal	• Timescales / scale of network modernisation programme • Cost of network modernisation programme • Labour costs
Battery recycling		✓	✓	✓				✓	• Cost / income from battery recycling • Costs of collection and storage contract	• Environmental impacts / costs associated with recycling of batteries • Contractual conditions with suppliers
Hazardous waste disposal	✓	✓	✓	✓	✓				• Costs of waste removal / storage / disposal	
Payphones refurbishment		✓		✓		✓	✓		• Costs of replacement programme • Savings through reuse of equipment	• Additional handling resources / costs • Costs of collection / storage

Table 10. 5: Environmental costing at Monsanto Ltd (from Bennett, 1996)

Expenditure	
Operating costs	$ 150 million
Capital costs	$ 90 million
Staff costs	$ 60 million
Land remediation	$ 20 million
Environmental R&D	$ 20 million
	$ 360 million
Income	
Recoveries	$ 30 million

Baxter International, a leading producer, developer and distributor of health care products and services, have one of the most advanced environmental accounting systems. Income and savings are compared with the costs of the proactive environmental programme on an annual basis (Table 10.6). Ongoing savings from previous years initiatives are also included. Although their accounting system is one of the most advanced no attempts are made to quantify legal liability and intangible costs although undetermined costs are referenced in the report (Table 10.7).

10.2.1 Accounting for Legal Liability Costs

Legal liability costs are those associated with inactivity resulting in criminal fines or civil liabilities. Without effective control systems, there is no guarantee for how long a company will avoid such litigation. Calculations of legal liability costs are complex involving probabilities of prosecution and potential fines. They can be useful, however, in justifying expenditure on initiatives designed to improve legislative compliance.

Table 10. 6: Estimated costs and savings world-wide at Baxter International ($million)(from Baxter International, 1996)

Environmental costs:	**1994**	**1993**	**1992**
Costs of proactive programme:			
Corporate environmental affairs	1.4	1.6	1.5
Auditor's and attorney's fees	0.6	0.3	0.9
Corporate environmental engineering / facilities engineering	0.8	0.9	0.8
Division/facility environmental professionals and programmes	7.0	6.5	5.0
Packaging professionals and programs for packaging reduction	2.1	2.0	1.8
Pollution controls, operations and maintenance	7.8	7.5	7.0
Pollution controls, depreciation	2.5	2.7	2.0
Total costs of proactive programme	**22.2**	**21.5**	**19.0**
Remediation and waste disposal costs			
Attorney's fees for clean-up claims, NOVs	0.3	0.2	0.2
Waste disposal	2.8	3.4	3.8
Remediation / clean-up on site	1.2	0.8	5.0
Remediation / clean-up off site	1.1	0.3	0.0
Total remediation and waste disposal costs	**5.4**	**4.7**	**9.0**
Total Environmental Costs	**27.6**	**26.2**	**28.0**
Environmental income, savings and cost avoidance associated with environmental initiatives in report year			
Ozone-depleting substances cost reductions	1.8	1.2	1.4
Hazardous waste - disposal cost reductions	0.9	0.6	0.6
Hazardous waste - material cost reductions	0.5	0.5	0.5
Non-hazardous waste - disposal cost reductions	0.5	0.5	0.5
Non-hazardous waste - material cost reductions	5.4	1.3	3.7
Recycling income	3.5	2.7	2.2
Green lights energy conservation - cost savings	0.3	1.1	0.4
Packaging cost reductions	10.5	6.3	5.4
Total income, savings and cost avoidance for report year's initiatives	23.4	14.2	14.7
- As a percentage of the costs of proactive programme	105	66	77
Total income, savings and cost avoidance from report year's initiatives	23.4	14.2	14.7
Cost avoidance in report year from efforts initiated in prior years back to 1989	51.2	38.4	16.3
Total income, savings and cost avoidance	**74.6**	**52.6**	**31.0**

Table 10. 7: Examples of undetermined costs and savings included in Baxter's environmental report (from Baxter International, 1996)

Examples of undetermined costs:

- environmentally driven materials research and other R&D
- capital costs of modifying processes other than adding pollution controls
- costs of substitutes for ozone-depleting substances and other hazardous materials
- lost sales from environmental issues
- extra capital cost for environmentally superior lighting and other equipment that is more expensive than alternatives

Examples of undetermined savings:

- reduction in liability exposure resulting from tank removals, waste site evaluations and other risk management programs
- record-keeping and administrative costs
- increased goodwill, sales and employee morale
- capital cost savings for environmentally superior lighting and other equipment that is less expensive than alternatives

10.2.2 Accounting for Externalities & Intangible Costs

The accounting mechanisms described so far have been concerned with quantifying internal costs and savings. There is increasing interest in assessing and monitoring external environmental costs and savings (Holland, 1997). Companies are realising that through tightening legislation, increasing public opinion and the introduction of greater fiscal measures, today's external environmental costs are likely to become the internal costs of the future . An example is the use of private road transport which results in substantial costs to both businesses and the environment. Companies which provide services to reduce transport commitments will be able to generate both environmental and economic benefits to themselves and their customers. Few companies have experience in quantifying externalities. Those who have have done so mainly to compare alternatives or to highlight significant externalities as an impetus for organisational or governmental action (Bennett, 1996).

Ontario Hydro, an Canadian electricity producer, is a leader in the area of externality costing (Gray, 1997) (Bennett, 1996). They aim to calculate a monetary value for all significant environmental impacts to add to the internal cost of producing electricity. They believe a revised cost, reflecting the full life cycle of their projects, will result in decisions creating the least cost to society. To date they have developed estimates for some aspects of the impact of fossil fuel generation and nuclear generation, including effects of emissions to air on the mortality and morbidity of the local population and on agriculture. Those covered include sulphur dioxides, total suspended particulates and some nitrogen trioxides. They have developed a four stage approach for calculating a single monetary amount to reflect these environmental impacts. The first stage is to identify all emissions and their potential impacts. This is relatively straightforward and easily achieved using up to date monitoring equipment. The second stage requires emission dispersion modelling, a process they have found difficult but reliable. The final two stages rely largely on measurements and calculations provided by the government and other bodies. The third involves quantifying, in physical terms, the impacts on society such as the mortality and morbidity of the local population, and impacts on agriculture. This has some inherent uncertainties as impacts are based on probabilities. The final stage, monetising these impacts, is perhaps the most complex. In the case of impacts on local agriculture the actual market prices of the crops affected can be determined. Monetising impacts on health is more difficult and involves estimating the cost of the average length of stay in hospital, which is 11 days for respiratory diseases, plus typical personal insurance claims and loss of earnings. For mortality costs an average of $4 million per life was assumed based on the current literature available on the subject (Bennett, 1996).

The process of monetising externalities is subjective and time consuming. Ontario Hydro believe the costs are justified since it will support better decision making. Whilst monetisation may be desirable in principle it is not feasible for all environmental impacts due to a lack of available information. In terms of monitoring the ongoing value of environmental management systems it is recommended that companies start by establishing annual accounts of tier 1 and 2 costs, allowing costs and revenues to be compared. Calculations of legal liability costs and externalities can be beneficial in decision making but even those companies leading the field have not included such costs in their annual accounts.

10.3. MEASURING THE VALUE OF AN EMS

The first stage in measuring the value of an EMS is to establish accounting systems similar to those adopted by Monsanto and Baxter International. This allows annual comparisons of the costs incurred and savings generated from implementing and operating the EMS. The establishment of recording systems from the start of implementation allows financial appraisal techniques to be used retrospectively to appraise the outcome of the project. This typically involves an assessment of the amount of revenue accruing from the project against its costs. Financial data included in such investment appraisals can be conveniently divided into six categories (Table 10.8). The decision to adopt an EMS standard will increase variable costs through additional labour requirements whilst savings may result from reduced resource consumption or waste disposal costs. Capital costs may need to be considered if any new equipment is purchased (Chapter 9).

Table 10. 8: Types of costs and savings typically included in investment appraisal

Capital Costs	One-off costs usually incurred in the purchase of plant and materials
Capital Income	One-off income usually incurred in the sale of plant or materials
Variable Cost Savings	Variable costs reduced by the installation of the new system (eg use of less resources)
Variable Cost Increase	Variable costs increased by the installation of the new system (eg extra maintenance)
Fixed Cost Savings	Fixed costs reduced by the installation of the new system (eg the removal of building and thereby reducing rates)
Fixed Cost Increase	Fixed costs increased by the installation of the new system (eg by renting more space for the production increase)

By comparing implementation costs with financial savings a clearer picture of the value of the system can be gained. At Birds Eye Wall's Ice Cream, the cost of achieving certification was estimated at £100,000 of which £65,000 paid for a consultant and a graduate who helped the company prepare its documentation (ENDS Report 264b, 1997). The remainder represented the cost of management time. In addition £15,000 was spent on improving containment of hazardous substances. In 1996 as a direct result of the investment the site saved £250,000. Annual savings were therefore over twice the implementation costs. Further evidence is provided by Renlon who identified savings of over £22,000 which were sufficient to cover the annual costs of operating the system (Hill, et al., 1996).

The most commonly used investment appraisal technique is the calculation of payback periods. This involves comparing an initial outlay with annual savings resulting from the investment. At its most simple level it provides a time period in which the capital investment is recouped. This occurs at the time by which the aggregate of costs and savings resulting from a project equals zero (Energy Efficiency Office Best Practice Programme, 1993). The shorter the payback period the better the investment. Payback periods can be calculated for EMS implementation where data are available on the costs of implementing and maintaining the system and the resulting income, savings and cost avoidance.

The results of the 1996 SGS Yarsely pan-European survey found that companies with a certified EMS perceived them to be highly cost effective. ISO 14001 was considered to be cost effective by 85%, EMAS by 80% and BS 7750 by 82%. In addition 60% expected a payback after one year and 75% would recommend the standard to others (SGS Yarsley, 1996). Similar results were reported in the Institute of Environmental Manager's 1996 Members Survey (Institute of Environmental Management, 1996a). All members felt their EMS had been worth the effort of implementation and many were surprised at how rapidly the system was proving itself to be effective.

Wolstenholme International is one of the few certified companies to have established an accounting system to measure EMS performance (Garrett, 1998b and 1997) (ETBPP, 1996b) (ENDS Report 263). The first stage was to calculate the costs of improvement initiatives, one-off savings and annual savings (Table 10.9). The costs of maintaining the system, which were calculated to be £7,500, were deducted from the annual savings to give a net annual saving of £96,000 (Table 10.10). Costs of EMS implementation were calculated at £71, 300 including new equipment and personnel costs. This was compared with the savings to calculate a payback of 4.5 months (Table 10.11).

Table 10. 9: Cost of environmental initiatives versus savings at Wolstenholme International (from ENDS 263, 1996)

	Cost (£)	*One-off savings (£)*	*Annual Savings (£)*
Waste reduction	5,800	-	39,000
Raw material and consumables	8,000	25,000	32,000
Energy efficiency	24,000	6,000	31,800
Liquid effluent	4,100	-	-
Avoided equipment	-	4,000	-
TOTAL	**41,900**	**35,000**	**103,600**

Table 10. 10: Net annual savings from EMS at Wolstenholme International (from ENDS Report 263, 1996)

	Cost / Saving (£)
Annual savings	103,600
Annual labour costs (waste reduction)	2,000
Annual maintenance costs (EMS)*	5,500
Net annual saving	**96,100**

* 75 man days plus the certifiers annual surveillance fee for BS 7750 of £1,100

Table 10. 11: Payback period for EMS implementation at Wolstenholme International (from ENDS 263, 1996)

	Cost / Saving (£)
Implementation costs (equipment & EMS)	71,300
One-off savings	35,000
Net total implementation cost	**36,300**
Annual savings	103,600
Annual labour costs (waste reduction)	2,000
Annual maintenance costs (EMS)*	5,500
Net annual saving	**96,100**
Payback	**4.5 months**

* 75 man days plus the certifiers annual surveillance fee for BS 7750 of £1,100

Similar calculations can be undertaken for Vauxhall Motors in Ellesmere Port. The estimated cost for preparation and certification of BS 7750 over twelve months was £327,000 including £200,000 capital expenditure for plant modifications (pers. comm. Woodward, 1995). Electricity savings amounted to £120,000 in six months and reduction of waste to landfill secured savings of £1,600 per week (Healy, 1995). In total these amounted to over £323,000 per annum giving less than a one year payback on the costs of implementation (Table 10.12).

Table 10. 12: Payback period for EMS implementation estimated for Vauxhall Motors

	Cost / Saving (£)
Implementation Costs (including capital expenditure)	**£327,000**
Annual savings (electricity usage)	£240,000
Annual savings (waste reduction)	£83,200
Net Annual saving	**£323,000**
Payback	**12 months**

Of the companies participating in the survey, few were able to provide sufficient financial data to develop accounts as detailed as those at Wolstenholme International. Of the 77% who achieved financial savings only five companies (45%) could estimate these in financial terms and provide an estimation of EMS implementation and maintenance costs. Net annual savings, ranging from £18,700 to £490,000, were calculated by deducting the annual EMS maintenance costs from the annual savings (Table 10.13). By comparing the implementation costs with these annual savings a payback period could be calculated (Table 10.14). In all five company's the costs of implementing the system were recouped within 18 months of certification. Capital expenditure has been excluded as for the majority of companies it was required to meet legislation rather than to achieve financial savings (Chapter 9). The inclusion of certification fees paid to third party registration bodies increased implementation costs on average by £4,000 and annual maintenance costs by £1,000 (Chapter 9). This has the impact of reducing payback by approximately 1 month per company (Table 10.15).

Table 10. 13: Net annual savings or costs resulting from EMS implementation (excluding capital costs & certification fees)

Company Name	*No of Employees*	*Annual Costs**	*Annual Savings#*	*Net Savings*
Applied Chemicals	150	£8,000	£100,000	£92,000
P P Payne	252	£31,200	£50,000	£18,800
BICC Cables	350	£9,600	£500,000	£490,400
Ricoh (UK) Products	740	£106,600	£150,000**	£43,400
Epson Telford	1,700	£80,000	£130,000	£50,000

* assuming a cost of £200/day to cover salary and overheads
\# savings achieved within first year after certification
** savings quoted as £100,000 - £200,000 therefore averaged as £150,000

Table 10. 14: Payback periods for EMS implementation excluding certification fees

Company Name	*No of Employees*	*Implementation Costs**	*Net Savings#*	*Payback (months)*
Applied Chemicals	150	£80,000	£92,000	10
P P Payne	252	£21,400	£18,700	14
BICC Cables	350	£40,000	£490,400	1
Ricoh (UK) Products	740	£61,200	£43,400	17
Epson Telford	1,700	£74,600	£50,000	18

* based on £200 per day to cover salaries and overhead costs
# savings achieved within first year after certification

Table 10. 15: Payback periods for EMS implementation including certification fees but excluding capital equipment costs

Company Name	*No of Employees*	*Implementation Costs**	*Net Savings#*	*Payback (months)*
Applied Chemicals	150	£84,000	£91,000	11
P P Payne	252	£25,400	£17,700	17
BICC Cables	350	£44,000	£489,400	2
Ricoh (UK) Products	740	£65,200	£42,400	18
Epson Telford Ltd	1,700	£78,600	£49,000	19

* based on £200 per day to cover salaries and overhead costs
# savings achieved within first year after certification

Although five (23%) companies experienced favourable payback periods an additional five (23%) reported their systems had not generated any financial savings in the first year of operation (Chapter 8). Should this situation continue, they would therefore not recoup the costs of implementation through direct savings on operational efficiency. A further twelve companies (55%) did achieve financial savings but were unable to quantify these.

Table 10. 16: Summary of payback periods on EMS implementation for participating companies

	No of companies	*Percentage of companies*
Payback less than 1 year	2	9%
Payback between 1-2 years	3	14%
Savings achieved but unsufficient data to calculate payback	12	55%
No payback	5	23%

Whilst the calculation of payback periods provides a useful estimation of EMS value it has a number of basic weaknesses. Of particular relevance is the fact that further cost savings may be identified after the first year following certification. It can not be assumed that no further savings will be achieved in subsequent years. In the second year, for example, environmental initiatives may be implemented which substantially increase annual savings and therefore reduce payback periods. In addition, this technique ignores the fact that financial values vary with time due to interest and inflation.

There are a number of complex investment appraisal techniques overcoming some of these problems. Return on investment considers the full life-time of the project. Total savings are divided by the costs to give an average rate of return per year. For example, if a project results in annual savings of £170 and the full project life is 5 years the total savings will be £850. If the initial capital cost was £300 then the total return would be 283%, or a rate of return of 57% per annum (BRECSU, 1995). Other techniques are available to compensate for the time value of money. Standard discounted cash flow can be used to calculate the true value of costs in the future. By applying a discount factor the effects of interest and inflation can be incorporated into investment appraisal calculations.

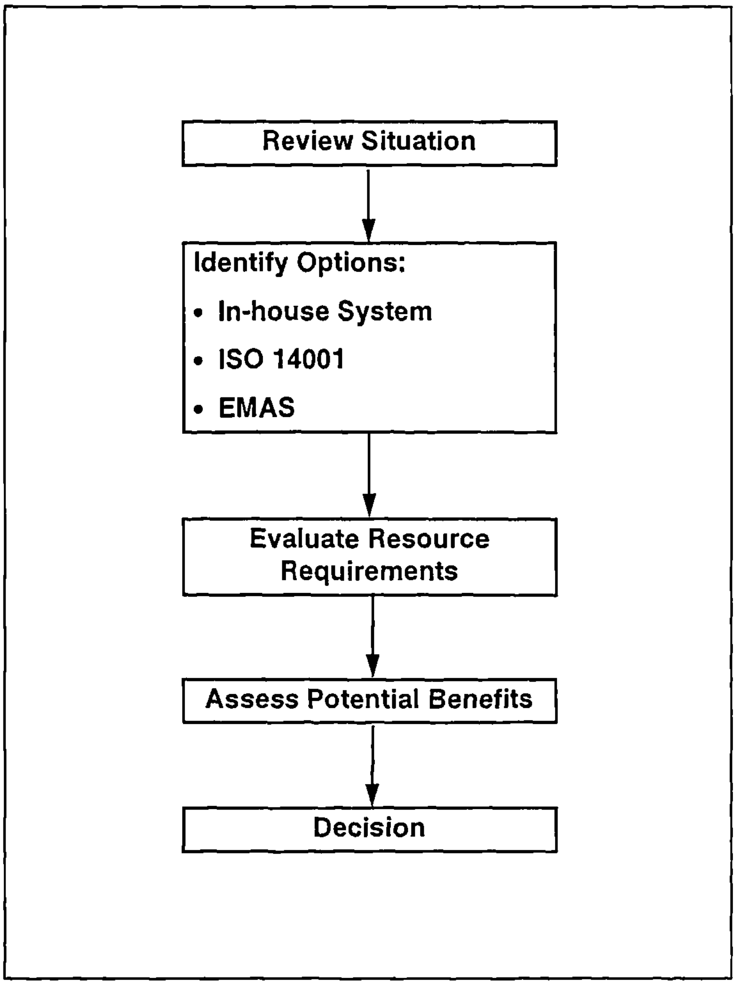
These techniques can only be applied to projects with a known life time where savings and costs occurring over this period can be easily estimated. In the case of the implementation of an EMS the project lifetime is unknown and the savings likely to occur in the future difficult to predict. However, where an EMS is already in place its performance can be measured through the establishment of annual environmental accounts which detail the cash flow for that period.

A second weakness of traditional investment appraisal is its limitation to income resulting from direct improvements in process efficiency. In determining the overall value of an EMS it is also necessary to consider income resulting from enhanced legal compliance, improved competitive advantage, reduced insurance costs as well as avoided future costs. Such benefits are difficult to monetise but essential to consider.

10.4. PREDICTING THE VALUE OF AN EMS

It is essential that companies considering adopting an EMS standard appraise the commercial costs and benefits of participation before taking action. It is recommended that such companies undertake a four stage decision making process (Figure 10.2).

Figure 10. 2: Four stages in determining whether to adopt a recognised EMS standard



10.4.1 Reviewing the Situation

The first stage in the decision making process is a review of the current situation including identifying relevant standards and their uptake within industry. At present there are two EMS standards, EMAS and ISO 14001, although in the UK uptake of ISO 14001 is substantially greater than EMAS. ISO 14001 and EMAS are both due for revision in 2000 (ENDS Report 289, 1999) (Environmental Information Bulletin, 1998e). This is expected to incorporate ISO 14001 as the environmental management system for EMAS and to introduce a requirement for annual reporting into both standards. In the future there is the possibility that these will be unified and an integrated quality and environmental standard published (Chapter 2). As the situation is continually developing, knowledge of the current situation is essential for those considering EMS implementation.

10.4.2 Identifying the Options

The next stage is to identify the options available to the organisation. At present, manufacturing companies in the EC have the choice of two recognised standards, EMAS or ISO 14001. For those outside of the EC or involved in non-manufacturing this is currently limited to ISO 14001. This situation is expected to change with the review of EMAS in 2000 which is likely to be opened up to non-manufacturing sites and potentially those outside the EU (Environmental Information Bulletin, 1998e).

A further option, for all organisations despite their location or industrial sector, is the adoption of an in-house system. These vary in complexity from simple compliance based activities to those encompassing detailed waste minimisation or life-cycle analysis techniques. The extent to which these systems are formalised varies from minimal documentation to fully developed systems consisting of a policy, procedures, manuals and records.

10.4.3 Evaluating Resource Requirements

An evaluation of the likely resource implications of each option is recommended as the next stage in the decision making process. Research from companies certified to ISO 14001 and EMAS assists in this process (Table 10.17) (Chapter 9). During the first years following their publication companies were typically taking over 300 days to implement the standards which amounted to £70,000 including consultancy fees and certification charges. However, certified companies have demonstrated that implementation is possible within 6 to 12 months and a resource input of approximately 100 days. It is likely this could be reduced further with the use of external consultants with substantial experience of EMS implementation. Additional costs may be incurred for companies requiring capital expenditure to ensure legal compliance. Registration to EMAS is likely to cost another £10,000 for the preparation of the environmental statement and the verification process.

Table 10. 17: Typical Resource Requirements of adopting a certified EMS (from Chapter 10)

Task	*Costs (Range)*	*Costs (Average)*
Staff-time (Implementation)[1]	£21,000 - £136,000	£66,000
Consultancy Fees	£600 - £1,500	£1,000
Capital Costs	£0 - £250,000	£67,000
Certification Fees	£700 - £10,000	£4,000
EMAS Implementation[2]	£400 - £20,000	£7,200[2]
EMAS Verification[2]	£1,000 - £4,408	£1,900
Annual Staff-time (Maintenance)	£5,000 - £106,000	£27,000

1 Assuming daily costs of £200 to cover management's salary and overheads

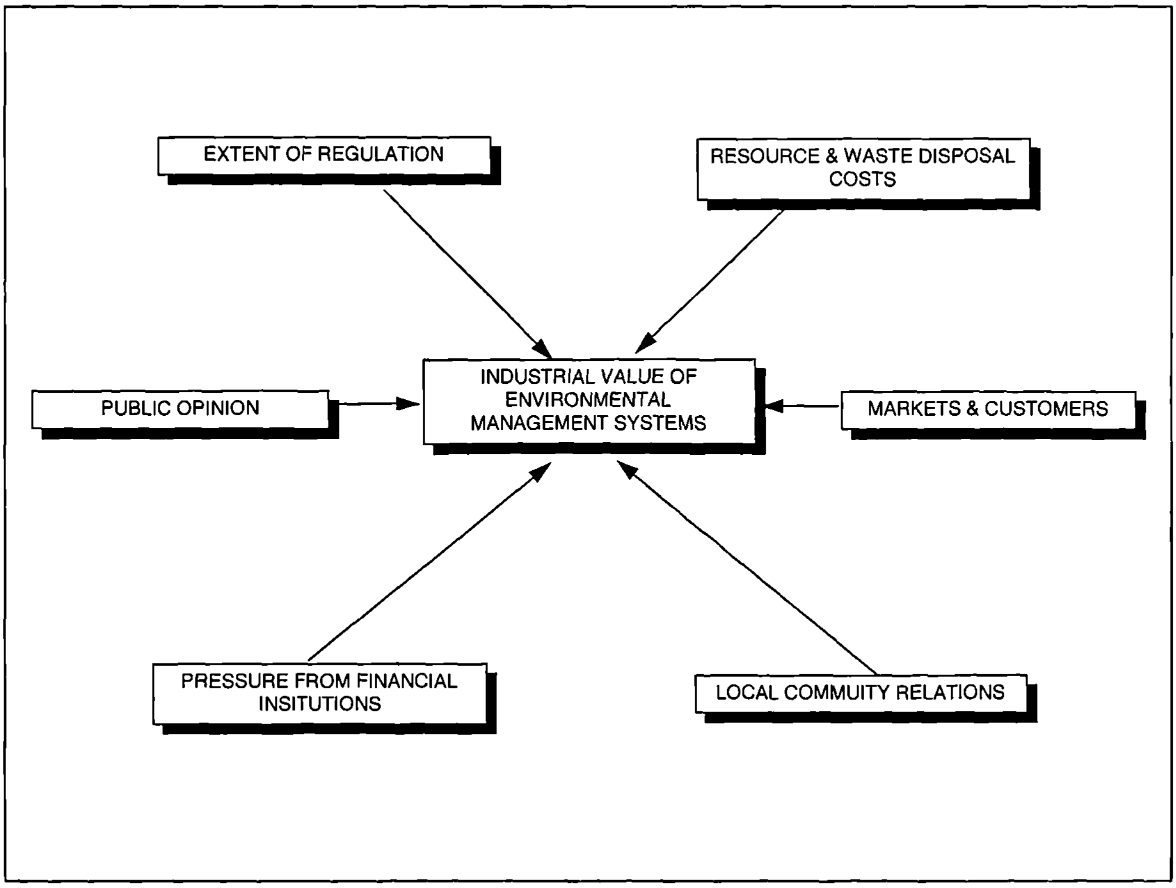
2 From Baxter, 1997

2 The majority of companies responding already had BS 7750 / ISO 14001

10.4.4 Assessing Potential Benefits

Assessing potential benefits of EMS approaches is less straightforward due to the large number of variables to be considered (Figure 10.3). Each variable influences the extent to which the organisation is likely to benefit from an EMS and can therefore assist a company determine their environmental strategy.

Figure 10. 3: Factors to be considered in assessing the benefits of adopting an EMS



Decision Making Criteria 1: Potential Financial Savings

An EMS has the potential to result in significant cost savings from waste minimisation (Chapter 8). The potential for savings depends on the organisation's environmental costs, in terms of resources and waste disposal. The greater the expenditure the more substantial the likely savings. Scope to save in individual companies can be predicted by considering evidence from demonstration projects such as the Aire & Calder

Project, Project Catalyst, Leicestershire, West Midlands, Humberside and Merseyside (Environment Agency, 1996) (Table 10.18). An estimate of the scope to save can be calculated from these guidelines. A predicted payback period can be estimated by comparing the likely resource requirements with potential savings. As the costs of implementation do not substantially alter with company size these will be most favourable in organisations with high raw material, utility and waste disposal costs.

Table 10. 18: Calculating scope to save from waste minimisation (from Environment Agency, 1997)

Raw Materials:	
• First most used	1 - 5%
• Second most used	1 - 5%
• Third most used	1 - 5%
• All other materials	1 - 5%
Packaging	10 - 90%
Ancillary Materials	5 - 20%
Consumables	10 - 30%
Energy:	
• Electricity	5 - 20%
• Heat for process and space heating (gas and fuel oil)	10 - 30%
• Vehicle fuel	10 - 30%
Water	20 - 80%
Trade Effluent	20 - 80%
Solid & Liquid Waste	10 - 50%

The long-term feasibility of environmental improvement projects will depend on future raw material, utility and waste disposal costs. It is widely accepted by economists that environmental damage needs to be reflected in terms of its true costs to society (Evans, 1998) (Lewis, 1995) (Gray, et al., 1993) (Pearce, 1992). A Worldwatch Institute report estimated that during 1994-1996 consumption of fossil fuels were subsidised by $230 million each year with one estimate as high as $800 million in the early 1990s (Haavisto, 1996). One mechanism to prevent this is the use of eco-taxes such as the UK's 1996 landfill tax, which introduced a £7 tax on each tonne of waste sent to landfill which has since increased to £13 per tonne (Environment Business, 1999). It aimed at ensuring landfill waste disposal was properly priced and promoting greater efficiency in the waste management market and economy as a whole (Lewis, 1995).

As the Commission's White Paper on Growth, Competitiveness and Employment recommends a shift towards green taxes industry is likely to be faced with higher future resource costs (Auken, 1996). This has manifested itself in the 1999 budget which introduced an levy on the business use of energy of up to 40% (Environment Business, 1999). To predict likely eco-tax trends in the UK a review of fiscal measures adopted in countries with more stringent environmental policies is useful (Table 10.19). This highlighted substantial support for eco-taxes within the EC.

Decision Making Criteria 2: Markets

Improvements in competitive advantage resulting from EMS certification depends on the markets in which the company operates. As a first stage, companies considering an EMS should review their customer's environmental policies to determine their existing and future requirements. An EMS will be particularly beneficial to those supplying customers certified themselves or those with stringent requirements, typically the larger corporate organisations (Figure 10.4). A survey of 500 leading UK businesses undertaken by BSI in November 1998 found that two thirds had an EMS and one third employed external auditors to verify its effectiveness (Environment Information Bulletin, 1998d)

Table 10. 19: Status on Eco-taxes within the EC (from Burke, 1996)

Denmark	Adoption of a tax reform in 1993 introduced green taxes consisting of an energy package and tax initiatives concerning pesticides, nickel-cadmium batteries and chlorinated solvents. These were fully implemented in 1996 and revenues are expected to amount to 5% of GDP or 10% of overall tax burden. Denmark calls for global taxes especially in energy, agriculture and transport.
Finland	Calls for the introduction of EC wide green taxes and has conducted research which found that if these replaced some employment tax the result would be to create employment intensive growth.
Belguim	Levies have been introduced for waste including waste water, water abstraction and animal manure.
Netherlands	Their second national Environmental Policy, issued in 1993, concluded a tax was required to reduce carbon dioxide emissions by 3-5% by 2000. This was introduced in 1996 and is focused on smaller users including households, small commercial establishments, hospitals and schools. Revenues are recycled back to tax payers through reductions in direct taxes.
Germany	Calls for internalisation of environmental costs to enable full implementation of the Polluter Pays Principle. Europe needs a long-term, ongoing environmental policy which deliberately affects market forces. The German Federal Government will do its upmost to ensure a high level of environmental protection within the EC and calls also for intensive international efforts.
Ireland	States that market based instruments, including fiscal and economic instruments and voluntary agreements are particularly important in achieving sustainable development. Calls for a better understanding of the environmental costs of economic activities and realisation that progressive environmental policies, including greener taxation measures, can benefit competitiveness and employment creation.
Norway	Established the Norweigen Green Tax Commission to evaluate the role of tax policies in achieving both increased employment and long-term environmental improvements. The relevant tax reform proposals will be considered within the ordinary annual budget process. Norway is one of the pioneering countries in the field of natural resource accounting with established accounts for energy and air pollution.
Sweden	In 1990-91 became the first country to embark on a green tax by introducing a value added tax (VAT) on energy and transport which mostly affected households. A carbon tax as well as a sulphur tax was introduced. The tax was increased in 1993 and differentiated according to categories of consumers. In 1995 the tax rate for industry was doubled. Further green taxes are currently being investigated by the Swedish Tax Change Committee.
Switzerland	In 1995 approved the introduction of incentive taxes on VOCs, and on extra-light heating oils with a sulphur content more than 0.1%. The revenues are returned to the population. Legislation aimed at curbing CO2 emissions provides for a carbon tax if others methods do not prove effective. Also approved a mileage related tax on HGVs in 1994 which is expected 2001.
UK	Introduced a tax on all categories of waste going to landfill in 1996 as a transition from taxing jobs to taxing pollution. In 1993 announced it would increase the overall exise duty on road fuel by an average of at least 3% per annum above inflation which has since been raised to 5%.

Figure 10. 4: Companies requiring stringent environmental standards of their suppliers

• Body Shop	• IBM[1]
• British Telecommunications	• Rover Group[1]
• British Gas	• Jaguar[1]
• B & Q	• Volvo Group
• Sharp	

1 Companies requiring suppliers to become certified to ISO 14001 or EMAS

The second stage in predicting the likely benefits in terms of competitive advantage is to review uptake of the standards within customers. This will vary both with their location and industrial sector. Companies exporting to countries with large numbers of certified companies, such as Japan and Germany, would be well advised to achieve EMS certification (Chaper 2). This is also true where they export to countries with a high uptake per head of population, such as Switzerland, Sweden, Ireland, Finland and the Netherlands. In addition to the number of certificates, consideration of the trends in EMS uptake in respective countries can be useful in predicting the future situation. Since Spring 1995 uptake of the standards has been most rapid in Germany, where EMAS predominates, followed by Japan (Garrett, 1998b).

Potential improvements in competitive advantage will also depend on customer's activities. The greatest benefit is likely in those supplying an industrial sector with high EMS uptake. This includes the electronics industry; chemical manufacture; power generation; paper and printing and automotive industries (Chapter 2). It is also necessary to consider the degree to which competitors are adopting the EMS standards. Where a company operates within an industrial sector with high uptake, certification may be necessary to remain competitive and maintain market share.

Decision Making Criteria 3: Extent of Regulation

Improvements in legal compliance and cost avoidance, in terms of fines and clean-up fees, will depend on the extent to which a company is regulated (Chapter 8). These benefits will be greatest in those tightly regulated under Integrated Pollution Control. In considering whether to adopt a recognised standard it is necessary to consider not only current legislation but also trends and developments in UK, European and International policy. Each year the Environment Agency publishes a ten point list of priorities targeted for more stringent inspection. In 1998 this included increased enforcement relating to water pollution and waste management licences and reduced carbon dioxide emissions (Table 10.20). Pollution related prosecutions have recently increased by 16% and since the Environment Agency was launched over 1,000 incidents have been taken to court (Lee, 1998).

Table 10. 20: The Environment Agency's ten-point action plan for 1998 (from Environment Information Bulletin, 1998c)

1. Enforcement - reduce confirmed water pollution incidents by 5%.
2. Waste management - increase waste management licence inspections by 25% and ensure that every site is inspected at least once during the year.
3. Partnerships - tackle environmental problems at 500 sites by working in partnership with farmers, industry, local authorities, green groups and others.
4. Consultation - develop over 80 local Environment Agency Plans with local communities.
5. Climate change - work towards reducing carbon dioxide emissions from regulated industries by 3 million tonnes.
6. Water resources - reduce over-abstraction at sites of special scientific interest, alleviate low flows on 30km of river and review abstraction licences at 10 sites.
7. Water quality - improve the quality of 200km of river and 26 bathing waters, and restore fish to 100km of river.
8. Flood defence - increase the proportion of properties receiving flood warnings by 40%.
9. Contaminated land - encourage and support the clean-up of 50 seriously contaminated sites.
10. Information - improve the quality and access of information to the public, and establish 26 new local customer service centres.

EC legislation has doubled in the last ten years and continues to rapidly increase (Chapter 1). In 1997 a number of key developments likely to have a significant impact on industry were introduced (Table 10.21). On 15 July the Department of Environment, Transport and the Regions launched a consultation document on the implementation of EC Directive 96/61 on Integrated Pollution Prevention and Control (IPPC). The Directive is similar to the UK's Integrated Pollution Control (IPC) but more stringent requiring organisations to look at their inputs as well as outputs. This holistic requirement will encourage a systematic approach to environmental management. The new regime will also increase the number IPC sites from around 2,200 to 8,000

(Environment Information Bulletin, 1998a). Draft regulations implementing the Directive are expected during 1999 (Fuller, 1998).

A key event of 1997 was the third meeting of the parties to the Convention on Climate Change in Kyoto, Japan on 1-10 December. This led to agreement for developed countries to cut emissions of six main greenhouse gases by 5.2% between 2008 and 2012. The EU agreed their position in March 1997, aiming for reductions of 15% for developed countries and at least 7.5 for developing countries by 2010. Prior to the meeting the UK Government committed itself to a cut of 20% in CO_2 emissions by 2010 compared with 1990 levels (Environment Information Bulletin, 1998a).

Future changes to legislation can be predicted by reviewing areas targeted within national and EC policy. *The Dobris Assessment: The European Environment Agency's State of the Environment Report* identifies 56 key environmental issues for Europe. Britain's environmental policy is documented in the *Sustainable Development: The UK Strategy*, published in response to the Rio Earth Summit (Department of the Environment, 1994). Future environmental policies and commitments are determined through annual reports to *This Common Inheritance: Britain's Environmental Strategy* (Department of the Environment, 1990). Recent UK developments include the publication of *Indicators for Sustainable Development for the UK* which identify mechanisms for measuring progress towards sustainable development (Department of the Environment, 1996a). In 1998 the Government published *Opportunities for Change, Consultation Paper on a Revised UK Strategy for Sustainable Development* (DETR, 1998) and a number of associated documents, one of which is specifically related to opportunities and challenges for business (DETR, 1998b). This details a number of areas where the Government will be seeking to encourage improvements in industry's environmental performance and summarises their preferred route to ensure this is achieved (Table 10.22).

Table 10. 21: Key legislative and other developments in 1997 (Environment Information Bulletin, 1998b)

Acidification	• EC Adoption of a strategy on acidification
Air Pollution	• UK strategy on SO_2 reductions • EC agreement on Directives to reduce vehicle pollution • EC proposals to introduce tighter air quality standards
Climate Change	• UK commitment to cut CO2 emissions by 20% by 2010 compared with 1990 levels • International agreement requiring cuts in greenhouse gases of 5.2% between 2008 and 2012 in developed countries • EC strategy aiming at reduction of methane emissions 30% in 2005 and 40%
Chemicals	• UK action plan for phasing-out and destroying polychlorinated biphenyls • Ongoing Greenpeace anti-PVC campaign
Contaminated Land	• Contaminated land regime delayed until 1998
Domestic Legislation	• New regulations to clarify legislation on water discharge consents • New regulations on recycling and recovering packaging • New regulations introducing statutory quality standards for 13 substances in water • Update of waste management legislation to take account of the landfill tax.
Enforcement	• 500 prosecutions by the Environment Agency • 6 jail sentences of 1-18 months for environmental offences
Environmental Assessments	• Amended EC Directive requiring 14 new categories of projects requiring environmental impact assessment
IPC	• Consultation document on the implementation of EC Directive on Integrated Pollution Prevention Control
Landfill	• EC Commission adopts a proposal for a Directive to control waste to landfill • Landfill tax raises £343 million in first year
Major Accident Hazards	• Seveso II Directive adopted by the EU at the end of 1996, regulations to implement the directive are expected in 1998
Noise	• EC Green paper focuses on reducing noise from traffic
Ozone Depletion	• Agreement to phase-out methyl bromide by 2015
Renewable Energy	• EC White Paper aims to increase renewables' share of EU energy market from 6% to 12% by 2010 • EC strategy aims to double market penetration of combined heat and power to 18% by 2010
Transport	• Draft UK strategy on an integrated transport system • Road Traffic Reduction Act 1997 requires local authorities to set targets for reducing traffic
Waste Management	• EC waste strategy adopted based on the concept of producer responsibility
Water	• Labour Government water summit in London

Table 10. 22: Areas targeted by the Government in their consultation paper on sustainable development and business in the UK (DETR, 1998b)

- Increased voluntary agreements between industry and government. This is expected for energy efficiency by the end of 1999.
- Increased design, manufacture and marketing of products which have lower environmental effects .
- Market transformation by removing poor performing products from the market place, possibly through the use of legislation.
- Increased eco-efficiency to achieve more from less resources.
- Increased status of the "Green Claims Code" and review of the legal framework for dealing with false environmental claims.
- Focus on producer responsibility initiatives for waste streams with the potential for increased recycling and recovery including electrical and electronic equipment, lead-acid batteries, end-of-life vehicles, newspapers and tyres.
- Increased business involvement in local regeneration and the elimination of poverty. Empowerment of employees to create a better working environment.
- Increased communication between business and stakeholders, including local communities, to ensure business becomes better at spotting key contentious issues.
- To encourage all large businesses to have a publicly declared environmental policy and report to stakeholders on their performance including the environmental impacts of products and services.
- Promotion of existing guidelines for environmental reporting including those published by the ACBE, UNEP's Engaging Stakeholders Programme and the ACCA.
- Increased use of performance indicators, targets and benchmarking against different comparitors including company's own year-on-year performance, legal standards and other companies' performance.
- Innovation in cleaner technology to allow UK businesses to change their products and processes to minimise their burdens on the environment through the promotion of life-cycle analysis and other related techniques.
- Maximise the potential of existing awareness programmes including the Environmental and Energy Efficiency Best Practice Programme .
- Expand the Making a Corporate Commitment Campaign beyond energy efficiency to embrace sustainable development and EMS principles.
- Encouragement of business to develop green commuter plans and to set voluntary targets for reducing single car commuting.
- Encouragement of business to adopt systematic approaches to environmental management including ISO 14001 and EMAS.

Decision Making Criteria 4: Local Community Relationships

A company's location and relationships with local residents need to be considered when determining an environmental strategy. Those having attracted concern from local residents in the past, perhaps even complaints, are more likely to benefit from the improved image associated with EMS certification than those interacting less with the public. The adoption of EMAS, in particular, will assist in alleviating their concerns through the publication of the externally verified environmental statement.

Decision Making Criteria 5: Pressure from Financial Institutions

The degree of pressure on a company to adopt an EMS from financial institutions will influence the extent to which they will benefit from certification. Larger organisations, especially those associated with adverse environmental effects, are likely to find it increasingly difficult to obtain insurance or access to investment unless they can demonstrate they are environmentally responsible (Chapter 8). The existence of a certified system, especially EMAS, demonstrates the existence of strong environmental systems and helps to alleviate their concerns. Insurance companies, in particular, will be far more rigourous about checking the environmental credentials of their customers following the publication in September 1998 of recommendations on the underwriting of sudden and accidental pollution by the Joint Pollution Working Group (Environment Information Bulletin, 1998f).

Decision Making Criteria 6: Public Opinion

The nature of public opinion concerning the industrial sector in which an organisation operates needs to be considered in the decision making process. Those operating activities associated with a negative public image are more likely to see the value of an external endorsement of their environmental management. This includes those involved in chemical manufacture; the nuclear industry or those manufacturing timber related products such as paper or furniture. Market surveys assist in gauging public and consumer environmental awareness. The survey reported by the Harris Research Centre in March 1995 found 80% of respondents to be concerned about the environment of which 23% were very concerned (Blaza, et al., 1997). Trends in consumer practices were investigated by the MORI Business and the Environment survey conducted in August 1995. They found environmental considerations substantially impacted on consumer's purchasing practices. 49% of respondents bought products in recycled packaging and 53% bought products made from recycled materials (Blaza, et al.,1997).

10.4.5 The Decision

The final decision regarding whether to adopt an EMS and seek external certification requires consideration of all six decision making criteria. Decisions should not be based purely on the estimated payback period which does not include the additional benefits of improved competitive advantage, legal compliance, public relations and employee motivation.

A simple scoring system can assist companies in their decision making process (Table 10.23). Those with a high score in several categories are likely to significantly benefit from EMAS or ISO 14001 (Table 10.24). EMAS is particularly beneficial for those organisations seeking to improve their image with stakeholders. Companies with high scores in one criteria, who do not consider the costs of adopting a full EMS can be justified, have the option to adopt a staged implementation approach focusing initially on their specific needs (Table 10.25). Once their immediate problems or opportunities have been addressed it may become feasible to implement full systems at a later date. Careful consideration of these criteria is as useful during the identification of significant environmental aspects and in determining the focus of an EMS (Chapter 4).

A high score in criteria 1 indicates substantial scope for cost savings through waste minimisation and improved efficiency. In many instances these can be realised without adopting a full certified EMS. Waste minimisation programmes can either be established in-house or through participation in local or national schemes. Success in achieving savings can be invaluable in demonstrating the benefits of environmental management and encouraging adoption of full certified systems.

A high score in criteria 2 indicates an urgent need to ensure customers' requirements are met. This may not necessarily require certification as in some cases demonstration of a policy and legal compliance is sufficient. However, companies within this category would be well advised to consider adopting a recognised EMS as it provides an easy answer to customers' enquiries and ensures a continued place on approved supplier lists.

Table 10. 23: Deciding whether to adopt a recognised EMS standard

Decision Making Criteria		*Score*
1	***Financial Savings***	
	a) payback less than 18 months predicted	5
	b) payback between 18 and 30 months predicted	3
	c) payback over 30 months predicted	1
2	***Markets***	
	a) customers include "environmental leaders"	5
	b) customers located in countries or sectors with high EMS uptake	3
	c) neither a) or b)	1
3	***Extent of Regulation***	
	a) activities tightly regulated and likely to increase	5
	b) some legislation applies but likely to increase	3
	c) minimal existing legislation and not likely to significantly increase	1
4	***Local Community Relationships***	
	a) activities having previously attracted complaints	5
	b) site adjacent to local residents but no previous complaints	3
	c) site not located adjacent to local residents	1
5	***Pressure from Financial Institutions***	
	a) high impact activity / currently seeking investment funding	5
	b) medium impact activity / may need to seek investment funding	3
	c) neither a) or b)	1
6	***Public Opinion***	
	a) activities associated with negative public opinion	5
	b) activities may result in future negative public opinion	3
	c) activities unlikely to result in negative public opinion	1
	TOTAL SCORE	

Table 10. 24: Determining an environmental strategy

Score	*Recommended Approach*
Scores of "5" in the several categories	EMAS / ISO 14001
Scores of "5" in one category	In-house system / ISO 14001
Scores of "1" in the majority of categories	In-house systems for compliance

Table 10. 25: Bespoke systems addressing company's needs

Score	*Recommended Approach*
High score in criteria 1	Waste minimisation programmes
High score in criteria 2	Systems to address customers' requirements
High score in criteria 3	Risk assessment and improved legal compliance
High score in criteria 4	Local community initiatives
High score in criteria 5	Risk assessment and improved legal compliance
High score in criteria 6	Publication of environmental reports

A high score in criteria 3 or 5 indicates the need to ensure adequate systems and controls are in place to guarantee legal compliance. The initial focus should be on the use of risk assessment to identify areas of non-compliance and the implementation of improvements where necessary. Improvements may also be required to ensure the continual review and identification of new or amended legislation and its implementation. Only when full compliance is achieved is it feasible to progress to a further developed system.

A high score in criteria 4 indicates that significant improvements in public image are feasible through addressing the needs of local residents. This requires the establishment of reliable procedures for recording and responding to environmental complaints and enquiries. Such companies would also be well advised to establish resident liaison groups and become involved in local community improvement programmes. The publication of regular newsletters or reports may also be beneficial in improving public image.

A high score in criteria 6 calls for initiatives to improve the general public's opinions regarding the company's activities. In this case, addressing the area of the business causing concern would be most beneficial. It could include the publication of regular reports on progress and involvement in local and national awareness programmes through organisations such as trade associations.

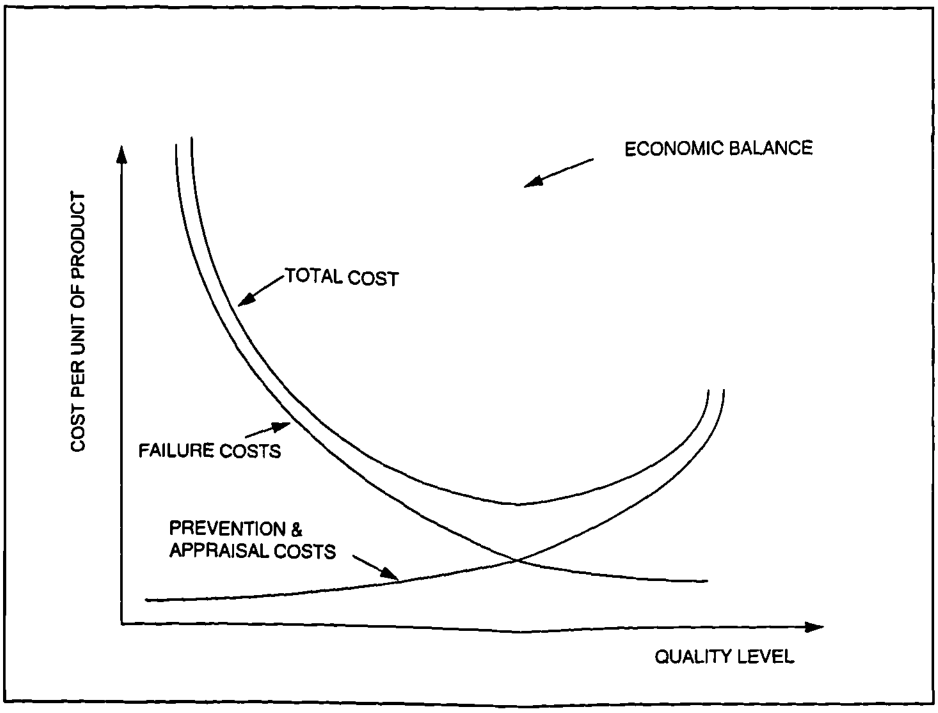
10.5. BEYOND CERTIFICATION

In predicting the ongoing inter-relationships between the costs of EMS maintenance and the anticipated income it is advantageous to consider previous research in the field of quality management. The Economic Balance Model or Quality Cost Model, a general model for predicting how quality costs interrelate, was developed by Juran (Parker, 1995) (Figure 10.6). It predicts that initially it will be feasible to obtain dramatic reductions in non-conformance costs through relatively little effort. With time it will become increasingly harder to reduce costs further and eventually a balance position results where the costs of improving further will outweigh the potential benefits.

Curve 1 represents the costs of poor performance, or non-conformance costs, and Curve 2 the costs of improving quality levels. The model predicts that as quality levels are improved by greater investment in prevention and appraisal the costs of failure reduce dramatically thereby reducing total costs. As this continues significant further investment will produce only modest reductions in failure costs. At the balance point the cost of securing higher quality would exceed the benefits of improvement.

This model can also be applied to environmental costs. Curve 1 would represent the cost of poor environmental performance in terms of both internal costs, such as waste disposal and resource consumption, and external costs, such as fines, complaint investigations and clean-up costs. Curve 2 would represent the costs of operating the management system to achieve improved performance (Table 10.1). According to this model it is possible to dramatically decrease environmental costs during the early phases of EMS operation. However, with time it will require greater resources to reduce costs further and beyond a certain point it would no longer be advantageous to attempt to further improve the company's environmental performance.

Figure 10. 5: The Quality Cost Model (from Musgrove, et al., 1991)



Juran's model is still widely accepted but has now been discredited due to the fact that improvements in quality usually have longer term benefits not included in the calculations. A modification to the model assumes that prevention and appraisal costs can be "traded off" as increased investment in prevention calls for less appraisal (Parker, 1995) (Figure 10.6). Increased investment in prevention will not increase total costs as appraisal costs will drop. As a result total costs will continue to decrease with time due to improved quality levels.

According to the revised Quality Cost Model an EMS will continue to be cost effective as the costs of its operation will be offset by the generation of further savings. This will require new methods or solutions to lower the static cost curve. This requires a fundamental shift away from compliance based systems, with their focus on direct impacts, towards sustainability. Sutton (1997) believes to achieve ecological sustainability society will have to achieve six goals (Figure 10.7). He suggests the use of inspirational stretch goals to inspire both a steady stream of incremental improvement and break though innovations (Figure 10.8).

Figure 10. 6: Modified Quality Cost Model (from Parker, 1995)

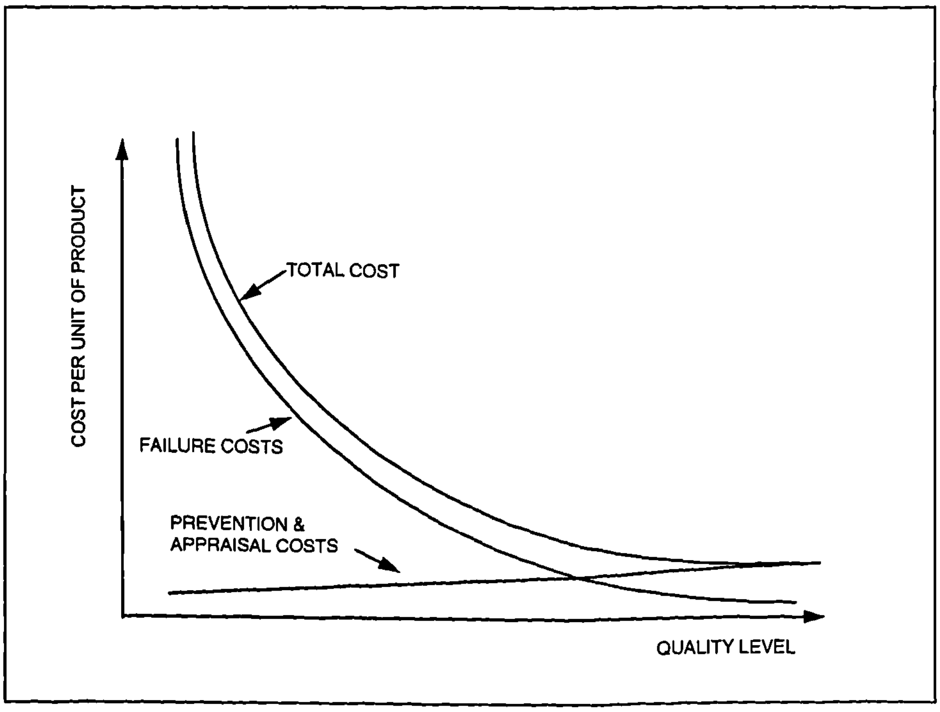


Figure 10. 7: Actions required to achieve ecological sustainability (from Sutton, 1997)

- **Reduce CO_2 emissions globally by at least 60% of the 1998 levels**
- **Prevent the accumulation of toxic and artificial substances in the natural environment**
- **Ensure that the chemical and physical composition of the atmosphere and of water stays within natural levels**
- **Ensure that there is virtually no further destruction of natural environments globally**
- **Restore natural habitats to the extent needed to safeguard threatened species**
- **Adopt a closed-cycle economy in which virtually all wastes are recycled**

Figure 10. 8: Inspirational stretch goals for sustainability seeking firms (Sutton, 1997)

- **A zero-extinction economy and society**
- **A zero-climate-damage economy and society**
- **A zero-soil-degradation economy and society**
- **A zero-damage-to-natural-ecocycles economy and society**
- **A closed-cycle economy and society (based on 100% recycling)**
- **A dematerialised economy and society (reducing resource consumption)**
- **A renewed-resource economy and society**
- **A sustainable-population society and economy**
- **A win-win economic and society that can achieve the above objectives with a major trade-off with income, employment and social justice objectives.**

This approach has been adopted by Du Pont, who have a 190 year history of pursuing a zero accidents policy. Their accident rate is now less than one thirtieth of the average for the US industry and one tenth the average for comparable industries globally. They are now extending these concepts to the environment and in 1994 established goals of zero waste and emissions (Figure 10.9).

Figure 10. 9: The Dupont Commitment to Safety, Health and the Environment

- **Highest Standards of Performance; Business Excellence**
- **Goal of Zero Injuries, Illness and Incidents**
- **Goal of Zero Waste and Emissions**
- **Conservation of Energy and Natural Resources; Habitat Enhancement**
- **Management and Employee Commitment; Accountability**
- **Open and Public Discussion; Influence on Public Policy**

The move towards a sustainable enterprise requires focusing on meeting the needs of all its stakeholders, including customers; shareholders; banks; insurers; employees; suppliers; regulators; media; environmental groups and local communities (Welford, et al., 1998a). One of the keys to success will lie in establishing their confidence in the management to address the environment in a positive, strategic way, seeking to minimise or preferably eliminate negative impacts. Forward thinking corporates, such as Shell UK and IBM, are embracing these concepts by undertaking extensive consultation exercises with their stakeholders.

A key difference between ISO 14001 and sustainable development is that the first is typically short-term, tactical and problem solving whereas the latter is long-term, strategic and holistic (Sheldon, 1996). Callens, et al., (1998) suggest the move towards sustainable development should focus on the elimination of factors of unsustainability, including short-termism and non-systematic views which give priority to one component instead of considering the full environmental situation. This requires a change in culture from a company's private interest towards sustainability thinking and value to society. The sustainable seeking company is motivated by both private interest and society's needs and focus on the creation of new products and programmes as a means of improving society's environmental performance. A sustainable direction is required to all activities, including purchasing, and the organisation's sustainability performance must be measured against their stakeholder's expectations (Welford, et al., 1998a). Critical to this process is the move towards eco-efficiency which the World Business Council for Sustainable Development describes as the delivery of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity (Institute of Environmental Management, 1998).

Spencer-Cooke (1997) introduces the idea of sustainability management and audit systems (SMAS) to address those aspects of corporate performance not covered by the current EMS standards. Such systems are lifecycle-based, sustainability-driven and focused on environmental and social impacts rather than systems. In addition to addressing eco-efficiency, which is partially addressed in the EMS standards, SMAS will look to address eco-justice. Their aim will be to achieve a more equitable system of access to the world's resources and the wealth they produce through trade and industry, for all the world's people (Evans, 1998). The extension of EMSs to incorporate such broader issues is, at present, limited to a few often specialised companies including B & Q, The Body Shop and Traidcraft.

In the mid 1990's the Swedish oncologist, Karl-Henrik Robert, made a substantial contribution to the concept of sustainable development. His concept, the Natural Step, is based on thermodynamics and cell biology. The framework defines sustainable development in terms of four system conditions (Figure 10.10). Eco-efficiency and eco-justice are both incorporated in the fourth condition which aims to meet everyone's needs through the equitable distribution of resources.

Figure 10. 10: The Natural Step (from Brady, et al., 1998)

1. **Substances from the earth's crust must not systematically increase in nature**
2. **Substances produced by society must not systematically increase in nature**
3. **The productivity and diversity of nature must not be systematically deteriorated**
4. **We must be efficient enough to meet basic human needs everywhere**

Welford, et al., (1998a) advocates a model for achieving sustainable consumption and production based on six key areas (Figure 10.11). This encompasses the work and frameworks developed by many different people and brings together issues and tools commonly associated with sustainable development. His approach places substantial emphasis on social and ethical issues which are considered to be essential to achieve true sustainability. The business is expected to have a policy in each of the six areas, to operationalise that policy using the tools suggested and to regularly report externally on their progress. Environmental management systems play an important role in this framework by assisting in the achievement of ecological sustainability. They can not themselves be expected to transform the business into a sustainable company but must form part of a much broader integrated strategy encompassing ecological, economic and social sustainability.

Table 10. 26: Policy areas and tools for sustainable development (Welford, et al., 1998a)

Policy area	Indicative tools
Environment	life cycle assessment
	environmental management system and audits
	functionality assessment
	resource management
Empowerment	team building
	participation
	equal opportunities
	declaration of rights
Economics	profits / surplus
	employment
	quality
	long-term financial stability and investment
Ethics	transparency of objectives
	openness to concerns
	honesty
	values statement
Equity	fair trade policy and activity
	end-price auditing
	development aid
	sponsorship
Education	training
	customer information
	community involvement
	campaigning

The Brundtland Report acknowledges that to achieve sustainability environmental considerations need to be integrated into policy and plan formulation. Companies work within a framework set by corporate wide policies, national government policy and local authority policies and plans. They can not be expected to deliver sustainable development, which must be an overall goal of society. Individual companies attempting to achieve sustainability will be limited by economic considerations unless they work within an adequate infrastructure where environmental costs have been fully considered in pricing policies (Evans, 1998). Ecological dimensions of policy need to be considered at the same time as the economic, trade, energy, agricultural, industrial and other dimensions (World Commission on Environment and Development, 1987). This calls for the more widespread use of strategic environmental assessment (SEA) in the development of environmental policies and plans. This is a systematic process for evaluating environmental consequences of proposed initiatives to ensure they are fully included and appropriately addressed at the earliest stage of decision making along with economic and social considerations (Sadler, 1998).

10.6. SUMMARY

It is essential that organisations operating EMSs establish effective accounting systems to measure the ongoing value of their system. Few companies routinely develop environmental accounts although there are simple mechanisms for comparing the costs of environmental improvements with the resulting benefits. In developing such accounts it is important that those costs and savings not easily quantified, including competitive advantage, reduced liabilities and improved public image are also reported. The quantification of such issues in financial terms is extremely rare and limited to a few leading companies in the USA.

Companies considering adopting an EMS standard should carefully consider their position and apply a formal decision making process. This requires an estimation of the likely costs and benefits through the consideration of a number of criteria. These include the feasibility and scale of potential cost savings; the degree of relevant legislation; the markets in which the company operates; their relationships with local residents; the extent of pressure from financial institutions and the general public's opinion. During the process it is also necessary to predict future circumstances in terms of resource costs and the likely impacts of developments in the legal framework.

Many benefits can be achieved without implementing a full system certified to the requirements of an EMS standard. It is recommended that the individual needs are carefully considered and initial efforts focused on addressing the major risks and opportunities. Adopting a recognised standard, however, provides a ready made framework and certification provides external credibility, assurance that the system works and additional motivation.

CHAPTER 11

11.0. CONCLUSIONS & RECOMMENDATIONS

11.1. INTRODUCTION

During the early years following the publication of the first internationally recognised EMS standard in 1994, industrial awareness and uptake of formal environmental management systems was limited. Few small and medium sized enterprises (SMEs), adopted the standard due to their perception of high costs and a lack of appreciation of the potential benefits. Since then both uptake and awareness has continued to steadily grow, particularly since the publication of the international version, ISO 14001, in autumn 1996 which catalysed significant interest in the industrial community. By the end of 1998 over 7,000 certificates had been issued world-wide and uptake was increasing at a rate of over 300% per annum (ENDS Report 287, 1998). This is set to continue in parallel with the increasing industrial environmental awareness seen throughout the 1990s (ETBPP, 1999).

11.2. SUMMARY OF FINDINGS

Uptake of the EMS standards is being driven by industry's desire to achieve a competitive advantage and legislative compliance. Legislation is a particularly effective driver for industrial sectors tightly regulated under Integrated Pollution Control (IPC). These organisations are also more likely to seek registration to the more stringent EC Eco-management and Audit Scheme (EMAS). In comparison, SMEs who are typically less tightly regulated, are mainly motivated by the desire to achieve a competitive advantage. Their motivation arises from pressure exerted by customers and the desire to achieve an advantage over their competitors. Such organisations seldom see any additional benefit from becoming registered to EMAS unless this is specifically required by their customers.

A key development of the 1990s is the dramatic increase in supply chain pressure for environmental improvement. This has arisen largely from corporate organisations, often the first to become certified to an EMS standard, using environmental probity in determining their choice of supplier. An increasing number are asking their suppliers to become EMS certified and many provide practical assistance to them by hosting seminars or undertaking individual site visits and audits. Supply chain pressure is particularly significant within the electronics and car manufacturing sectors but is expected to grow throughout industry with increased international uptake of the standards. In the future it is likely that EMS certification will become a prerequisite to supply the larger corporate organisations.

11.2.1 Implications for Industrial Environmental Management Practices

The EMS standards are based on similar management principles and share many of the requirements of the ISO 9000 quality standards. Each requires an environmental policy and a documented system of procedures, manuals and records (Chapter 4). Significant environmental impacts must be identified and managed by the EMS either through operational controls or the adoption of objectives and targets for improvement. Compliance with the system is checked through record keeping, audits and management reviews. EMAS is more stringent, also requiring an externally verified environmental statement reporting on performance against pre-determined objectives and targets.

Adopting an EMS standard has the most significant impact within those organisations with limited existing environmental management. Larger companies, especially those regulated under Integrated Pollution Control, already operate many EMS elements (Chapter 6). These frequently include an environmental policy, employee training, environmental monitoring systems, improvement projects and systems to ensure legal compliance. The main impact in such organisations is the requirement to formalise management practices. This includes the documentation of registers of regulations and environmental impacts, the setting of objectives and targets and the development of a documented system of procedures.

An area of the standards having particular impact, and one causing considerable concern within implementing organisations is the requirement to identify significant environmental effects or aspects. Third party certification bodies require evidence that all issues have been considered and their relative importance compared through a consistent approach. This requires a rigorous approach to decision making, based on a full understanding of the environmental situation. The wide scope of the assessment, requiring direct and indirect impacts, resulting from past, present and future activities, products and services is broadening the range of environmental issues being addressed by industry. In addition to direct pollution it is also necessary to consider less tangible impacts such as those resulting from supplier's activities, use of raw materials, impacts on local communities and the final use and disposal of products.

Techniques being adopted by certified companies to compare the relative significance of these issues range from complex scoring systems to simple verbal descriptions (Chapter 4). Industrial experience with these techniques indicate that there is little added value from adopting complex numerical scoring methodologies. These are frequently time consuming and difficult to apply to the wide range of potential direct and indirect environmental impacts resulting from an organisation (Chapter 5).

The EMS standards are having a substantial impact on the workforce's environmental awareness. All staff must be continually trained on the environmental impacts of their activities, the benefits of improved environmental performance and the consequences of departure from specified operating procedures. It is no longer adequate for knowledge of environmental law and best practice to be limited to a single individual but must be appreciated throughout the organisation. This is encouraging all individuals to participate in the process of continual environmental improvement and to contribute towards the achievement of the company environmental policy.

It is inevitable that the introduction of a formal recognised standard will increase documentation. However, this is rarely perceived to be a disadvantage by those operating the systems (Chapter 7). In contrast documented procedures prove to be useful in ensuring that staff are aware of their responsibilities, particularly during periods of absence or turnover. Managers have more time as a result of the records and instructions facilitating the delegation of tasks throughout the organisation.

The EMS standards are having a considerable impact on the alliance between environmental management and other management disciplines. Their similarities with the ISO 9000 quality standards mean that in many cases the quality manager is assigned responsibility for the environment. This is having a dramatic impact on the extent of integration between management systems. At the least, certified organisations are adopting similar systems to those previously established for employee training, document control, non-conformances and auditing. Some companies are developing fully integrated systems with combined policies, management manuals, procedures and in some cases combined audits and management review meetings. This is raising the profile of environmental management to that of quality assurance and is helping to integrate it fully within the business.

11.2.2 Implications for Industrial Environmental Performance

A key objective of the EMS standards is to encourage voluntary and continual environmental improvement. This investigation shows their effectiveness in encouraging industry to voluntarily minimise their environmental impacts. Certified companies are demonstrating considerable improvements outside of the scope of legislation typically in waste minimisaton and energy efficiency, increased recycling and greater environmental control through improved storage of chemicals and safer drainage systems.

Although the standards are successful in encouraging voluntary environmental improvement they do not attempt to specify acceptable performance criteria beyond legal compliance and continual improvement. This means that the level of improvement sought varies greatly between certified companies (Chapter 5 and 7). Some publish annual objectives supported by detailed quantified performance targets. Others establish only a few objectives over several years, without quantified targets. The most demanding and detailed are usually set by EMAS registered companies, which are required to report publicly on their progress. This accountability to stakeholders is set to increase with the expected incorporation of external environmental reporting into ISO 14001 at its next revision due before the end of 2000 (ENDS Report 289, 1999).

Whilst certified companies are demonstrating significant improvements this rarely applies to all areas of their activities. It cannot be assumed that certified companies will follow a linear approach towards environmental excellence. The extent of further improvement will vary over time, depending on the degree of external pressure on the organisation. The lack of standardised performance indicators makes comparisons between certified companies difficult especially between those which do not publish their progress against objectives and targets. This will be partially addressed by the publication of ISO 14031 "*Guidelines for environmental performance evaluation*" but demonstrates the need for sector specific benchmarking standards across a range of environmental issues.

Although the EMS standards require the consideration of indirect impacts, such as those associated with raw material manufacture and design and use of products, these broader issues are rarely translated into objectives and targets for improvement. In particular few certified companies, even those registered to EMAS, are incorporating the broader principles of sustainable development in their policies or objectives.

11.2.3 Implications for Industrial Legal Compliance

In addition to encouraging voluntary environmental improvement, in areas such as waste minimisation and energy efficiency, the EMS standards are improving industry's compliance with the law. Certified companies are experiencing substantially improved understanding of legislation, regulatory compliance and reduced environmental incidents. They have found maintaining a register of regulations ensures awareness of current and changing legal requirements (Chapter 8). The assessment of environmental impacts identifies areas of concern and the documentation of procedures, outlining the law, improves compliance. Environmental incidents in certified companies are being reduced through improved control and contingency plans.

Whilst an EMS minimises risks it can not guarantee that accidents will not occur. This is particularly true on sites handling large volumes of chemicals and operating older manufacturing equipment. By the end of 1998 only two ISO 14001 certified companies in the UK, from over 700, had been prosecuted for environment related incidents

(Chapter 8). Although certification does not prevent accidents, or prosecution, it is proving to be a beneficial mitigating factor leading to substantially reduced fines. In the future it is likely to become increasingly difficult to mount a defence without being able to demonstrate the existence of a strong environmental management system.

It is expected that companies with a certified EMS will be less tightly regulated in the future. This will be particularly relevant for those regulated under Integrated Pollution Control as the Environment Agency is currently investigating methodologies for reducing inspection of such sites. This would give tightly regulated industries, such as chemical sector, an added incentive to implement an EMS and achieve certification.

By demonstrating that self-regulation is effective, the widespread adoption of the standards would give industry a stronger position to oppose tighter regulation. Their success in encouraging voluntary improvement would help convince regulators that further legislation is not necessary. However, before regulators are likely to be sufficiently reassured to introduce such schemes there would need to be wider EMS uptake and a demonstration from the assessors of their ability to identify and address potential legal problems and ensure ongoing continual improvement.

11.2.4 Implications for Business Performance

Although external factors, such as legislation and competitive advantage, are the most effective drivers for EMS uptake certified companies are reporting the internal benefits of improvements in process efficiency and employee motivation to be most significant (Chapter 8). The majority, including those of various sizes and industrial sectors, are experiencing some financial savings, averaging £170,000 per annum in larger organisations and £60,000 in SMEs. These are typically being achieved through improved waste management and energy efficiency.

Financial savings are most feasible in companies which have not previously considered energy and waste audits to minimise high resource and waste disposal costs. The minority not experiencing cost savings from their EMS either have low environmental costs, with limited opportunities for improvement, or have previously implemented substantial resource reviews. In some cases certified companies have not yet reached the stage of implementing improvements and are still collating data and investigating the feasibility of various options.

It is expected that traditional improvements in efficiency will become harder to achieve as the company's environmental performance improves. The simplest and most cost effective improvements are likely to be implemented in the early years following certification. However, technology developments and increased disposal and resource costs will mean further savings are possible with ongoing reviews of changing circumstances, taxation, legislation and the feasibility of capital investment programmes.

The EMS standards have provided industry with a recognised mechanism by which to promote their environmental commitment to stakeholders. Many certified companies, especially those supplying environmental leaders or exporting to countries with high EMS uptake, such as Germany or the Far East, are experiencing significant improvements in their market position (Chapter 8). Certification is allowing them to secure contracts with corporate companies with high environmental standards. This is particularly beneficial for SMEs seeking to supply larger companies. The standards are also encouraging the more strategically thinking companies to develop less environmentally damaging products and services and to work more closely with customers to ensure their requirements are met.

EMS certification has provided industry with the ability to externally demonstrate environmental commitment to the general public. This is helping to alleviate their concerns and promote the business within the local community. Many certified companies have become involved in local community groups including the scouts, schools, colleges and environmental organisations such as the Groundwork Trust. Involvement in such projects has the added value of substantially improving employee pride and motivation.

Insurers, banks and investment companies are increasingly recognising the potential of the EMS standards as tools to assess environmental risk within their clients. Many are currently developing and piloting tools for assessing environmental liabilities, which consider the adequacy of management systems. Those with a certified EMS are more likely to achieve a high score and benefit from easier access to insurance, capital and investment (Chapter 8). It is expected that this will increase in the future with the further use of risk assessment by financial organisations.

11.2.5 Implications on Resources Committed to the Environment

The EMS standards are substantially increasing the resources being committed to environmental management by industry. Companies adopting the standards are assigning large percentages of senior manager's time to their development and ongoing operation. The environment is frequently being assigned comparable resources to the more traditional disciplines of quality management and health and safety.

The most significant resource requirement is the staff time required to implement a system prior to certification (Chapter 10). This depends on many factors including the company's starting position, the complexity of their operations and their choice of project champion. In the majority of cases companies use current employees to implement the system rather than recruiting new staff (Chapter 10). External consultants are frequently employed particularly during the initial stages of implementation. Indirect costs associated with an EMS include third party registration fees of several thousand pounds plus ongoing surveillance costs paid to assessment bodies. Capital expenditure is frequently incurred to ensure legal compliance and cannot be directly attributable to the EMS. Costs associated with EMAS, over ISO 14001, relate principally to the management time required to develop the public environmental statement and the validation fees paid to external verifiers. This varies according to the complexity of the company and the availability of environmental performance data. Following certification, the annual costs required to operate an EMS are reduced to half those incurred during the implementation period.

Few certified companies operate routine accounting systems for monitoring environmental income and expenditure. Those which publish quantified environmental accounts tend to be leaders in the field, typically based in North America or Canada. Even these do not attempt to quantify externalities or legal liability costs. In the few cases where sufficient data are available to compare EMS costs and benefits savings typically outweigh the system implementation and maintenance costs and payback periods on implementation are frequently less than two years (Chapter 10).

11.3. CONCLUSIONS

The 1990s have seen many significant developments in industrial environmental management. In parallel with the introduction of substantially tighter legislation and tougher enforcement there has been a growing realisation within industry of the need to address stakeholders' requirements and the business opportunities presented by the environment. Increasingly environmental management is perceived not only to be about compliance and pollution prevention but as key to business success. Industry is acknowledging the environment as a competitive issue essential for meeting stakeholder's expectations, in particular those of their customers, and staying ahead the competition.

The EMS standards have acted as a catalyst in this process by providing industry with a systematic and recognised approach to environmental management. Initially they appealed to larger organisations, many of which have operated informal systems since the 1980s, as tools for consolidating their management activities. Certification appealed by providing a mechanism by which their efforts could be externally approved and promoted.

The more strategic thinking corporate organisations are realising that sound environmental performance cannot be achieved without considering their suppliers activities. The standards have reinforced this by requiring indirect impacts, including the consequences of purchasing decisions, to be addressed. In addition the availability of external certification has provided customers with a recognised standard against which to assess their suppliers. This has led to the standards being encouraged by customers and has contributed substantially to the increase in supply chain pressure. This has further substantiated industry's realisation of the competitive advantage which can be achieved through certification. In particular, the standards have been instrumental in encouraging companies without extensive environmental impacts or regulatory oversight, who would not previously have considered it to be a priority, to address the environment. These developments have resulted in a situation where environmental improvement is being driven by industry internally rather than solely by the external influence of pressure groups and public opinion.

The uptake of the EMS standards is resulting in some significant developments in the industrial approach to environmental management. Traditionally, environmental management has focused on a limited number of largely unrelated issues, such as effluent and air pollution. The EMS standards are encouraging industry to consider the full environmental situation. They require a holistic and dynamic approach considering all impacts, with individual EMS components closely inter-related and dependent upon each other. This holistic approach is encouraging companies to adopt a more strategic outlook towards environmental management by considering indirect impacts and issues of future importance. These include the broader issues of choice of raw materials and design of products.

The value of an environmental management system is not inherent within the imposed documentation and management processes but rather in the vision and expectations of the company. The standards provide a management tool to enable the company to achieve its individual goals and aspirations. Implementation is an investment equipping a company with the necessary mechanisms to meet existing and future environmental pressures. Whilst the cost of this investment can be substantial, especially for smaller organisations, an EMS presents many opportunities. It cannot be adequately valued in terms of traditional investment appraisal techniques alone. Its true value is substantially greater than the immediate cost savings achieved through traditional improvements in energy efficiency and waste minimisation. Whilst shorter payback periods are more likely in certain organisations this should not deter others from addressing and controlling their environmental impacts. In the future the ability to demonstrate good environmental performance will be essential in meeting stakeholder's expectations.

11.4. RECOMMENDATIONS

11.4.1 Decision Making

Whilst there are substantial benefits to be achieved from adopting an internationally recognised EMS standard the resource implications are also significant (Chapters 8 and 9). It is therefore essential to ensure that this is the most appropriate decision for the organisation concerned. Those considering EMS implementation and external certification are recommended to apply a formal decision making process. Likely implications should be estimated by considering the feasibility and scale of potential cost savings; the impact of current and future legislation; the markets in which the company operates; their relationships with local residents and the extent of pressure from stakeholders (Chapter 10). The decision to adopt an EMS should not be made on financial criteria alone but also needs to consider the broader implications on competitive position, employee motivation and public image. A change in culture is required within industry where environmental improvements are not subjected purely to traditional cost benefit analysis. Companies need to create longer term visions for their future incorporating all their impacts on society.

Many of the benefits of an EMS can be achieved without implementing full certified systems. The alternatives should therefore be considered during the decision making process. Individual company needs must be clearly identified and initial efforts focused on addressing the major risks and opportunities. Larger companies frequently develop their own in-house systems which are often as effective in ensuring legislative compliance and financial cost savings. For SMEs a full system can be unjustified unless there is significant opportunities for improving competitive position. An environmental policy and action plan for achieving compliance and cost savings is a beneficial first stage. The standards, however, provide a framework to assist in EMS implementation and can be useful in identifying the weaknesses of an in-house system. They ensure that environmental decisions are based on an assessment of the full environmental situation and that all issues are considered. Certification increases the profile of the system within the company and provides internal and external credibility.

11.4.2 EMS Implementation

Management commitment is essential for EMS success. Senior management, in particular the Managing Director, play an important role in the process of achieving certification. Resource implications should be fully understood and made available prior to implementation. The organisation needs to be willing to learn and bring in outside help where in-house skills or resources are lacking.

The standards are a flexible guide not a step-by-step implementation plan. They provide a useful model to focus on company needs rather than on documentation and procedures. The aims of the system need to be fully understood and reflected in the environmental policies and overall direction of the EMS. Tightly regulated companies need to adopt a compliance based approach whilst others may move more strategically on choice of raw materials and design of products. To ensure the EMS delivers year on year improvement it is necessary to adopt a broad scope by considering as many elements as possible in the effects assessment. A clear link between significant effects, objectives and management programmes must be established to ensure the most important aspects are addressed first. Organisation's seeking external certification must ensure all significant effects are managed within the system and each objective is supported by targets and improvement programmes. Once those of immediate importance have been addressed, others will increase in significance and form the basis of future efforts.

A team approach to implementation is needed to ensure input from all business activities. This would normally include representatives from a range of departments, including senior management and manufacturing. Ownership and commitment are promoted by involving everyone in the implementation process. Changing culture and management practices is the hardest element of EMS implementation (Chapter 8). Overcoming resistance to change requires substantial effort but yields significant benefits. Improvements in employee awareness and motivation are frequently reported by certified companies to be the most beneficial outcome of their systems (Chapter 7).

Several mechanisms are required to achieve the desired levels of employee environmental awareness. It is recommended that all staff attend a minimum of one formal environmental training session of at least several hours covering the environmental aspects of their activities and introducing them to the EMS. Operational staff have the knowledge and experience of procedures in their particular area of the organisation and should be encouraged to write their own protocols. Employee involvement in local landscaping or conservation work, can be beneficial in raising their commitment and motivation for the environment.

The system should be kept simple and tailored to the working situation. Complex systems are frequently later simplified, particularly for the effects assessment and objectives and targets. Simple approaches coupled with several key objectives are sufficient to meet the requirements of the certification bodies. The EMAS public environmental statement does not need complex detailed reports though the organisation may believe that they would be beneficial to their public image.

It is not always necessary to undertake detailed evaluations of supplier's environmental performance. The relative significance of these impacts compared to others of organisation needs to be considered during the formal effects assessment. Only where these are identified as significant is it necessary to control the impact by encouraging suppliers to improve or by identifying alternatives. Collaborative approaches to encouraging suppliers enable environmental initiatives to be focused on the needs of the individual company (Green, et al., 1996). This type of approach is essential to ensure SMEs are able to meet their larger customers' requirements.

The strengths of existing formal and informal quality and health and safety systems should be incorporated into the EMS design to reduce resource requirements and minimise bureaucracy. It is recommended that companies have a clear strategy for integration from the start of the project decided at senior management or board level. To ensure ownership of the combined system this needs to include the designation of clear responsibilities for any shared documents.

In organisations with well developed in-house systems designed to meet the requirements of legislation it cannot be assumed these meet all the requirements of the EMS standards. An improvement programme to meet IPC, is likely to focus on direct pollution and is unlikely to adequately address the softer issues of resource consumption, nuisance and indirect impacts. This is also true with traditional environmental risk assessment which typically cover accidental releases but not the impacts resulting from normal, past and future operating conditions. In these situations it is recommended that parallel systems are developed to address the outstanding areas of the standard.

11.4.3 EMS Operation

It is essential that organisations operating EMSs should establish accounting systems to measure the ongoing value of their system. This will promote environmental management within the organisation and assist in emphasising its importance to employees. In developing such accounts those costs and savings not easily quantified should also be included. These may include meeting customer's requirements, winning new contracts, reducing liabilities and improving public image. It is also important for industry to adopt internationally recognised environmental performance indicators to allow comparisons between organisations and benchmarking between those within particular industrial sectors.

During the early years of EMS operation the focus should be to minimise costs, meet customers immediate requirements and ensure legal compliance. Once this has been achieved a broader approach is required to achieve sustained EMS value. This will require working towards the ultimate goal of global sustainability incorporating the needs of society as well as business. To ensure continued competitiveness it is important to move towards a strategic system by addressing those issues likely to be of future concern. This may include reviewing product and process design and choice of raw materials. However, there is a responsibility on larger companies to be sensitive to the needs of their suppliers and to work with them to improve their environmental performance.

External assessors play an essential role in ensuring EMSs are beneficial to industry. Certifiers must understand the philosophy of the standards and have a responsibility to focus on ensuring real continual environmental improvement rather than unnecessary system documentation. The focus of surveillance visits must be to determine improvements in performance rather than to check on the maintenance of documentation and records. Third party certification bodies also have a responsibility to ensure the cost of certification and the ongoing surveillance are manageable, in particular for SMEs.

11.4.4 SUMMARY

The EMS standards have had a dramatic impact on the profile of environmental management within industry. They have catalysed a rapid increase in supply chain pressure for improvement and contributed towards the growing realisation of the environment as a competitive issue core to business success. Certified companies are recognising their value in generating cost savings, competitive advantage, improved public image and enhanced employee motivation. This has lead to industry voluntarily seeking to improve its environmental performance beyond the requirements of legislation. The standards' requirements to address indirect as well as direct environmental impacts are encouraging the consideration of more strategic issues such as raw material manufacture and design and use of products. In this way they have been key in moving environmental management from compliance and pollution prevention towards a wider agenda. The next challenge is to shape the way in which environmental management systems are used from end of pipe pollution prevention and traditional waste minimisation towards a longer term vision and recognition of overall impact on society.

CHAPTER 12

12. FUTURE RESEARCH

This research has collated empirical data and developed guidelines, based on experience surveys and case-studies, to assist those companies contemplating adopting an EMS to assess the likely costs and benefits to their organisations. The recent publication of the standards and the low numbers of companies certified during the early years of the study period necessitated an exploratory and inductive research design. The first national standard, BS 7750, had just been published in its final version at the start of the study. Organisations could be certified to the standard six months later. The international standard, ISO 14001, was published two years later in 1996. There was little information available on the implications of adopting a recognised EMS standard and the experiences of those few organisations seeking certification. The research therefore focused on industrial experiences with the standards from initial commitment, through the implementation period and the early years after certification. This chapter describes the theory and ideas, developed throughout the investigation, to be tested by both future quantitative and qualitative research.

12.1 Future Quantitative Research

Since 1997 there has been a substantial global increase in the number of EMS certificates. By the end of 1998 world-wide uptake was increasing at a rate of over 300% per annum, with 700 UK certified sites and 7,000 globally (ENDS Report 287, 1998). A survey to compare with the findings of this study, based on a larger sample, would determine whether the resources required to achieve certification, in terms of staff time, decrease with industry's increasing understanding of the requirements and philosophy of the standards. It would also determine whether companies adopting the standards several years after their publication experience the same benefits as those becoming certified in their early years. The availability of a larger number of participants would allow more analysis of organisations from different industrial sectors, company size and national identity.

12.2 Future Qualitative Research

This research focused on changes occurring within organisations during the implementation period and early years after certification. The standards are now more mature and future qualitative research to evaluate the experiences of organisations during the years following certification would be useful for testing theories regarding the evolutionary nature of EMSs, resource requirements, business benefits and environmental activity.

Of particular interest is the question of whether certified companies continue to improve their environmental performance. Certified companies may not necessarily follow a linear route towards environmental excellence. The majority of effort could be focused on achieving certification and little further environmental improvement achieved after certification. The feasibility of achieving year-on-year improvement and associated financial savings is not being explored. Industry has expressed fears that traditional savings will become harder to achieve and less dramatic. The extent to which initial financial savings are sustainable, the proactive steps organisations take to ensure further cost saving opportunities and the sustainability of other EMS benefits need categorising to provide possible incentives for companies to adopt environmental policies.

The extent to which an EMS encourages a more strategic approach towards environmental management could emerge over several years and allow progress from legal compliance to the evaluation of a broader range of issues. The incorporation of product and process design could be augmented with the adoption of the broader principles of sustainability.

Further research into the experiences of organisations after certification is recommended with participating companies identified early in the study to allow their EMS implications to be monitored over a substantial period. The early development of standardised questionnaires, in-depth interviews and regular monitoring would create a system to identify annual savings and expenditure resulting from the operation of an EMS. This would allow annual expenditure and revenue to be compared each year to evaluate EMS value.

THE IMPLICATIONS FOR INDUSTRY

OF INTERNATIONALLY RECOGNISED

ENVIRONMENTAL MANAGEMENT SYSTEM

(EMS) STANDARDS

Vol. II of II

Appendices

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Submitted in Partial Fulfilment of the Requirements of the Degree of Doctor of Philosophy, April 1999

APPENDIX 1: EXPERIENCE SURVEY- POSTAL QUESTIONNAIRE

QUESTIONNAIRE ON BS 7750

SECTION A - GENERAL INFORMATION

Company Name:	Name of Site(s) Certified to BS 7750:
Contact Address:	Telephone No: No of Employees on Certified Site (s):
Contact Name:	Position:

Brief description of activities:

Do you have any processes scheduled as Part A (regulated by HMIP) or Part B (regulated by the Local Authority) under the Environmental Protection Act 1990 ? If yes please specify.

Scope of Certificate:

Date of Certification to BS 7750:

SECTION B - THE BENEFITS OF THE EMS

1	What aspects of an EMS did your organisation have in place before starting to implement BS 7750?
2	What was your main reason for implementing BS 7750 (indicate with a ✓) To ensure legislative compliance ------ To meet pressure from customers ------ To improve public image ------ To achieve competitive advantage ------ To achieve financial savings ------ Others (please specify)

APPENDIX 1: EXPERIENCE SURVEY- POSTAL QUESTIONNAIRE

3	What has been the main benefit of implementing BS 7750 ?
3	To what extent do you feel that the implementation of BS 7750 has led to the following improvements? (5 = substantial improvement, 0 = no improvement). Improved understanding of legislation 0 1 2 3 4 5 Increased legislative compliance 0 1 2 3 4 5 Improved relationships with regulators 0 1 2 3 4 5 Improved understanding of environmental impacts 0 1 2 3 4 5 Improved relationships with suppliers 0 1 2 3 4 5 Improved employee environmental awareness 0 1 2 3 4 5 Improved public image 0 1 2 3 4 5 Improved integration with health & safety management 0 1 2 3 4 5 Improved integration with quality management 0 1 2 3 4 5
4	In which of the following areas has BS 7750 led to environmental improvements (not including improvements required to meet legislation) ? Reduced Atmospheric Releases ( ) Improved Monitoring ( ) Reduced Releases to River ( ) Reduced Traffic ( ) Reduced Releases to Sewer ( ) Reduced Material Usage ( ) Reduced Waste Production ( ) Reduced Energy Usage ( ) Increased Recycling ( ) Reduced Water Usage ( ) Reduced Environmental Incidents ( ) Improved Containment ( ) Any specific examples of environmental improvements would be most appreciated:
5	Has the implementation of the standard led to financial savings ? Yes / No If yes please describe how these were achieved and if possible estimate the arising annual savings. Can you estimate of the total savings resulting from BS 7750 since implementation ?
6	Has certification led to any improved access to financial funding or reductions in insurance premiums ? Yes/No If yes please give details:

7	Has certification led to a reduction in the number of visits from enforcing authorities ? Yes/No If yes please give details:
8	Has certification improved your competitive advantage or allowed you to bid for previously unavailable tenders? Yes/No If yes please give details:
9	Do you believe certification has improved you public image ? Yes / No If so in what way ?
	SECTION C - THE COSTS OF THE EMS
10	How long did it take your organisation to achieve certification to the standard ? How many people did you have working on implementing BS 7750 ?
11	Can you estimate the man hours spent implementing the standard ? Can you estimate the total cost of implementing the standard (excluding capital spending on new equipment, process improvements etc) ? Which area of the standard did you find the most time consuming ?
12	Did you have a member of staff responsible for the environment before BS 7750? Yes / No Was a new member of staff employed to implement the standard ? Yes / No If no who was given this responsibility ?
13	Have you used external consultants in the development of BS 7750 ? Yes / No If yes are you willing to give details (e.g Company Name and Costs ?)
14	How much environmental training of employees did the standard require ? Was this provided internally ? Yes / No Can you estimate the man hours required to provide this training ?

15	Did BS 7750 result in any capital spending on environmental protection e.g new equipment, process changes, bunding etc Yes / No If yes please specify:
16	Can you estimate the total man hours spent maintaining the system ? Can you estimate the total cost of maintaining the system ?
17	Have you assessed your suppliers environmental performance ? Yes / No If yes, has this so far influenced your source of suppliers? Yes / No Do you intend to ask your suppliers to become BS 7750 certified ? Yes / No
18	Can you estimate the costs of having the EMS certified ?
19	Are there any particular disadvantages of the BS 7750 approach or requirements you feel are not beneficial ?
20	Do you think your organisation would have developed a formal environmental management system without the publication of BS 7750 ? Yes / No

APPENDIX 1.2: EXPERIENCE SURVEY- PARTICIPATING COMPANIES

Company Name	*Location*	*Certification Body*	*Industrial Sector*	*Number of Employees*	*Process Classification**	*Starting Position Prior to BS 7750*
Akzo Nobel Chemicals Ltd	Kent	BSI	Speciality Chemicals	132	Not Prescribed	• Environmental Monitoring
Alcan Smelting & Power UK	Scotland	BSI	Metal Smelting	172	Part A	• Preparatory Review • Environmental Policy • Environmental Targets • Management Programme • External Audit
Anaplast Ltd	Scotland	Lloyd's	Packaging Manufacture	170	Part B	• Waste Control • Energy Reduction • Recycling
Applied Chemicals	Coventry	Aspects	Industrial Lubricants / Cleaners	150	Not Prescribed	• Testing and Monitoring • Waste Reduction • Legislative Compliance
Arjo Wiggins Fine Papers Ltd	Kent	BSI	Paper Manufacture	230	Not Prescribed	• Auditing • Management Review
Auto-Smart Ltd	Staffordshire	Aspects	Automotive Cleaning Chemicals	55	Not Prescribed	• Reference in Design Procedures
The Beacon Press Ltd	East Sussex	SGS	General Printers	70	Not Prescribed	• Approx 70% of BS 7750
BICC Cables Ltd	Manchester	BASC	Telecommunication Cables	350	Part B	• Copper Recycling
BOC Gases Europe	Liverpool	Lloyd's	Industrial gasses	60	Part A	• Spill Contingency • Legislative Compliance • Waste Procedures

APPENDIX 1.2: EXPERIENCE SURVEY- PARTICIPATING COMPANIES

Company Name	*Location*	*Certification Body*	*Industrial Sector*	*Number of Employees*	*Process Classification**	*Starting Position Prior to BS 7750*
Carson Office Furniture Systems	Essex	Trada	Wood Based Office Products	160	Part B	• Environmental Policy • Product Analysis • Supplier Probity • Legislative Compliance • Objectives & Targets
Curtis Fine Papers	Scotland	Lloyd's	Printing and Writing Papers	350	Part B	• Legislative Compliance
Dunlop Limited, Precision Rubber Division (Shepshed and Bagworth Sites)	Leicestershire	Lloyd's	Precision Rubber Products	162 (Shepsted) 98 (Bagworth)	Part B	• Legislative Compliance
Epson Telford Ltd.	Shropshire	Lloyd's	Computer Printers	1,700	Not Prescribed	• None
Gleaner Oils Ltd	Scotland	BSI	Oil and Gas Distribution	130	Not Prescribed	• None
Lindsey Oil Refinery Ltd	South Humberside	Lloyd's	Oil Refining	500	Part A	• Environmental Monitoring • Complaint Procedure • Local Liaison Committee
NDM Manufacturing	Shropshire	Lloyd's	Automotive Air Conditioning	650	Not Prescribed	• Environmental Policy • Targets • Working Groups • Environmental Committee • Environmental Co-ordinators

APPENDIX 1.2: EXPERIENCE SURVEY- PARTICIPATING COMPANIES

Company Name	*Location*	*Certification Body*	*Industrial Sector*	*Number of Employees*	*Process Classification**	*Starting Position Prior to BS 7750*
P P Payne	Nottingham	SGS	Packaging Products	252	Part B	• Spill Containment • Waste Documentation
Philips Components	Lancashire	SGS	Screens for TVs and Monitors	400	Part B	• Legislative Compliance • Environmental Monitoring
Ricoh UK Products Ltd	Shropshire	BSI	Office Automation Equipment	740	Part A & Part B	• Process Monitoring • Waste Recycling / Reduction • Environmental Committee • Environmental Policy • 60% of Records Required
Shields Special Metals Ltd	Essex	DNV	Dismantling and Recycling Electro Mechanical Equipment	100	Not Prescribed	• Environment procedures under ISO 9002 for work practices.
Thomas Swan & Co Ltd,	Co Durham	Aspects	Speciality Chemicals	145	Part A	• Approx 70% of BS 7750
Wavin Buildings Products Ltd	Wiltshire	Aspects	Plastic Pipes and Fittings for the Building Industry.	500	Not Prescribed	• Recycling • Legislative Compliance

* As categorised by Environmental Protection (Prescribed Processes and Substances) 1991

APPENDIX 1.3: EXPERIENCE SURVEY- EMS DRIVERS, BENEFITS & DISADVANTAGES

Company Name	*Main Driver for EMS Implementation*	*Comments on Main Benefit of adopting BS 7750*	*Comments on Disadvantages of adopting BS 7750*
Akzo Nobel Chemicals Ltd	• Legislative Compliance	"Cost savings - the project paid for itself in less than a year".	"None"
Alcan Smelting & Power UK	• Legislative compliance and Public Image	"Employees are more aware of environmental impact and how they perform their jobs to minimise environmental effects. They now report minor incidents".	"None"
Anaplast Ltd	• Public Image	"All employees quickly become aware of the part they must play to maintain and achieve the standard".	"Establishing realistic objectives and targets"
Applied Chemicals	• Competitive Advantage	"Systematic approach, improved waste management, improved environmental performance".	"Lack of reward for exceeding set objectives and targets. Set a target of 25% reduction in special waste and achieved 48%. This makes our job harder in subsequent years."
Arjo Wiggins Fine Papers Ltd	• Competitive Advantage	"Competitive advantage".	"None"
Auto-Smart Ltd	• Pressures from Customers	"Improved efficiency, less wastage both in time as well as resources".	"None"
The Beacon Press Ltd	• Competitive Advantage	"Cost savings".	No comment
BICC Cables Ltd	• Pressures from Customers	"Employee motivation".	"None"
BOC Gases Europe	• Legislative Compliance	"Better trained workforce; more rigorous action planning; improved legislative compliance".	"Indirect effects from customers activities offer little benefit."
Carson Office Furniture Systems	• Financial Savings	"Public image".	"Communications register unnecessary"

APPENDIX 1.3: EXPERIENCE SURVEY- EMS DRIVERS, BENEFITS & DISADVANTAGES

Company Name	*Main Driver for EMS Implementation*	*Comments on Main Benefit of adopting BS 7750*	*Comments on Disadvantages of adopting BS 7750*
Curtis Fine Papers	• Competitive Advantage	"Consistent approach to managing environmental issues".	"Too early to comment"
Dunlop Limited, Precision Rubber Division (Shepshed and Bagworth Sites)	• Pilot Site in the Introduction of a Company wide EMS	"Through the effects analysis all disciplines are now more focused on the impacts of our activities".	No comment
Epson Telford Ltd.	• Pilot Site for company in Japan	"You actively look to improve performance in certain areas, so the mechanisms to achieve improvements are sought".	"Bureaucratic; some parts of the standard are interpreted differently by different parties and it may be difficult relating certain clauses to organisations."
Gleaner Oils Ltd	• Pressures from Customers	"A worthwhile management discipline for the security, continuity and success of our Company".	"None"
Lindsey Oil Refinery Ltd	• Legislative Compliance	"Staff environmental awareness improved; better appreciation of corrective action; management commitment confirmed".	"None"
NDM Manufacturing	• Legislative Compliance	No comment	"None"
P P Payne	• Pressures from Customers	"Waste minimisation; better understanding of effects of the process (effects register is a very useful tool)".	"Lack of the requirement to report performance."
Philips Components	• Legislative Compliance	"Employee awareness; improvements in energy conservation; improvement in waste control".	"None"
Ricoh (UK) Products Ltd	• Pressure from Parent Company	"Clear responsibility / accountability; management programme traceable to objectives; cost reduction, improved community relations; more professional approach to Environmental Committee meetings; improved supplier /	"None"

APPENDIX 1.3: EXPERIENCE SURVEY- EMS DRIVERS, BENEFITS & DISADVANTAGES

Company Name	*Main Driver for EMS Implementation*	*Comments on Main Benefit of adopting BS 7750*	*Comments on Disadvantages of adopting BS 7750*
		subcontractor / employee awareness".	
Shields Special Metals Ltd	• Competitive Advantage	"Securing contracts with major plcs"	"None, although certification bodies can be over zealous in auditing."
Thomas Swan & Co Ltd,	• Financial Savings	"Public image".	No comment
Wavin Buildings Products Ltd	• Public Image	"Improving overall awareness throughout the organisation of environmental issues".	"None"

APPENDIX 1.4: EXPERIENCE SURVEY - ENVIRONMENTAL IMPROVEMENTS & COST SAVINGS

Company Name	***Quantification of Savings***	***Environmental Improvements***
Akzo Nobel Chemicals Ltd	£80,000 pa	• Reduced releases to river • Reduced waste • Increased recycling • Improved monitoring • Reduced raw material usage • Improved containment
Alcan Smelting & Power UK	Not applicable	• Reduced air releases • Reduced released to river • Reduced waste production • Reduced incidents • Improved monitoring • Improved containment
Anaplast Ltd	Not applicable	• Reduced energy usage • Improved monitoring • Improved containment
Applied Chemicals	£100,000 (through waste reduction techniques and energy/natural resource utilisation)	• Reduced air releases • Reduced releases to sewer • Increased recycling • Reduced energy usage • Reduced waste production • Improved containment
Arjo Wiggins Fine Papers Ltd	Not quantified	• Improved monitoring

APPENDIX 1.4: EXPERIENCE SURVEY - ENVIRONMENTAL IMPROVEMENTS & COST SAVINGS

Company Name	*Quantification of Savings*	*Environmental Improvements*
Auto-Smart Ltd	Not quantified	• Reduced energy usage • Improved monitoring • Reduced waste • Improved containment
The Beacon Press Ltd	Not quantified	• Reduced releases to river • Increased recycling • Improved monitoring • Reduced energy usage • Improved containment
BICC Cables Ltd	£500,000/annum estimated through waste management.	• Reduced waste • Increased recycling • Reduced incidents • Improved monitoring • Reduced raw material usage • Reduced energy usage • Reduced water usage
BOC Gases Europe	Not quantified	• Reduced releases to river • Reduced energy usage • Improved monitoring • Reduced material usage • Improved containment

APPENDIX 1.4: EXPERIENCE SURVEY - ENVIRONMENTAL IMPROVEMENTS & COST SAVINGS

Company Name	*Quantification of Savings*	*Environmental Improvements*
Carson Office Furniture Systems	£30,000/annum estimated through waste management and energy management	• Reduced waste • Increased recycling • Reduced incidents • Improved monitoring • Reduced raw material usage • Reduced energy usage • Reduced water usage • Improved containment
Curtis Fine Papers	Not applicable	• Reduced energy usage • Improved monitoring • Reduced waste production • Improved containment
Dunlop Limited, Precision Rubber Division (Shepshed and Bagworth Sites)	Reductions in insurance premiums as a result of preventative procedural actions now in place	• Reduced air releases • Improved monitoring
Epson Telford Ltd.	£105,200/a saved through reduced landfill costs by increased recycling of office paper. £24,000/a saved through returning and reusing wooden pallets.	• Reduced air releases • Increased recycling • Improved containment
Gleaner Oils Ltd	Use of diesel cars for high mileage uses; energy saving ideas from staff - reduced temperature of boiler heating heavy fuel.	• Reduced waste • Improved monitoring • Reduced energy usage • Improved containment

APPENDIX 1.4: EXPERIENCE SURVEY - ENVIRONMENTAL IMPROVEMENTS & COST SAVINGS

Company Name	*Quantification of Savings*	*Environmental Improvements*
Lindsey Oil Refinery Ltd	Not quantified	• Increased recycling • Reduced energy usage • Reduced waste production • Improved containment
NDM Manufacturing	£50,000 through waste reductions and energy savings	• Reduced waste • Increased recycling • Reduced raw material usage • Reduced energy usage
P P Payne	£12,750 waste reduction; £7,200 saved through disposal costs, £30,000 reduced raw material consumption.	• Reduced waste • Increased recycling • Reduced incidents • Improved monitoring • Reduced raw material usage • Reduced water usage • Improved containment.
Philips Components	£150,000 in 1996 through energy reduction, water reduction and reduced waste disposal.	• Increased recycling • Reduced incidents • Improved monitoring • Reduced raw material usage • Reduced energy usage • Reduced water usage • Improved containment

APPENDIX 1.4: EXPERIENCE SURVEY - ENVIRONMENTAL IMPROVEMENTS & COST SAVINGS

Company Name	*Quantification of Savings*	*Environmental Improvements*
Ricoh (UK) Products Ltd	£100-200,000 pa	• Reduced releases to river • Reduced waste • Increased recycling • Improved monitoring • Reduced raw material usage • Reduced energy usage • Reduced water usage • Improved containment
Shields Special Metals Ltd	£35,000/a	• Reduced air releases • Reduced waste production • Increased recycling • Reduced raw material usage • Reduced energy usage • Reduced water usage
Thomas Swan & Co Ltd	Not quantified	• Reduced waste • Increased recycling
Wavin Buildings Products Ltd	Not quantified	• Reduced waste production • Increased recycling • Improved monitoring • Reduced raw material usage • Improved containment

APPENDIX 1.5: EXPERIENCE SURVEY : RESOURCE REQUIREMENTS

Company Name	***Resource Requirements During Implementation***							***Maintenance Costs***
	Timescale (months)	***No of people***	***Total Hours****	***Total Cost***	***Capital Costs***	***Certification Fees***	***Most Time Consuming***	***(Hours / year)***
Akzo Nobel Chemicals Ltd	18	8	5,107	£55,000	Not quantified	£5,000	Effects Register	Not quantified
Alcan Smelting & Power UK	14	2	2,000	Approx £30,000	None	£700	Operational Control	200
Anaplast Ltd	36	2	Not quantified	Not quantified	Not quantified	Not quantified	No Comment	1000
Applied Chemicals	36	7	> 3000	Approx £45,000	Not quantified	Not quantified	No comment	300
Arjo Wiggins Fine Papers Ltd	18	1	5,107	£150,000	Not quantified	Not quantified	Effects Register	500
Auto-Smart Ltd	24	2	851	£15,000 - £20,000	£20,000	Not quantified	No comment	250
The Beacon Press Ltd	12	3	Not quantified	£20,000	Not quantified	Not quantified	Effects Register	Not quantified
BICC Cables Ltd	5	4	Not quantified	No additional cost	Not quantified	£3,500 plus £10,000/a surveillance	Effects Register	360
BOC Gases Europe	17	3	1,702	£40,000	Not quantified	Not quantified	No comment	Not quantified
Carson Office Furniture Systems	18	6	3,000	£20,000	£10,000	£3,000	Manuals / Procedures	Not quantified

APPENDIX 1.5: EXPERIENCE SURVEY : RESOURCE REQUIREMENTS

Company Name	***Resource Requirements During Implementation***							***Maintenance Costs***
	Timescale (months)	***No of people***	***Total Hours****	***Total Cost***	***Capital Costs***	***Certification Fees***	***Most Time Consuming***	***(Hours / year)***
Curtis Fine Papers	24	8	2,500	£37,000	£2.5 m / a	Not quantified	No comment	400
Dunlop Limited, Precision Rubber Division (Shepshed and Bagworth Sites)	24-36	9	Not quantified	Not quantified	Not quantified	Not available	No comment	Not available
Epson Telford Ltd.	7	5	2,800	£55,000	£50,000 budget for equipment expenditure for 1996.	Not quantified	No comment	3000
Gleaner Oils Ltd	24	6	Not quantified	Not quantified	Yes (bunding tanks, spill kits for vehicles etc)	Not quantified	Effects Register	Not quantified
Lindsey Oil Refinery Ltd	24	2	3,405	£51,000	Not quantified	Not quantified	No comment	420
NDM Manufacturing	9	10	Not quantified	£10,000	Yes (bunding of a process and provision of emergency spillage equipment).	Not quantified	Effects Register	Not quantified

APPENDIX 1.5: EXPERIENCE SURVEY : RESOURCE REQUIREMENTS

Company Name	*Resource Requirements During Implementation*							*Maintenance Costs*
	Timescale (months)	*No of people*	*Total Hours**	*Total Cost*	*Capital Costs*	*Certification Fees*	*Most Time Consuming*	*(Hours / year)*
P P Payne	6	6	800	£12,000	£6000	Not quantified	Internal Procedures	1175
Philips Components	9	1	1500	£22,000	None	Not quantified	Effects Register	Not quantified
Ricoh (UK) Products Ltd	7	12	2300	£12,000	Not quantified	Not quantified	Effects Register	4000
Shields Special Metals Ltd	14	1	Not quantified	Not quantified	None	£10,000	Effects Register and Procedures	Not quantified (£30,000/a)
Thomas Swan & Co Ltd,	24	7	Not quantified	£30,000	Yes	Not quantified	Effects Register	Not quantified
Wavin Buildings Products Ltd	24	4	800-1000	£20,000	None	£6,000	Effects Register	Not quantified

* Assuming 226 days a year at 7.5 hours a day i.e 1695 hours a year

APPENDIX 2.1: SOLVAY INTEROX'S EMS - IMPLEMENTATION PROGRAMME

YEAR 1													
Tasks	Weeks	1994			1995								
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
Company Induction	**1**												
Identification of BS 7750 Requirements	**1**												
Identification of EMAS Requirements	**1**												
Strategy for Integration with ISRS/ISO 9000	**4**												
Determination of Project Stages	**2**												
Draft Environmental Management Manual	**4**												
TCS Induction & Mini-Project	**4**												
Develop New Environmental Policy	**2**												
Develop Effects Assessment Methodology	**4**												
Pilot Effects Procedure on Capa Plant	**4**												
Co-ordinate Effects Assessment of Site	**6**												
Procedures for New Legislation	**4**												
Register of Regulations & Policy Requirements	**4**												
Supervise Supplier Assessment Project	**3**												
Training Procedures	**4**												
TOTAL WEEKS	**48**												

APPENDIX 2.1: SOLVAY INTEROX'S EMS - IMPLEMENTATION PROGRAMME

		YEAR 2											
Tasks	Weeks	1995			1996								
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
Completion of Effects Assessment	**4**												
EQS Software Trial & Assessment	**4**												
Proposals for HSE Integration	**2**												
Draft new RCLP Integrated HSE Manual	**2**												
Emission Inventory Procedures	**8**												
Environmental Auditing Procedures	**4**												
Review Contractor Awareness Procedures	**2**												
Procedures for Objectives & Targets	**6**												
Update Effects Assessment & Procedure	**4**												
Identify Operational Control Procedures	**5***												
Final Report	**2**												
Supporting Studies, Courses, Papers etc	**4**												
TOTAL	**47**												

* Time available within TCS project

APPENDIX 2.1: SOLVAY INTEROX'S EMS - IMPLEMENTATION PROGRAMME

YEAR 3													
Tasks	Weeks	1996			1997								
		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
RCLP Manual Issue & Communication	3												
Sewer Effluent Simulation & Procedure	0.5												
Environmental Programme	2												
Update Register of Regulations & Procedure	2												
Issue Enviro Group Procedures Manual	2												
Operational Control Procedure	5												
Training Needs Analysis, Plan & Procedure	5												
Update Induction Handout	1												
Auditing (including training)	5												
Management Review Procedure	1												
New Developments Procedure	3												
TOTAL	47												

APPENDIX 2.2: SOLVAY INTEROX'S EMS - ENVIRONMENTAL POLICY CHECKLIST

COMMITMENTS	GUIDING POLICIES						COMPANY POLICIES					
	Valdez Principles	CIA Responsible Care	CIA Prod Stew	CEFIC Principles	ICC Charter Sus Dev	EMAS Scheme	ICI	Du Pont	Monsanto	Glaxo	Solvay Group	✓
Educate General Public		*		*	*							X
Support Local Community					*							✓
Publish Environmental Reports	*		*		*		*	*				✓
Liaise with Local Community												✓
Provide Info in Open Manner						*					*	✓
Cause No Offence to Local Residents												✓
Improve Staff Info & Training	*	*	*	*	*	*	*	*				✓
Ensure Personal Responsibility							*	*				✓
Employ Qualified Personnel	*											✓
Encourage Supplier Performance	*	*	*		*	*		*				✓
Control Raw Material Sourcing												X
Encourage Performance of Contractors	*	*	*		*	*	*	*				✓
Set Equal Standards for Contractors		*	*	*	*							X
Product Stewardship	*	*	*	*	*	*	*	*			*	✓
Meet or Exceed Legal Requirements	*	*			*		*			*		✓
Work with Appropriate Authorities										*		✓
Environmental Management System												✓
Carry Out Environmental Audits										*		✓
Assess, Control & Reduce Impact				*		*		*		*	*	✓

APPENDIX 2.2: SOLVAY INTEROX'S EMS - ENVIRONMENTAL POLICY CHECKLIST

COMMITMENTS	GUIDING POLICIES						COMPANY POLICIES					
	Valdez Principles	CIA Responsible Care	CIA Prod Stew	CEFIC Principles	ICC Charter Sus Dev	EMAS Scheme	ICI	Du Pont	Monsanto	Glaxo	Solvay Group	✓
Use Effective Controls						*						✓
Set and Review Objectives											*	✓
Carry out Monitoring and Targeting							*					✓
Assess & Quantify Progress											*	✓
Integrate Environmental Management				*	*							✓
Accept Cradle to Grave Responsibility												X
Undertake Life-Cycle Analysis	*											X
Promote Products use in Env. Protection							*				*	✓
Adopt Safe Technologies	*								*			✓
Prevention & Mastering risk of Incidents						*		*			*	✓
Contingency Procedures For Incidents						*						✓
Take Effective Action on Incidents	*			*	*	*		*				✓
Energy Conservation	*				*	*		*				✓
Conserve Non-Renewable Resources	*			*	*	*		*				X
Conserve Renewable Resources	*			*		*		*				X
Sustainable Development Commitment	*				*	*		*				X
Continuous Improvement Commitment	*					*	*	*	*		*	✓
Environmental Transport Policy												X
Environmental Investments												X

APPENDIX 2.2: SOLVAY INTEROX'S EMS - ENVIRONMENTAL POLICY CHECKLIST

COMMITMENTS	GUIDING POLICIES						COMPANY POLICIES					
	Valdez Principles	CIA Responsible Care	CIA Prod Stew	CEFIC Principles	ICC Charter Sus Dev	EMAS Scheme	ICI	Du Pont	Monsanto	Glaxo	Solvay Group	✓
Considerations in Decision Making						*		*		*		X
Aim for "Waste Free" Processes								*	*			X
Treat Waste at Source												X
Minimise, Reduce or Reuse Wastes	*		*	*	*	*		*	*			✓
Increase Recycling	*		*		*	*		*			*	✓
Dispose of Waste with Minimal Impact												✓
"Duty of Care" for Waste Disposal	*		*	*	*	*		*			*	✓
Minimise / Reduce Pollution	*			*		*		*	*			✓
Ensure Groundwater Safety									*			✓
Minimise Effects of New Processes				*	*	*						✓
Research Environmentally Sound Processes												X
No Undue to Risks to. Employees									*			✓
No Undue Risks to Community									*			✓
Control & Reduction of Noise						*						✓
Protection of Communities								*		*		✓
Keep Plant Open to Community									*			✓
Commitment to Responsible Care							*	*				✓
Commitment to ICC Charter							*					X
Manage Real Estate to Ben Nature								*	*			X

APPENDIX 2.2: SOLVAY INTEROX'S EMS - ENVIRONMENTAL POLICY CHECKLIST

COMMITMENTS	GUIDING POLICIES						COMPANY POLICIES					
	Valdez Principles	CIA Responsible Care	CIA Prod Stew	CEFIC Principles	ICC Charter Sus Dev	EMAS Scheme	ICI	Du Pont	Monsanto	Glaxo	Solvay Group	✓
Protect Eco-habitats	*			*	*							X
Tackle Conservation Problems	*											X
Company Group Policy												✓

APPENDIX 2.3: SOLVAY INTEROX'S EMS - TRAINING NEEDS ANALYSIS

	General Awareness	Legal Liabilities for Director	Regulatory Background	Legislative Control	Operational Procedures	Waste Minimisation	Environmental Effects	Spillage Response	Local Community Liason	Environmental Auditing	Product Stewardship	Objectives & Targets	Emission Monitoring	BS 7750 / ISO 14001
M.D & Executive Committee	✓	✓	✓						✓			✓		✓
Production & Environmental Services Manager	✓		✓	✓	✓	✓	✓		✓			✓		✓
Operations & Engineering Managers	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Communications Manager	✓								✓		✓			
Transport Manager	✓													
Purchasing Manager	✓													
Technical Staff	✓		✓	✓		✓	✓					✓	✓	✓
Project Engineering Staff	✓		✓	✓	✓			✓						✓
Commercial Staff	✓										✓			
Team Managers	✓			✓	✓	✓	✓	✓				✓	✓	
Lab Staff	✓			✓	✓	✓	✓	✓				✓	✓	
Process Operators & Maintenance	✓			✓	✓	✓	✓	✓				✓	✓	
Security Officers	✓													
Environmental Coordinators	✓		✓	✓	✓	✓	✓	✓				✓	✓	
Environmental Auditors	✓									✓				
Emergency Response Team	✓			✓				✓						
Office Based Personnel	✓													

APPENDIX 2.3: SOLVAY INTEROX'S EMS - TRAINING NEEDS ANALYSIS

KEY

General Awareness: to include RCLP policy, environmental objectives and key targets, Responsible Care commitment, site environmental issues and effects, benefits of improved environmental performance and consequences of departure from specified operating conditions.

Regulatory Background: to include BATNEEC, BPEO, IPC, EPA 1990 and Duty of Care.

Legislative Control: to include discharge consents, IPC Authorisation Limits etc

Operational Procedures: to include bund emptying, tanker off-loading, waste management, accidental releases etc

APPENDIX 2.4: SOLVAY INTEROX'S EMS - GROSS FACTORS FOR ENVIRONMENTAL EFFECTS ASSESSMENT

GROSS FACTORS																				
	X	SEW	RIV	LANDFILL							TREAT.	INCINERATION				REC	REUSE	WASTE CATEG.		GROSS FACTOR
				LIQ	SLD	SLDG	ORG	INORG	CONT	D&D		CLN	HAL	REC	NO-REC			SPEC	NON-SP	
	X	3	20	3	1	2	3	1	8	12	3	1	3	1	3	0.1	0.1	3	1	
Sewer Effluent - H_2O_2	3	3																		9
Sewer Effluent - C.O.D	7		20																	140
Sewer Effluent - SO_4	0.01	3																		0.03
Sewer Effluent - Oil & Grease	7	3																		21
Sewer Effluent - SS	12	3																		36
Sewer Effluent- Cl^-	0.01	3																		0.03
Sewer Effluent - Hg (kg)	100		20																	2000
River Effluent - H_2O_2	3		20																	60
River Effluent - C.O.D	7		20																	140
River Effluent - Cl^-	0.01		20																	0.2
River Effluent - SO_4	0.01		20																	0.2
River Effluent - Hg (kg)	100		20																	2000
River Effluent - Cd (kg)	100		20																	2000
River Effluent -SS	12		20																	240
River Effluent - $P0_4$	20		20																	400
River Effluent -H_2S0_4	50		20																	1000
River Effluent - Boron	5		20																	100
Capa Residues					1		3		8											72
Capa - Solid Polymer Waste					1		3		8										1	24

APPENDIX 2.4: SOLVAY INTEROX'S EMS - GROSS FACTORS FOR ENVIRONMENTAL EFFECTS ASSESSMENT

GROSS FACTORS

	X	*SEW*	*RIV*	*LANDFILL*							*TREAT.*	*INCINERATION*				*REC*	*REUSE*	*WASTE CATEG.*		*GROSS FACTOR*
				LIQ	*SLD*	*SLDG*	*ORG*	*INORG*	*CONT*	*D&D*		*CLN*	*HAL*	*REC*	*NO-REC*			*SPEC*	*NON-SP*	
	X	*3*	*20*	*3*	*1*	*2*	*3*	*1*	*8*	*12*	*3*	*1*	*3*	*1*	*3*	*0.1*	*0.1*	*3*	*1*	
Capa - Liquid Polymer Waste											3								1	3
Capa - Caustic Meths Washings											3							3		9
Capa - Reactor Liquid Waste											3							3		9
Capa - Ketone Tank Cleaning Slops												1			3			3		9
Capa - Process Samples												1			3					9
Capa - Residue Samples (Light Residues)					1		3		8									3		72
Capa - Oily Water Separator Sludge						2	3												1	6
AO - Caustic Tars				3				1	8									3		72
AO - Working Solution														1				3		3
AO - Spent Catalyst																0.1				0.1
AO -Spent Carbons																0.1				0.1
Persalts - Tincal Sludge						2		1		12									1	24
General Waste					1			1	8										1	8
Drums					1												0.1			0.1

Key:

LIQ = Liquid; SLD = Solid; SLDG = Sludge; INORG = Inorganic; CONT = Contained Landfill; D&D = Dilute and Disperse Landfill; CLN = Chlorinated; HAL = Halogenated; NO - REC = No Heat Recovery; REC = Recycled; SPEC = Special Waste; NON-SP = Non-Special

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO Crude	Air	VOCs released from carbon absorption beds (sextate and shellsol AB/Solvessa 150)	Associated with ground level ozone formation and some depletion of ozone layer. Prescribed substances for release to air (EPA 1990).	14.1	100	1410	High	Limit in 1998 will be set by EA of 80mg/m^3. Compliance with this limit is an outstanding issue.
AO Crude	Air	VOCs from process vents, valves, storage and transfer operations (sextate and shellsol AB/Solvessa 150)	Associated with ground level ozone formation and some depletion of ozone layer. Prescribed substances for release to air (EPA 1990). Potential to cause nuisance due to pungent odour.	N/A	N/A	N/A	Low	
AO Crude	Air	Hydrogen peroxide released from various stages of the process e.g. purification, distillation, blending, storage and distribution.	Consequences are not likely to be severe eg a typical transfer of 18m^3 of 35% will only release ~ 5g of vapour.	0.1	1	0.1	Low	
AO Crude	Sewer	COD	Gives rise to odour problems in NW pumping station. Associated with de-oxygenation in receiving water course.	265	140	37,100	High	12 complaints received in 1995 regarding odours from NWW pumping station.
AO Crude	Sewer	Oil and Grease (free phase working solution)	Enhances odour problem in pumping station.	0.1	N/A	N/A	Med/High	
AO Crude	Sewer	Chloride ions	No particular environmental concerns when released into Mersey Estuary.	136	0.03	4.08	Low	
AO Crude	Sewer	Sulphate ions	Not associated with any particular concerns when discharged into an estuary. Effluent analysis indicates levels of 104mg/l which is significantly below discharge consent = 1000mg/l.	8	0.03	0.24	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO Crude	Sewer	Quinone & Derivatives	Contributes towards COD loading. Tests by NWW indicate good biodegradability for secondary treatment plant to be installed 1998.	6.73	140	942.2	Low	
AO Crude	Sewer	Di-n-Butylamine		0.47	140	65.8	Low	
AO Crude	Sewer	Suspended solids	Removed from effluent during treatment by NW water. Sludge disposed of at sea.	7.5	36	270	Low	
AO Crude	Sewer	Temperature	Discharge Consent = 43.3^{o}C	< 30^{o}C*	N/A	N/A	Low	
AO Crude	Sewer	Flowrate	Average flow is 7.53 m^3/hr although levels exceed discharge consent of 18m^3/hr.	10-30 m^3/hr	N/A	N/A	Low	In previous years flow exceeded consent - engineering controls now ensure compliance
AO Crude	Sewer	Acidity / Alkalinity	Acidic conditions have a corrosive effect on NWW drainage system and pumping station . Potential to breach discharge consent = 6-10	N/A	N/A	N/A	High	50% failure rate compared with consent conditions.
AO Distillation	River	Hydrogen Peroxide (<10*mg/l)	Effluent analysis indicates levels < 10*mg/l. Contributes towards hydrogen peroxide levels in site effluent (outfall consent = 100mg/l).	17.5	60	1050	Med/High	Uncontrolled release associated with poor containment and occasional high still overhead losses.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	TYPE	SOURCE	CONSEQUENCE	Quantity (te/a)	Gross Factor	Weighted Effect	RATING	COMMENTS
AO Distillation	River	Chemical Oxygen Demand (31* mg/l).	Effluent analysis indicates levels of 31* mg/l - contributes towards COD levels in site effluent (outfall consent = 200mg/l). Associated with de-oxygenation of River Mersey.	32	140	4480	Med	Measurement affected by chlorine ion content
AO Distillation	River	Chloride Ions (2640* mg/l)	No concerns when discharged into an estuary.	4039	0.2	807.8	Low	
AO Distillation	River	Hg (from well water)	Contributes towards heavy metals in site effluent (outfall consent = 10mg/l). Prescribed substances for release to water (EPA 1990), however, quantities released are extremely small.	0.183	2000	366	Low	
AO Distillation	River	Temperature	Contributes towards temperature of site effluent (outfall consent = 30^oC)	< 30^0C*	N/A	N/A	Low	
AO Distillation	River	Suspended Solids (< 30*mg/l).	Contributes towards suspended solids in site effluent (outfall consent = 100mg/l).	10	240	2400	Low	
AO Distillation	River	Acidity/Alkalinity (pH 8-8.2*).	Contributes towards pH of site effluent (outfall consent = 5-10).	N/A	N/A	N/A	Low	
AO Distillation	River	Flowrate	Contributes towards flowrate of site effluent (outfall consent = 11,000m^3/hr).	210m^3/hr	N/A	N/A	Low	
AO New Distillation	Sewer	Effluent from new Distillation Plant containing peroxide and small quantity of COD. To mix with PBS-4 effluent before discharge to sewer.	Contributes towards peroxide and COD loading of site effluent.	N/A	N/A	-	Med/High	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
New DMW	River	Acidity / Alkalinity - normally acidic.	Contributes towards pH of site effluent (outfall consent = 5-10). Consequences not likely to be severe as effluent is neutralised by alkaline PBS effluents before discharge to River.	N/A	N/A	N/A	Low	PCS effluent neutralisation will mean DMW effluent will cause a breach of NRA consents at outfall.
New DMW	River	Mercury (from contaminates in sodium hydroxide and well water)	Prescribed substance for release to water (EPA 1990). Extremely small quantity released.	0.006	2000	12	Low	
New DMW	River	Cadmium (from contaminates in sodium hydroxide and well water)	Prescribed substance for release to water (EPA 1990). Extremely small quantity released.	0.006	2000	12	Low	
New DMW	River	COD resulting from concentration of TOC in towns water.	Contributes towards COD levels in site effluent (outfall consent = 200mg/l). Associated with de-oxygenation of River Mersey.	N/A	N/A	N/A	Low	
New DMW	River	Flowrate	Approximately $35m^3/hr$ - contributes towards flow rate of site effluent (outfall consent = 11,000 m^3/day)	$35m^3/hr$	N/A	N/A	Low	
AO Crude	Waste	AO Tars - containing a range of organic compounds e.g. alkyl benzenes, quinones and alkyl benzoates. 80% water.	Currently one stream being disposed to sewer other stream landfilled after neutralisation. Landfill gas management system in operation at landfill site.	158	72	11,376	High	
AO Crude	Waste	Working Solution (organic polar solvents, aromatic hydrocarbons and quinones) - infrequent disposal.	Incineration is usual method of disposal - associated with air pollution.	–	3	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO Crude	Waste	Waste spent palladium catalyst - periodic disposal.		-	0.1	N/A	Low	
AO Crude	Waste	Disposal of waste carbons from carbon beds.	Recycled as a waste kiln fuel.	–	0.1	N/A	Low	
New DMW	Waste	Disposal of brine wash waste from DMW caustic wash of resins - high COD, strong brown colour	Stored in tankers for subsequent off site disposal via treatment.	-	-	N/A	Med /High	Current operation poses risks associated with temporary handling facilities and additional acid/alkaline effluent loading.
AO General	Waste	Leaks of working solution from AO drainage system.	Land contamination with working solution consisting of organic solvents and quinones.	N/A	N/A	N/A	Low	New stainless steel drainage system installed Sept 1995.
AO General	Resource Usage	Acid Sodium Pyrophosphate		15.8	N/A	N/A	Low	
AO General	Resource Usage	New Activated Carbon	Not classified as dangerous (CHIP)	2.2	N/A	N/A	Low	
AO General	Resource Usage	Regenerated Activated Carbon	Not classified as dangerous (CHIP)	830	N/A	N/A	Low	
AO General	Resource Usage	Ammonia		119	N/A	N/A	Low	
AO General	Resource Usage	Caustic Soda Liquor	Alkaline	135	N/A	N/A	Low	
AO General	Resource Usage	Di-n-Butylamine		1.8	N/A	N/A	Low	
AO General	Resource Usage	Dequest 2010		0.8	N/A	N/A	Low	
AO General	Resource Usage	Ethyl - Anthraquinone	Not classified as dangerous (CHIP). No particular environmental concerns.	44	N/A	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO General	Resource Usage	Working Solution		170	N/A	N/A	Low	
AO General	Resource Usage	Hydrogen Gas	Highly flammable (CHIP). Piped directly to site from ICI. No particular environmental concerns.	29,000 km^3	N/A	N/A	Low	
AO General	Resource Usage	Nitric Acid	Corrosive (CHIP)	81	N/A	N/A	Low	
AO General	Resource Usage	Nitrogen	Not classified as dangerous (CHIP)	1593km^3	N/A	N/A	Low	
AO General	Resource Usage	Palladium Catalyst (Bought)	Not classified as dangerous (CHIP)	2	N/A	N/A	Low	
AO General	Resource Usage	Aromatic Solvent (Solvesso 150)	Harmful (CHIP)	203	N/A	N/A	Low	
AO General	Resource Usage	Sextate (purchased)		118	N/A	N/A	Low	
AO General	Resource Usage	Towns water	Depletion of natural resources.	52,813m^3	N/A	N/A	_	See Site General
AO General	Resource Usage	Well water (used to supplement cooling water supplies). Abstracted locally from 5 wells.	Depletion of natural resources.	533,668m 3	N/A	N/A	_	See Site General
AO General	Resource Usage	Low pressure steam (used in crude and distillation stages).	Produced by BP Power House. Associated with air pollution from burning gas.	32,375	N/A	N/A	_	See Site General
AO General	Resource Usage	Mains Electricity	Air pollution from burning fuel, depletion of natural resources. AO Plant uses approximately 50% of site supply.	14,626 MWH	N/A	N/A	_	See Site General
AO General	Resource Usage	Compressed Air		2450km^3	N/A	N/A	_	See Site General

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO General	Resource Usage	DMW water (used in extraction and reversion washing; cooling; in-line addition to reactants, products and intermediates; and for domestic supply)	Depletion of natural resources.	97,483m^3	N/A	N/A	_	See Site General
AO General	Nuisance	Noise	Contributes towards general noise from site. However, no specific high noise sources.	N/A	N/A	N/A	Low	No specific complaints received therefore not considered significant.
AO General	Indirect	Use of product by chemical industry - generally high strength to 70%.		N/A	N/A	N/A	Low	Advice and support is provided to customers.
AO General	Indirect	Use of product in textiles - generally high strength to 70%.		N/A	N/A	N/A	Low	Advice and support is provided to customers.
AO General	Indirect	Use of product in pulp & paper industry as bleach - generally high strength to 70%.		N/A	N/A	N/A	Low	Advice and support is provided to customers.
AO General	Indirect	Use of product in cosmetic toiletries - low quantities of low strength material e.g. hair bleach and mouth wash.	Material below 10% does not give rise to significant safety problems.	N/A	N/A	N/A	Low	Advice and support is provided to customers.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
AO General	Indirect	Use of product in effluent and sewerage treatment odour control.		N/A	N/A	N/A	Low	Advice and support is provided to customers.
AO General	Indirect	Use of sodium chlorite - used in water treatment, textile bleaching and electronics industry.		N/A	N/A	N/A	Low	
Capa	Air	Acetic acid form storage tanks and transfer operations. Max release occurs during bulk deliveries.		0.042	100	4.2	Low	Quench tank installed on acetic acid storage tank.
Capa	Air	Cyclohexanone from storage, delivery and transfers. Max release occurs during bulk deliveries.	Cyclohexanone - potential to cause nuisance from Pungent / Sweetish Odour. GLC up to 1.8 mg/m^3 (Max allowable = 2.5 mg/m^3).	0.313	100	31.3	Med/High	Currently on hold with EA agreement pending shut-down of old Capa Plant.
Capa	Air	Hydrogen peroxide from various process vents.	Consequences not likely to be sever due to extremely small quantity released. Not a prescribed substance for release to air.	0.015	1	0.015	Low	
Capa	Air	Arcton HCFC 22 Hydro Fluoro Chloro Gas released from refrigeration units on polymer plant	Associated with stratospheric ozone depletion. Included in scope of Montreal Protocol - manufacture to be phased out.	0.001	1000	1	Med	
Capa	Air	Nitrogen gas	No particular environmental concerns.	381	0.01	3.81	Low	
Capa	Air	Peracetic acid from still dump to happenings pit.	Potential to cause nuisance due to pungent odour. Controlled by Statutory Nuisance Legislation (EPA 1990).	N/A	N/A	N/A	Med	No complaints from the public since previous assessment.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Air	Vapours of caproic & valeric acid from residue tank vents.	Potential to cause nuisance due to pungent odour . Controlled by Statutory Nuisance Legislation (EPA 1990).	0.02	100	2	Med/High	No complaints from the public since previous assessment.
Capa	Sewer	COD (in process effluent from 400 section scavenging column and small purge on 100 section reactor)	Contributes towards de-oxygenation in River Mersey.	237	140	33180	High	
Capa	Sewer	Flow rate (in process effluent from 400 section scavenging column and small purge on 100 section reactor)	Average flow of $44.6m^3/hr$ average Causes breach of discharge of consent of $27m^3/hr$.	NA	N/A	N/A	High	Causes a breach of discharge consent although a temporary higher consent limit is agreed with authorities.
Capa	Sewer	Heavy Metals (in process effluent from 400 section scavenging column and purge on 100 section reactor)	Mercury and Cadmium are classed as prescribed substances for release to water (EPA 1990). However, effluent analysis indicates levels of 1.4mg/l - significantly below discharge consent of 10mg/l.	N.A	N.A	N.A	Low	
Capa	Sewer	Hydrogen Peroxide (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)		8.69	9	78.21	Low	
Capa	Sewer	Acidity (of process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Generally within consent range of 6-10. Neutralised on plant by NaOH.	N/A	N/A	N/A	Med/High	Several incidents in 1995 gave rise to alkaline effluent from spillages and neutralisation system faults.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Air	Vapours of caproic & valeric acid from residue tank vents.	Potential to cause nuisance due to pungent odour . Controlled by Statutory Nuisance Legislation (EPA 1990).	0.02	100	2	Med/High	No complaints from the public since previous assessment.
Capa	Sewer	COD (in process effluent from 400 section scavenging column and small purge on 100 section reactor)	Contributes towards de-oxygenation in River Mersey.	237	140	33180	High	
Capa	Sewer	Flow rate (in process effluent from 400 section scavenging column and small purge on 100 section reactor)	Average flow of $44.6m^3/hr$ average Causes breach of discharge of consent of $27m^3/hr$.	NA	N/A	N/A	High	Causes a breach of discharge consent although a temporary higher consent limit is agreed with authorities.
Capa	Sewer	Heavy Metals (in process effluent from 400 section scavenging column and purge on 100 section reactor)	Mercury and Cadmium are classed as prescribed substances for release to water (EPA 1990). However, effluent analysis indicates levels of 1.4mg/l - significantly below discharge consent of 10mg/l.	N.A	N.A	N.A	Low	
Capa	Sewer	Hydrogen Peroxide (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)		8.69	9	78.21	Low	
Capa	Sewer	Acidity (of process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Generally within consent range of 6-10. Neutralised on plant by NaOH.	N/A	N/A	N/A	Med/High	Several incidents in 1995 gave rise to alkaline effluent from spillages and neutralisation system faults.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Sewer	Suspended solids (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Removed during NWW water treatment.	16.4	36	590.4	Low	
Capa	Sewer	Oil & Grease (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Effluent analysis indicates levels of < 1*mg/l ie significantly below discharge consent of 50mg/l.	0.3	21	6.3	Low	
Capa	Sewer	Sulphate ions (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Effluent analysis indicates levels of 154*mg/l which is significantly below discharge consent of 200mg/l. Not associated with any particular environmental concerns.	46	0.03	1.38	Low	
Capa	Sewer	Chloride ions (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Not associated with any particular environmental concerns.	900	0.03	27	Low	
Capa	Sewer	Temperature (in process effluent mainly from 400 section scavenging column and purge on 100 section reactor)	Consent of 43.3^{0}C	N/A	N/A	N/A	Med/High	No current regular monitoring to ensure compliance.
Capa	River	Oily Water Separator Overflow	Contents can overflow to River due to inadequacy of existing pump and pipework.	N/A	N/A	N/A	High	
Capa	River	Flow rate of cooling water		150m^{3}/hr	N/A	N/A	Low	
Capa	River	COD in cooling water		16	140	2240	Low	
Capa	River	Hg in cooling water		0.166	2000	332	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	River	Chloride ions in cooling water	No environmental concerns when discharged into an Estuary	3000	0.03	90	Low	
Capa	River	Peroxide and PAA added to cooling water as an algaecide (concentration of 25ppm or 30 litres a day).		11	60	650	Low	Impact predicted as insignificant.
Capa	Waste	Caprolactone residues from 400 section	"Special Waste", Irritant (CPL Regs). Landfilled - associated with leachate and gas formation.	1056	72	76032	High	
Capa	Waste	Solid polymeric waste	"Non-Special". Landfilled -associated with leachate and gas formation. High molecular weight polymers are particularly biodegradable.	61	24	1464	Low	
Capa	Waste	Caustic Meths Washings (IMS) (from annual cleaning of process equipment)	"Special Waste", Corrosive/Flammable (CPL Regs). Disposed of by treatment.	20	9	180	Low	
Capa	Waste	Monomer washings from reactors on polymer plant	"Special Waste". Currently disposed of as solid polymer waste (solidified by addition of HCl)	15	24	360	Low	
Capa	Waste	Cyclohexanone waste from tank cleaning	"Special Waste". Disposed of by incinerated which is associated with air pollution.	10.92	9	98.28	Low	
Capa	Waste	Process samples (drummed waste - disposed of via incineration)	Classified as "Special Waste" - Control of Pollution (Special Waste Regs 1980). Incineration is associated with air pollution.	36	9	324	Low	
Capa	Waste	Oily Water Separator Sludge - disposed of via landfill.	Considered to be Non-hazardous. Landfill is associated with leachate and gas formation.	1.9	6	11.4	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Resource Usage	Use of Sulphuric Acid	Corrosive (CPL)	64	N/A	N/A	Low	
Capa	Resource Usage	Use of Glacial Acetic Acid	Produced by BP Chemicals (Grade A). Corrosive/Flammable (CPL).	186	N/A	N/A	Low	
Capa	Resource Usage	Use of Caustic Soda Liquor	Corrosive (CPL)	184	N/A	N/A	Low	
Capa	Resource Usage	Use of Dibutyl Tin Dilaurate (Stanclere TC) - used as a catalyst.		0.015	N/A	N/A	Low	
Capa	Resource Usage	Use of Industrial Methylated Spirits (cleaning)		0	N/A	N/A	Low	
Capa	Resource Usage	Use of Nitrogen	Provided by BOC Gasses Ltd	423km^3	N/A	N/A	Low	
Capa	Resource Usage	Use of Hydrogen Peroxide	Corrosive/Oxidising (CPL). Produced on site by AO Plant	176	N/A	N/A	Low	
Capa	Resource Usage	Use of Cyclohexanone	Produced by DSM (Grade A). Harmful / Flammable(CPL)	7583	N/A	N/A	Low	
Capa	Resource Usage	Use of Stannous Octoate (Catalyst)	Irritant (CPL).	0.054	N/A	N/A	Low	
Capa	Resource Usage	Use of Santoflex IP		5.14	N/A	N/A	Low	
Capa	Resource Usage	Initiators eg di-ethylene glycol, glycerol, butane 1-4 diol, neopentylglycol, pentaerythritol, Irganox 1010, tri-methylol propane, topanol, polytetrahydrofuran glycol, cetyl Alcohol		< 600*	N/A	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Resource Usage	Additives eg sterically hindered phenol, santoflex IP/anchor IPPD, stanowhite powder, staboxol I anti-hydrolysis agent		< 20*	N/A	N/A	Low	
Capa	Resource Usage	Use of Towns (Purchased) Water - for showers, seals and domestic uses.	Use of a natural resources.	$4446m^3$	N/A	N/A	_	See Site General
Capa	Resource Usage	Use of Well Water - used for cooling purposes.	Use of natural resources - Abstracted locally from 5 wells (3 located on site). Capa Plant is one of the main users.	$1330km^3$	N/A	N/A	_	See Site General
Capa	Resource Usage	Use of Demineralised Water	Use of a natural resource. Provided by DMW Plant (see AO Assessment)	$66km^3$	N/A	N/A	_	See Site General
Capa	Resource Usage	Use of High Pressure Steam	Associated with natural gas usage, acid rain etc Provided by Site Boiler House (see Boiler House Assessment). Capa uses 5% of total for site.	$73km^3$	N/A	N/A	_	See Site General
Capa	Resource Usage	Use of Mains Electricity - used for fans, lights and pumps etc	Associated with acid rain, green house effects etc. Capa plant uses 8% of site electricity usage.	2, 861 MWh	N/A	N/A	_	See Site General
Capa	Nuisance	Noise	Contributes towards general noise from site. However, no specific high noise sources.	N/A	N/A	N/A	Low	No complaints since last assessment therefore not considered significant.
Capa	Indirect	Use of caprolactone monomer - to form polyesters and resins (paints, inks etc)	No particular concerns - Capa Monomer is classed as an Irritant (CPL)	N/A	N/A	N/A	Low	
Capa	Indirect	Use of low molecular weight polymers - to form hard wearing elastic, adhesives etc.	No particular concerns - capa polymer is non-hazardous.	N/A	N/A	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Capa	Indirect	Use of high molecular weight polymers - e.g in modelling kits, shoes etc	No particular concerns - capa polymer is non-hazardous.	N/A	N/A	N/A	Low	
Capa	Indirect	Final Disposal of Capa Products.	No particular environmental concerns - capa polymer is biodegradable.	N/A	N/A	N/A	Low	
New Capa	Air	VOCs from various process vents and valves.	Associated with low level ozone depletion	0.2	100	20	Low	Awaiting IPC Authorisation
New Capa	Sewer	Flow rate of process effluent	Estimated at ~ 30 m3/hr	N/A	N/A	N/A	Low	Awaiting IPC Authorisation
New Capa	Sewer	Chemical oxygen demand of process effluent.	Contributes towards de-oxygenation in River Mersey.	180	140	25200	High	Awaiting IPC Authorisation
New Capa	Sewer	Suspended solids in process effluent.	Effluent simulation indicates levels of 25 mg/l	6.5	36	234	Low	Awaiting IPC Authorisation
New Capa	Sewer	Hydrogen peroxide in process effluent.		2.2	9	19.8	Low	Awaiting IPC Authorisation
New Capa	River	Uncontaminated cooling water	No particular environmental concerns.	340 m^3/hr	N/A	N/A	Low	Awaiting IPC Authorisation
New Capa	Waste	Capa residues	Landfilled - associated with landfill gas production and leachate.	1949	72	140328	High	Awaiting IPC Authorisation
Persalts	Air	Dust from scrubbing systems	Invisible during normal operating conditions.	4	50	200		Abatement systems in place to reduce amount of airborne particulate matter.
Persalts	Air	CO_2 from PBS-1 Burners	Associated with global warming	465	0.5	232.5	Low	New boilers installed 1994
Persalts	Air	CO form PBS-1 Burners	Associated with global warming	0.05	5	0.24	Low	New boilers installed 1995
Persalts	Air	NO_x from PBS-1 Burners	Associated with acid rain formation.	0.05	100	4.8	Low	New boilers installed 1996

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Persalts	River	Cooling water - discharged direct to river without treatment.	Uncontaminated cooling water - contributes towards flow rate of site effluent (outfall consent = 11,000 m^3/day)	30m^3/hr	N/A	N/A	Low	
Persalts	River	Floor washings and contaminated rain water from the silo buildings and loading bay.	No treatment before discharge to river. Potential to cause high solids at outfall and high peroxide loading.	N/A	N/A	N/A	High	
Persalts	River	COD in PBS process effluent (mainly from overflow of mother liquor tank and L3 wet scrubber - passes through settlement pit before discharge).	Contributes towards COD loading of site effluent (Outfall consent = 200mg/l). Associated with de-oxygenation of River Mersey.	52	140	7280	Med	
Persalts	River	Hydrogen peroxide in PBS process effluent (from mother liquor tank overflow and L3 wet scrubber - passes through settlement pit before discharge).	Contributes towards peroxide loading of site effluent (outfall consent = 100mg/l.	103	60	6180	Med/High	High potential to breach consent. Tighter consent limits will be imposed by the NRA in 1996.
Persalts	River	Suspended solids in PBS process effluent (from mother liquor tank overflow and L3 wet scrubber).	Contributes towards suspended solids in site effluent (outfall consent = 100 mg/l)	6.57	240	1576.8	High	High potential to breach consent. Tighter consent limits will be imposed by the NRA in 1996.
Persalts	River	Phosphate ions in PBS process effluent (mainly from mother liquor tank overflow and L3 wet scrubber).	Associated with eutrophication in receiving water courses.	5.16	400	2064	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Persalts	River	Boron in process effluent from PBS process effluent (mainly from mother liquor tank overflow and L3 wet scrubber).	Not believed to be a significant problem in River Estuary	293	100	29300	High	Significant due to resource wastage.
Persalts	River	Chloride ions in PBS process effluent (mainly from PBS mother liquor tank and L3 wet scrubber)	No environmental concerns when discharged into Mersey Estuary.	598	0.2	119.6	Low	
Persalts	River	Hg in PBS process effluent (mainly from PBS mother liquor tank and L3 wet scrubber). From well water and contaminated NaOH	Toxic - however extremely small quantities (see IPC).	1.77	2000	3540	Low/Med	
Persalts	River	Flowrate PBS process effluent (mainly from PBS mother liquor tank and L3 wet scrubber)	Contributes towards flow rate of site effluent (outfall consent = 11,000 m^3/day)	20m^3/hr	N/A	N/A	Med/High	< 15m3/hr required to meet internal site consent.
Persalts	River	Sulphate Ions (1000-2000 mg/l) in process effluent from PBS effluent (mainly from PBS mother liquor tank and L3 wet scrubber)	No particular concerns regarding discharge to River Estuary.	200	0.2	40	Low	
Persalts	River	Alkalinity of PBS process effluent (mainly from PBS mother liquor tank and L3 wet scrubber)	Contributes towards pH of site effluent (consent = 5-10). Strong buffering effects from perborate at pH 9.	N/A	N/A	N/A	Med	
Persalts	River	pH of PCS process effluent	Contributes towards pH of site effluent (consent = 5-10) - potential to exceed pH 10 at outfall due to uncontrolled releases from PCS.	N/A	N/A	N/A		PCS not presently being produced.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Persalts	River	Suspended solids in PCS process effluent.	PCS effluent mixes with well water in surface drains to produce $CaCO_3$ precipitate.	N/A	N/A	N/A		PCS not presently being produced.
Persalts	Land	Tincal sludge	Landfill - Composition (%): Water 49; Soluble borates 5; Silica 10; Alumina 1; Calcium 20; Magnesium 15; and traces of Iron, Copper, Nickel. Duty of Care Regs (EPA 1990)	8219	24	197,256	High	Supplier rating = C (72%)
Persalts	Resource Usage	Caustic Soda Liquor (NaOH - 47%)		13,714	N/A	N/A	Low	
Persalts	Resource Usage	Lapofloc FN200		3, 918	N/A	N/A	Low	
Persalts	Resource Usage	Magnesium Sulphate		286	N/A	N/A	Low	
Persalts	Resource Usage	Magna Floc		0	N/A	N/A	Low	
Persalts	Resource Usage	Tincal	Opencast mining in Turkey	39,472	N/A	N/A	Low	
Persalts	Resource Usage	Hydrogen Peroxide	Transferred from AO Plant	4731	N/A	N/A	Low	

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AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Persalts	Resource Usage	Towns Water used mainly for the refrigeration plant which uses approximately 10% of site supply.	Associated with the use of natural resources.	1959m3	N/A	N/A	–	See Site General
Persalts	Resource Usage	Well Water	Used to supplement cooling water supplies. Abstracted from 6 wells (2 on site). Associated with the use of natural resources.	1,433km^3	N/A	N/A	–	See Site General
Persalts	Resource Usage	Steam - Low Pressure (used to heat air for the drying process)	Produced on site by BP Energy	20,309 m^3	N/A	N/A	–	See Site General
Persalts	Resource Usage	Steam - Intermediate Pressure (used to heat air for the drying process.	Produced on site by BP Energy	15,435 m^3	N/A	N/A	–	See Site General
Persalts	Resource Usage	Electricity	Associated with acid rain, greenhouse effect etc.	8,554MWh	N/A	N/A	–	See Site General
Persalts	Resource Usage	Natural Gas (PBS -1)	Associated with depletion of a natural resource	186,256 therms	N/A	N/A	–	See Site General
Persalts	Nuisance	Noise	Complaints have been received from driers in the past. Potential to breach Statutory Nuisance Regs (EPA 1990)	N/A	N/A	N/A	High	In 1995 4 complaints were received regarding line 4 drier and 3 complaints regarding lines 1-3. Line 1 removed in 1995, line 3 fitted with silencer
Persalts	Indirect	Use of PCS in Laundry Applications (washing powders)	Majority of PCS manufactured is used in washing powders (i.e 99%). Not associated with any particular environmental concerns.	N/A	N/A	N/A	Low	

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AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Persalts	Indirect	Use of PBS in Laundry Applications (washing powders)	Majority of PBS manufactured is used in washing powders (i.e 99%). May be future concern over the release of boron to water courses.	N/A	N/A	N/A	Low	
Persalts	Indirect	Use of PBS/PCS in Household Cleaning Products	No particular environmental concerns.	N/A	N/A	N/A	Low	
Persalts	Indirect	Use of PBS/PCS in Cosmetic Toiletries	No particular environmental concerns.	N/A	N/A	N/A	Low	
Persalts	Indirect	Use of PBS/PCS in Textile Bleaching	No particular environmental concerns.	N/A	N/A	N/A	Low	
Persalts	Indirect	Use of PBS/PCS in Vat Dye Oxidation	No particular environmental concerns.	N/A	N/A	N/A	Low	
Peracetic Acid Plant	Air	VOCs (acetic and peracetic acid) from reactor vents.	Max. GLC can be 1.9 mg/m^3 which is above odour threshold for HAC and both recommended GLCs. Odour complaints possible - potential breach of Statutory Nuisance Regs (EPA 1990)	2.19	100	219	_	Currently no production of PAA.
Peracetic Acid Plant	Air	VOCs (acetic acid) from bulk storage tanks and transfer operations.	Max. release rate occurs during bulk deliveries. GLC of acetic acid at site boundary can = 45mg/m^3 . Level above odour threshold and recommended GLC for acetic acid. Odour complaints possible. Statutory Nuisance (EPA 1990)	N/A	N/A	N/A	_	Currently no production of PAA. Although potential to breach nuisance regulations should production commence.
Peracetic Acid	River	Chemical Oxygen Demand in product heel left from reactor vessel (~ 5kg of product is released per 1t batch).	Effluent analysis indicates levels of 4423 mg/l - contributes towards COD of site effluent (outfall consent = 200mg/l).	5	140	700	_	Currently no production of PAA. Although uncontrolled & not regularly monitored during production.

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AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Peracetic Acid	River	Hydrogen peroxide from product heel left in reactor vessel.	Effluent analysis indicates levels of 14mg/l - contributes towards hydrogen peroxide in site effluent (outfall Consent = 100mg/l).	1.13	60	67.8	_	Currently no production of PAA. Should production commence consents to River are expected to become tighter in the 1996.
Peracetic Acid	River	Suspended solids from product heel left in reactor vessel.	Effluent analysis indicates levels of < 30mg/l - contributes towards suspended solids in site effluent (outfall consent = 100mg/l).	0.089	240	21.36	_	Currently no production of PAA.
Peracetic Acid	River	Acidity/alkalinity from product heel left in reactor vessel.	Contributes towards pH of site effluent (outfall consent = 5-10).	N/A	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	River	Chloride ions in product heel left in reactor vessel.	No particular environmental concerns.	60	0.2	12	_	Currently no production of PAA.
Peracetic Acid	River	Cooling water discharge	Cooling water should not be uncontaminated during normal operating conditions.	N/A	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	River	Reactor dump - contents of reactor released when to leave it in the reactor would cause a hazard.	Passed through a dilution pit to meet discharge consents, although an uncontrolled release causing high COD loading and release of PAA (a biocide). Can be associated with fish kills and may attract complaints.	N/A	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Use of DMW in production of certain grades of peracetic acid.		~16,000 m^3	N/A	N/A	-	Currently no production of PAA.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Peracetic Acid	Resource Usage	Use of Towns water used for: cooling; in-line addition to reactants, products and intermediates; and for domestic supply.	Depletion of a natural resource.	~40,000 m^3	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Use of Well Water - used to supplement cooling water. Abstracted locally from 5 wells (3 of which are located on site).	Depletion of a natural resource.	~233,000 m^3	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Mains electricity	Associated with acid rain, green house effect etc.	~1300	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	.P. steam - used to heat water in Hot Water System. Water is maintained at 30^oC to keep Acetic Acid above freezing point.		~5000*m^3	N/A	N/A	-	Currently no production of PAA.
Peracetic Acid	Resource Usage	Glacial Acetic Acid	Produced by BP Chemicals Ltd (Grade A).	1153	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Hydrogen Peroxide 86%	Produced on site by AO Plant	~500	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Hydrogen Peroxide 35%	Produced on site by AO Plant	~100	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Acetic Anhydride	Distributed by Ellis & Everard (No reply to questionnaire).	~10	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Dequest 2010	Distributed by Ellis & Everard (No reply) or Hays Chemicals (Grade E).	~15	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Sulphuric Acid 97-99%	Distributed by Ellis & Everard (No reply to questionnaire).	~7	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Resource Usage	Synperonic 91/8	Distributed by Ellis & Everard (No reply to questionnaire).	~1	N/A	N/A	_	Currently no production of PAA.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Peracetic Acid	Resource Usage	IXPER 75C		~0.5	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Resource Usage	Dipicolonic Acid	Produced by BDH Chemicals Ltd (No reply), Raschig UK Ltd (No reply) or Collinda (Grade A).	~ 0.2	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Resource Usage	Fragrance LK30524	Produced by Bush Boake Allen Ltd (Grade F)	~ 0.1	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Nuisance	Noise	Contributes towards general noise from site. However location of PAA plant not in vicinity of sensitive boundaries. No specific high noise sources.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of < 5% in Vetinary applications.	Used as a disinfectant - no particular environmental concerns.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 5% in J+J medical instrument sterilisation (new application).	Used as a disinfectant - no particular environmental concerns.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 5% - "*Clean in place*", dairy industry, breweries and food packing plants.	Used as a disinfectant - no particular concerns.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 5% - Animal health care, disinfecting agent for animal houses.	Used as a disinfectant - no particular concerns.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 12% - Oxymaster sewerage disinfectant.	Environmentally Beneficial Applications - used to clean sewerage outfalls.	N/A	N/A	N/A	–	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 12 % - Paper industry (new development) and biocide.	Used to remove bugs in paper pulp.	N/A	N/A	N/A	–	Currently no production of PAA.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Peracetic Acid	Indirect	Use of 15% - "Clean in place" Higher strength	Used as a disinfectant - no particular environmental concerns.	N/A	N/A	N/A	_	Currently no production of PAA.
Peracetic Acid	Indirect	Use of 36 - 40% (High strength grades) in pharmaceutical industry and in particular the manufacture of antibiotics (used as an intermediate).		N/A	N/A	N/A	-	Currently no production of PAA.
Boiler House	Air	Visible Smoke	Visible smoke is unlikely as release is well controlled with computer controlled combustion management system. IPC Limit < Ringelmann 2.	N/A	N/A	N/A	Low	
Boiler House	Air	Sulphur Dioxide	Associated with formation of acid rain. Controlled release below IPC limit of 35mg/m3 (gas) or 850mg/m3 (oil)	1.2	100	120	Low	
Boiler House	Air	Carbon Dioxide	Associated with global warming and acid rain formation.	41,780	0.5	20,500	High	
Boiler House	Air	Carbon Monoxide	Associated with acid rain formation.	4.7	5	23.5	Low	
Boiler House	Air	Dust	Associated with respiratory problems. IPC particulate limit = $5mg/m^3$ (gas), $5.0mg/m^3$ (oil)	0.9	50	45	Low	
Boiler House	Air	Nitrogen Dioxide	Associated with acid rain formation. Close to IPC authorisation limit of 240mg/m3 (gas), 275mg/m3 (gas oil).	49	100	4900	Med	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Boiler House	River	Temperature of blowdown effluent.	Reduced by mixing with other site effluents - contributes towards temperature of site effluent (outfall consent = $30^{0}C$)	$230^{0}C$	N/A	N/A	Low	
Boiler House	River	Flow rate of blowdown effluent	Contributes towards flow rate of site effluent (outfall consent = $11{,}000m^3/day$)	$2m^3/hr$	N/A	N/A	Low	
Boiler House	River	Mercury in blowdown effluent (from boiler treatment chemicals).	Toxic - however effluent analysis indicates levels of < 0.001mg/l which is significantly below IPC limit of 0.02mg/l.	0.002	2000	4	High	High as monitoring is required by IPC authorisation.
Boiler House	River	Cadmium in blowdown effluent (from boiler treatment chemicals)	Toxic, however effluent analysis indicates of < 0.01mg/l which is significantly below limit of 0.05mg/l	0.002	2000	4	High	High as monitoring is required by IPC authorisation.
Boiler House	River	Alkalinity of blowdown effluent (pH ~11)	Contributes to pH of site effluent (Consent = 5-10). Bufferred by site effluent.	No data	N/A	N/A	Med	
Boiler House	River	Suspended solids in blowdown effluent.	Diluted by mixing with other site effluents to within outfall consent of 100mg/l	No data	N/A	N/A	Med	
Boiler House	River	Chloride ions in blowdown effluent.	No particular environmental concerns when discharged to River Estuary.	100	0.2	20	_	
Boiler House	River	Flowrate of cooling water (consisting mainly of towns water) discharged to River via TPS.	Contributes towards flowrate of site effluent (outfall consent = 11,000 m^3/day).	10 m^3/day	N/A	N/A	_	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Boiler House	River	Temperature of cooling water.	Approximately 50^{o}C - contributes towards temperature of site effluent (outfall consent = 30^{o}C) although cooled by other site effluents.	N/A	N/A	N/A	Med	
Boiler House	River	Hg in cooling water from well water.	Toxic, however effluent analysis indicates extremely low levels	0.009	2,000	18	Low	
Boiler House	River	Chloride ions in cooling water from well water.	No particular concerns when discharged into an estuary.	199	0.2	39.8	Low	
Boiler House	River	Potential oil release into cooling water (from turbine oil cooling - damage to heat exchange may cause release of oil)	Potential to cause a breach of outfall consent which requires no visible signs of oil or grease.	N/A	N/A	N/A	Med/High	
Old DMW	River	Mercury in DMW effluent to River (from contaminated caustic soda).	Toxic - however effluent analysis indicates levels of 0.001mg/l significantly below IPC limit of 0.02 mg/l.	0.003	2000	6	High	High as monitoring is required by IPC authorisation.
Old DMW	River	Cadmium in DMW effluent to River (from contaminated caustic soda).	Toxic - however effluent analysis indicates levels of < 0.01mg/l which is significantly below IPC limit of 0.05 mg/l.	0.003	2000	6	High	High as monitoring is required by IPC authorisation.
Old DMW	River	Chlorides ions in DMW effluent to River from well water	Approximately 1149 mg/l - not associated with any particular environmental concerns when released to River Estuary.	No data	N/A	N/A	Low	
Old DMW	River	C.O.D of DMW effluent to River.	Effluent analysis indicates levels of 1mg/l - contributes towards COD in site effluent (outfall consent = 200 mg/l). Associated with de-oxygenation of River Mersey.	No data	N/A	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Old DMW	River	Suspended solids in DMW effluent to River.	Effluent analysis indicates levels of 10mg/l -contributes towards suspended solids in site effluent (outfall consent = 100mg/l).	1.8	36	240	Low	
Old DMW	River	Flowrate of DMW effluent to River	Approximately $20m^3/hr$ - contributes towards flow rate of site effluent (outfall consent = $458m^3/hr$).	$20m^3/hr$	N/A	N/A	Low	
Old DMW	River	Alkalinity	Contributes towards pH of site effluent (outfall consent = 5-10)	N/A	N/A	N/A	High	Relies on buffering capacity of tank, restricted outlet, no pH control.
Old DMW	Waste	Occasional disposal of the DMW plant resins.		N/A	N/A	N/A	Low	Previously resins have left plant from new DMW without transfer notes.
Old DMW	Waste	Brine Wash Effluent	Potential to cause high suspended solids at outfall if disposed of incorrectly to surface drains (formation of $NaCO_3$)	N/A	N/A	N/A	Med/High	Uncontrolled disposal requiring procedures for correct disposal.
Old DMW	Ground	Potential Leaking Effluent Pit	Potential to leak sulphate & sulphuric acid, caustic to drain.	N/A	N/A	N/A	High	Some improvements to drainage implemented Q2 1996.
Boiler House	Resource Usage	Towns Water Usage (Purchased Water).	Depletion in natural resources.	$4,971m^3$	N/A	N/A	_	See Site General
Boiler House	Resource Usage	Demineralised Water Usage	Depletion in natural resources.	$204,078m^3$	N/A	N/A	_	See Site General
Boiler House	Resource Usage	Well Water Usage	Abstraction licence required under the Water Resources Act 1991.	$15,162m^3$	N/A	N/A	_	See Site General

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Boiler House	Resource Usage	Electricity	Associated with global warming, acid rain formation and depletion in natural resources.	1,491MWh	N/A	N/A	–	See Site General
Boiler House	Resource Usage	Gas - piped directly to site by BP energy.	Depletion of natural resources. Flammable (CHIP) - depletion of a naturally occurring resource.	192,599 therms	N/A	N/A	Med	Combustion efficiency needs high degree of control.
Boiler House	Resource Usage	Gas Oil - tanker delivered (used as a standby fuel).	Flammable (CHIP) - depletion of a naturally occurring resource.		N/A	N/A	Low	
Boiler House	Resource Usage	Betz Prekleen 346 - boiler treatment chemical.	Irritant (CHIP)	No data	N/A	N/A	Low	
Boiler House	Resource Usage	Propane - used only as a standby fuel and therefore presumed to be of low quantity.	Flammable (CHIP)	No data	N/A	N/A	Low	
Boiler House	Resource Usage	Boilertek 904 - reacts with the remaining oxygen in the de-aerated water.	Volatile organic oxygen scavenger - irritant to eyes and skin.	4-5	N/A	N/A	Low	
Boiler House	Resource Usage	Boilertek 959 - maintains pH at 8.5 - 9.5.	Non-hazardous	4-5	N/A	N/A	Low	
Boiler House	Resource Usage	Boilertek 970 - Conditioning chemical.	Corrosive to eyes and skin.	4-5	N/A	N/A	Low	
Boiler House	Nuisance	Noise	Plant is located well away from sensitive boundaries and residential properties. General ambient noise levels are considered acceptable. Relief valves have silencers.	N/A	N/A	N/A	Low	No complaints have been received in the past therefore not considered to be significant.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Site General	Air	Air emissions from laboratory fume cupboards.	Release of VOCs, dust, potential odifierous substances.	No data	N/A	N/A	Low	No highly odiferous substances used with potential to cause complaints. Very low level for VOC/dust.
Site General	Air	Air emissions from engineering department and on site workshops.	Dust and welding fumes.	No data	N/A	N/A	Low	
Site General	Air	Use of radiography for detection of cracks etc	Release of radioactivity	N/A	N/A	N/A	Low	Generally accepted use.
Site General	Air	Use & potential release of halons from fire extinguishes.	Strong ozone depletor - manufacture and use to be phased out.	No data	N/A	N/A	Med/High	
Site General	River	Site effluent from cooling water, distillation effluent, persalts effluent, boiler house effluent and surface water drains to River Mersey	COD is associated with de-oxygenation of receiving water courses.	149	140	20860	High	In 1995 one consent breach was identified for pH, three breaches for peroxide.
Site General	Sewer	Domestic effluent released to sewer system eg from toilets, washbasins, kitchens etc.	Requires no discreet discharge consent - NWW charge is based on site head count.	N/A	N/A	N/A	Low	
Site General	River	Laboratory effluent released to River.	Effluent analysis indicates a flow rate of $1m^3/hr$ and COD release of 2.5 te/a	2.5	140	350	Low	
Site General	River	Storm water released to surface drainage system.	Potential to affect flow rate at river outfall (site effluent consent = 11,000 l/day).	N/A	N/A	N/A	Low	
Site General	River	Pickling plant effluent					?	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Site General	River	Potential release of contaminated fire- fighting water to surface drains in emergency situations.	Potential to cause river pollution and breaches of discharge consent	N/A	N/A	N/A	High	
Site General	Waste	Disposal of Laboratory waste solvents.	Removed by contractors and incinerated.	2		0	Low	
Site General	Waste	Disposal of general waste skips.	Removed by UK Waste Ltd and landfilled.	200	8	1600	Low	
Site General	Waste	Disposal of drums (metal and plastic)	Reclaimed	N/A	N/A	N/A	Low	
Site General	Waste	Disposal of pallets	Reclaimed	N/A	N/A	N/A	Low	
Site General	Waste	Disposal of waste oils from engineering work.		Unknown	-	-	Low	
Site General	Waste	Disposal of office waste paper - recycled by SCA	Recycled by SCA	10	27	270	Low	
Site General	Waste	Potential incorrect handling and disposal of waste by contractors.	Tightly controlled by Duty of Care Regs. Can cause degradation of local environment if waste escapes.	N/A	N/A	N/A	Med/High	
Site General	Waste	Waste plastic cups from vending machines in main offices.	Landfilled - associated with leachate and landfill gas production.	~4,000/a	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.
Site General	Waste	Printer toner cartridges	Recycled (Action Aid)	12/month	N/A	N/A	Low	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Site General	All Media	Potential releases during incidents and emergency situations due to lack of containment of process and storage areas across site as a whole.	Potential river pollution, breaches of discharge consents and land contamination.	N/A	N/A	N/A	High	
Site General	All Media	Potential spillages during tanker loading / offloading in general areas.	Potential for accidental releases to surface drains and breaches of discharge consents.	N/A	N/A	N/A	High	
Site General	Resource Usage	Electricity usage in main offices for heating / lighting etc.	Associated with global warming, acid rain formation and reduction in natural resources.	~6000MWh	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.
Site General	Resource Usage	Use of purchased water in technical, engineering and garage.	Associated with depletion in natural resources.	~22,000	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.
Site General	Resource Usage	Use of low pressure steam in offices for heating purposes.	Associated with depletion in natural resources.	~1748MG	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.
Site General	Resource Usage	Natural gas used by engineering department and welfare.	Associated with depletion in natural resources.	~72904	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.
Site General	Resource Usage	Paper usage in offices for printing, photocopying etc	Associated with depletion in natural resources.	1340 reams	N/A	N/A	Med/High	Significant as part of culture change and employee motivation.

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Site General	Resource Usage	Site use of electricity	Associated with global warming, acid rain formation and reduction in natural resources.	44,920 MWh	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of purchased water	Associated with depletion in natural resources.	?	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of DMW		?	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of well water		3,854,400 m^3	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of low pressure steam	Associated with gas usage i.e a natural resource.	132,718	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of intermediate pressure steam	Associated with gas usage i.e a natural resource.	22,873	N/A	N/A	Med/High	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	*TYPE*	*SOURCE*	*CONSEQUENCE*	*Quantity (te/a)*	*Gross Factor*	*Weighted Effect*	*RATING*	*COMMENTS*
Site General	Resource Usage	Site use of high pressure steam	Associated with gas usage i.e a natural resource.	92,982	N/A	N/A	Med/High	
Site General	Resource Usage	Site use of natural gas	Associated with depletion in natural resources.	192,599 therms	N/A	N/A	Med/High	
Site General	Nuisance	Employees transport.	Nuisance to local residents. Contribute towards ground level ozone formation and global warming.	~400/day	N/A	N/A	Med	
Site General	Nuisance	HGV movements	Nuisance to local residents. Complaints have been received in the past.	~500wk	N/A	N/A	High	9 complaints were received regarding HGVs during 1995. (Contributions to annual movements: AO = 25%, Capa 6%, Boiler House = 1%, Persalts = 50%, Peracetic acid = 1.6%)
Site General	Nuisance	Noise from fire alarm testing.	Nuisance to local residents. Complaints have been received in the past.	N/A	N/A	N/A	Low	No complaints received in the past.
Site General	Nuisance	Visual impact of site especially from high chimney and plume of Boiler House.	Nuisance to local residents, impacts on property prices etc.	N/A	N/A	N/A	Low/Med	
Site General	Indirect	Contractors working on site including BP Energy.	Potential accidental releases during incidents and accidents.	N/A	N/A	N/A	Med/High	

APPENDIX 2.5: SOLVAY INTEROX'S EMS - ENVIRONMENTAL EFFECTS REGISTER

AREA	***TYPE***	***SOURCE***	***CONSEQUENCE***	***Quantity (te/a)***	***Gross Factor***	***Weighted Effect***	***RATING***	***COMMENTS***
Site General	Indirect	Suppliers activities during manufacture of raw materials by suppliers.	Effects of producing and processing raw materials eg air releases, discharges to water, waste disposal etc.	N/A	N/A	N/A	–	See Supplier Assessments

APPENDIX 2.6: SOLVAY INTEROX'S EMS - REGISTER OF LEGAL & OTHER REQUIREMENTS

YEAR	*TOPIC*	*ACT / REGULATION*	*NUMBER*	*DUTY / PROHIBITION IMPOSED*	*RELEVANCE TO ACTIVITIES*	*Copy Location*	*Expert Resp.*	*Exec. Resp.*
1990	IPC	Environmental Protection Act 1990 - Part 1.		Set up system of IPC. Prescribed processes must apply for authorisation from either EA or LA. Application must include details of how operator will achieve BATNEEC.	Four of the processes on site are prescribed as requiring authorisation from HMIP. Authorisations have been granted for each of these processes.	Env Group	JMcD	RAH
1991	IPC	Environmental Protection (Applications, Appeals and Registers) Regulations 1991	SI 1991/507	Prescribe details to be included in authorisation applications for IPC and information to be kept in EA registers	Relevant for new or modified processes prescribed under IPC.	Env Group	JMcD	RAH
1996	IPC	Environmental Protection (Applications, Appeals and Registers) (Amendment) Regs 1996	SI 1996/667	Amends above Regulations	Relevant for information purposes.	Env Group	JMcD	RAH
1997	IPC	Environmental Protection (Applications, Appeals and Registers) (Amendment No 2) Regs 1996	SI 1996/979	Amends above Regulations	Relevant for information purposes.	Env Group	JMcD	RAH
1991	IPC	Environmental Protection (Authorisation of Processes) (Determination Periods) Order 1991(SI 1991/513)	SI 1991/513	This order varies the period available to EA or LAs to consider applications.	This procedure is relevant to those processes requiring IPC authorisations.	Env Group	JMcD	RAH
1991	IPC	Environmental Protection (Prescribed Processes and Substances) Regulations 1991- Schedule 1.	SI 1991/472	Schedule 1 of the Regulations list the processes which require authorisation under the EPA and the timetable for authorisation for all processes.	Chapter 4 section 4.2 specifies that the manufacture of caprolactone, hydrogen peroxide and peracetic acid as Part A processes. Chapter 1 section 1.1 specifies the operation of the boiler house as a Part A process.	Env Group	JMcD	RAH

APPENDIX 2.6: SOLVAY INTEROX'S EMS - REGISTER OF LEGAL & OTHER REQUIREMENTS

YEAR	*TOPIC*	*ACT / REGULATION*	*NUMBER*	*DUTY / PROHIBITION IMPOSED*	*RELEVANCE TO ACTIVITIES*	*Copy Location*	*Expert Resp.*	*Exec. Resp.*
1991	IPC	Environmental Protection (Prescribed Processes and Substances) Regulations 1991 - Schedule 2	SI 1991/472	Schedule 2 of the Regulations contains the rules for the interpretation of Schedule 1. The CIA guidance states that to classify as a "single process" one stream must feed directly into the other and there must not be side activities.	AO and PAA can be classed as a single process requiring one authorisation. Whereas Capa and the Boiler House require separate authorisations.	Env Group	JMcD	RAH
1991	IPC	Environmental Protection (Amendment of Regulations) Regulations 1991	SI 1991/836	Amend schedule 3 of the regulations concerned with dates of applications	Relevant for information purposes.	Env Group	JMcD	RAH
1992	IPC	Environmental Protection (Prescribed Processes and Substances) (Ammendment) Regulations 1992	SI 1992/614	Amendment of relevance relate to the burning of any fuel in two or more boilers or furnaces.	The amendment prescribes that the two burners on persalts do not have to be included in the IPC application for the Boiler House because they are less than 3MW each.	Env Group	JMcD	RAH
1993	IPC	Environmental Protection (Prescribed Processes and Substances) (Ammendment) Regulations 1993	SI 1993/1749	These Regulations amend the 1991 Regs to extend from 31st July 1993 to 31st October 1993 the dates of applications.	Relevant for information purposes.	Env Group	JMcD	RAH
1994	IPC	Environmental Protection (Prescribed Processes and Substances Etc)(Amendment) Regs 1994.	SI 1994/1271	The amendment removes some processes from control under Part 1 of the EPA.	The amendment does not affect the processes on site controlled under Part 1 of the Act.	Env Group	JMcD	RAH
1994	IPC	Environmental Protection (Prescribed Processes and Substances Etc)(Amendment)(No2) Regulations 1994	SI 1994/1329	These Regulations amend the 1994 Regs (SI 1994/1271) to make provision as to the date after which an authorisation is required for those processes which are affected by the 1994 Regs.	The amendment does not directly affect the processes on site.	Env Group (IPC File)	JMcD	RAH

APPENDIX 2.6: SOLVAY INTEROX'S EMS - REGISTER OF LEGAL & OTHER REQUIREMENTS

YEAR	*TOPIC*	*ACT / REGULATION*	*NUMBER*	*DUTY / PROHIBITION IMPOSED*	*RELEVANCE TO ACTIVITIES*	*Copy Location*	*Expert Resp.*	*Exec. Resp.*
1995	IPC	Environmental Protection (Prescribed Processes and Substances Etc)(Amendment) Regulations 1995	1995/3247		Relevant for information purposes.	Env Group	JMcD	RAH
1995	IPC	The Environmental Protection (Prescribed Processes and Substances) Regulations - A Consolidated Version (as at Ist December 1994)		This document consolidates the regulations.	Relevant for information purposes.	Env Group	JMcD	RAH
1994	IPC	Authorisation for the Manufacture of PAA and Hydrogen Peroxide	AK 7817	The authorisation specifies authorised release points, sets limits on the mercury content and flow rate of DMW effluent, details returns and notifications to be made to HMIP and contains an improvement programme.	Authorisation specifies discharge limits, reporting requirements and an improvement programme.	Env Group	JMcD	RAH
1994	IPC	Authorisation for the Operation of Gas/Oil Fired Combustion	AL 4872	The authorisation specifies authorised release points, sets limits on release of particulates, sulphur dioxide, oxides of nitrogen and cadmium and mercury to River. The authorisation also contains an improvement programme and specifies returns required.	Authorisation specifies discharge limits, reporting requirements and an improvement programme.	Env Group	JMcD	RAH
1994	IPC	Authorisation for the Manufacture of Caprolactone	AK 7809	The authorisation specifies authorised release points, details returns and notifications to be made to HMIP and contains an improvement programme.	Authorisation specifies discharge limits, reporting requirements and an improvement programme.	Env Group	JMcD	RAH
1958	Air	Dark Smoke (Permitted Periods) Regulations 1958	SI 1958/498	These regulations set out the permitted periods for emissions of dark smoke from a chimney.	Each persalts burner is permitted to emit dark smoke for 10 mins in any period of eight hours. This does not apply to the Boiler House which is controlled under IPC.	Env Group	JMcD	RAH

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YEAR	*TOPIC*	*ACT / REGULATION*	*NUMBER*	*DUTY / PROHIBITION IMPOSED*	*RELEVANCE TO ACTIVITIES*	*Copy Location*	*Expert Resp.*	*Exec. Resp.*
1969	Air	Clean Air (Emission of Dark Smoke) (Exemption) Regulations 1969	SI 1969/1263	These Regulations exempt the burning of certain matter from the prohibition of dark smoke emission from industrial premises.	Matter burnt for fire research or for training of fire fighters are exempt from the prohibition of dark smoke emission.	Env Group	JMcD	RAH
1969	Air	Clean Air (Height of Chimneys) (Exemption) Regulations 1969	SI 1969/46	These Regulations exempt certain boilers or plants from having to apply for chimney height approval.	The persalts burners are not exempt and therefore require chimney height approval from the local authority. (Check if we have such approval).	Env Group	JMcD	RAH
1984	Air	Council Directive of 28 June 1984 on the Combating of Air Pollution from Industrial Plants	SI 84/360/EEC		Relevant for information purposes.	Env Group	J.McD	RAH
1987	Air	Control of Asbestos at Work Regulations 1987	SI 1987/2115	These regulations control occupational exposure to asbestos.	These regulations would be applicable during the demolition of certain buildings on site containing asbestos.	Env Group	JMcD	LF
1989	Air	Air Quality Standards Regulations 1989	SI 1989/317	These Regulations implement EEC Directives setting air quality limit values and guide values for SO_2 and suspended particulates, a limit value for lead in air and air quality standards for NO_2.	Relevant for information purposes - needed for dispersion modelling uses etc.	Env Group	J.McD	RAH
1990	Air	Environmental Protection Act 1990		Part III of the EPA makes it an offence to create a statutory nuisance, e.g smoke, fumes, dust, odour or noise - the LA can serve an abatement notice.	Relevant for information purposes.	Env Group	JMcD	RAH
1993	Air	The Clean Air Act 1993 Part 1: Prohibition of Dark Smoke from Chimneys.	N/A	Part 1 of the Act prohibits the emission of dark smoke from chimneys and industrial premises. It does not apply to processes controlled by Part 1 of the Environmental Protection Act 1990.	Not relevant to the Boiler House which is controlled by Part 1 Environmental Protection Act 1990. However the release from the persalts burners and any other emission of dark smoke will come under this Act.	Env Group	J.McD	RAH

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1993	Air	The Clean Air Act 1993 Part 2: Smoke, Grit , Dust and Fumes from furnaces.	N/A	Part 2 of the Act requires that the local authority must be informed before installing a furnace in a building. The furnace must be capable of being operated continuously without emitting smoke when burning the designed fuel.	The persalts burners require approval from the local authority planning department. Not relevant to the Boiler House which is controlled by Part 1 Environmental Protection Act 1990.	Env Group	J.McD	RAH
1976	Water	Control of Pollution (Discharges into Sewers) Regs 1976	SI 1976/958	These regulations relate to appeals to a water authority which cancels a deemed consent. They also allow a consent to be transferred from one drain to another if the water authority closes one drain and provides an alternative.	These regulations would be relevant to the company's activities should NWW cancel a deemed consent or close a drain.	Env Group	JMcD	RAH
1989	Water	The Surface Waters (Dangerous Substances) (Classification) Regulations 1989	SI 1989/2286	These regulations prescribe parameters for classifying waters for setting water quality objectives. The waters are classified according to the concentrations of the prescribed dangerous substances present.	These regulations are relevant for information purposes as the classification of the River Mersey will affect consent limits of effluent.	Env Group	JMcD	RAH
1991	Water	Water Industry Act 1991		This Act covers water services and supply and requires that a consent must be obtained from the relevant water undertaker in order to discharge trade effluent into public sewers.	The AO effluent and Capa effluent to public sewer both require a consent from North West Water plc. These include consent limits for certain parameters (see individual consents).	Env Group	JMcD	RAH
1991	Water	Water Resources Act 1991		This Act covers the protection of water against pollution. It is an offence to discharge trade effluent, other polluting material of solid waste into controlled water unless a discharge consent has been obtained from the NRA.	The site effluent to the River Mersey requires consent from the NRA .	Env Group	JMcD	RAH
1991	Water	Environmental Protection (Prescribed Processes and Substances) Regulations 1991 (SI 1991/472)	SI 1991/472	These regulations prescribe processes subject to IPC and list substances which are prescribed for release to water.	The prescribed substances, mercury and cadmium, are released to controlled water in extremely small quantities from the site.	Env Group	JMcD	RAH

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1992	Water	The Surface Waters (Dangerous Substances) (Classification) Regulations 1992	SI 1992/337	These regulations set criteria for classifying relevant waters to comply with EC Directive 86/280/EEC.	The regulations are relevant for information purposes in that the organisation needs to be aware of the River Mersey's classification.	Env Group	JMcD	RAH
1994	Water	Surface Waters (River Eco-system) (Classification) Regulations 1994	SI 1994/1057	These regulations set parameters for classification of relevant rivers and watercourses for establishing water quality objectives.	These regulations are relevant for information purposes as water quality objectives may affect consent limits for site effluent.	Env Group	JMcD	RAH
1994	Water	The Urban Waste Water Treatment (England and Wales) Regulations 1994		These regulations implement the EC Directive (91/271/EEC) which lays down minimum requirements for the treatment of municipal waste water and for the disposal of sludge.	These regulations are relevant for information purposes as future consents will be based on these requirements.	Env Group	JMcD	RAH
1995	Water	NWW Consent for Site Discharge to River Mersey (28/2/95)(016990683)	N/A	Consent sets limits for chemical oxygen demand, hydrogen peroxide, suspended solids, pH, temperature, visible oils and grease and volume.	Relevant for information purposes.	Env Group	JMcD	RAH
1996	Water	NRA Notice of Variation of Consent to River (31/7//96)(016990683)	N/A	This consent authorises that the site effluent outfall to the Mersey be located at National Grid Reference SJ 5987 8652 until 31 May 1996.	Relevant for information purposes.	Env Group	JMcD	RAH
1976	Water	NWW Consent for Caprolactone Discharge to Sewer (1/8/76)	N/A	Consent sets limits for pH, separable grease & oil, temperature, sulphates, toxic metals and volume as well as for other specific parameters.	Relevant for information purposes.	Env Group	JMcD	RAH

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1986	Water	NWW Consent for AO Discharge to Sewer (26/3/86)	N/A	Consent sets limits for pH, separable grease & oil, temperature, volume, sulphates and toxic metals	Relevant for information purposes.	Env Group	JMcD	RAH
1974	Waste	Control of Pollution Act 1974	N/A	This Act introduced a site licensing system requiring all controlled waste to be disposed of only at licensed sites.	The majority of provisions relating to waste under this Act has been replaced by the Environmental Protection Act 1990. The registration of vehicles, however, is still under this act.	Env Group	JMcD	RAH
1975	Waste	Council Directive of 15 July 1975 on Waste	75/442/EEC	This framework Directive established general rules for waste management. It is being implemented by Part II of the Environmental Protection Act 1990.	Relevant for information purposes.	Env Group	JMcD	RAH
1988	Waste	Collection and Disposal of Waste Regulations 1988	SI 1988/819	These regulations clarify the definition of controlled waste and the cases for which a licence under COPA '74 is required. Waste which is not "Directive Waste" shall not be treated as controlled waste.	These regulations are being replaced by Part II of the EPA 1990, however "controlled waste" is still a legal term.	Env Group	JMcD	RAH
1989	Waste	Control of Pollution (Amendment) Act 1989	N/A	It is an offence under this Act to transport controlled waste unless the carrier is registered with the waste regulation authority.	All contractors used by the company to transport waste from the site require registration with the waste regulation authority.	Env Group	JMcD	RAH
1990	Waste	Environmental Protection Act 1990. Part II.	N/A	Part II of the Act introduces a Waste Management Licensing Scheme (s.33) and places a Duty of Care on anyone who handles controlled waste (s.34).	The company must a) prevent the illegal disposal, treatment and storage of its waste b) prevent the escape of waste c) transfer waste only to an authorised person d) provide a written description of their waste.	Env Group	JMcD	RAH

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1991	Waste	Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991	SI 1991/16	These regulations set out the details for the registration of waste carriers. The regulations list a number of exemptions e.g where the producer transports its own waste to a disposal site (exempt building or demolition waste)	All contractors must have waste carrier registrations.	Env Group	JMcD	RAH
1991	Waste	Council Directive of 18 March 1991 amending Directive 75/442/EEC on Waste		This Directive identifies 16 specific categories of waste. Member states are required to establish competent authorities to be responsible for issuing authorisations and waste management licences.	Many of the Directive's requirements either have, or are being implemented through Part II of the Environmental Protection Act 1990. Waste Regulation Authorities are responsible for waste management licences	Env Group	JMcD	RAH
1991	Waste	Environmental Protection (Duty of Care) Regulations 1991	SI 1991/2839	These regulations set up a system of transfer notes and record keeping under s.34 of the 1990 Act. Both the producer and receiver of waste must complete and sign a transfer note. A written description and the transfer note must be kept for two years.	Transfer notes and a written description of the waste must be kept for at least 2 years.	Env Group	JMcD	RAH
1992	Waste	Controlled Waste Regulations 1992	SI 1992/588	These regulations give a detailed definition of controlled waste, classifying the differences between household, commercial and industrial waste. The definition of controlled waste is amended in the Waste Management Licensing Regulations 1994.	Relevant for information purposes.	Env Group	JMcD	RAH
1993	Waste	Regulation on the Supervision and Control of Shipments of Waste within, into and out of the EC.	EEC 259/93	Establishes a system whereby the competent authority must be notified of despatch, transit and destination of shipments of waste.	Although the company does not ship waste into or out of the EC as a matter of routine. These regulations would be relevant should any waste ever be transported to Brussels or any other EC country.	Env Group	JMcD	RAH

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1994	Waste	Transfrontier Shipment of Waste Regulations 1994	SI 1994/1137	These regulations assist in the implementation of EC Regulation (EC 259/93) on the supervision and control of shipments of waste into, out of and through the EC.	Although the company does not ship waste into or out of the EC as a matter of routine. These regulations would be relevant should any waste ever be transported to Brussels or any other EC country.	Env Group	JMcD	RAH
1994	Waste	Waste Management Licensing Regulations 1994	SI 1994/1056	These regulations implement the waste management licencing scheme introduced by Part II of the EPA and replace s. 3-11 of COPA '74. It is an offence to dispose of, treat or store controlled waste without a waste management licence.	The Warrington site does not require a waste management licence as the majority of processes require authorisation under other legislation (other processes produce quantities below the threshold for requiring a licence).	Env Group	JMcD	RAH
1995	Waste	Waste Management Licensing (Amendment etc) Regs 1995	SI 1994/288	The main amendment is the provision of exemptions for scrap metal recovery.	Relevant for information purposes.	Env Group	JMcD	RAH
1995	Waste	Waste Management Licensing (Amendment No 2) Regulations 1995.	SI 1995/1950	These regulations extend the transitional period of waste treatment plants to apply for a licence and, where necessary, a certificate of technical competence.	Relevant for information purposes.	Env Group	JMcD	RAH
1996	Waste	Waste Management Licensing (Amendment) Regulations 1996.	SI 1996/1279	Amends the above regulations	Relevant for information purposes.	Env Group	JMcD	RAH
1996	Waste	The Landfill Tax (Contaminated Land) Order 1996	SI 1996/1529	Set out the provisions for exempting waste from clearing historically contaminated land.	Relevant for contaminated soil removed from site from ground decontamination.	Env Group	JMcD	RAH
1996	Waste	The Landfill Tax (Qualifying Material) Order 1996	SI 1996/1528	Define the categories of waste to which a lower rate of tax will apply.	Specifies which of the site's waste will qualify for the lower tax rate.	Env Group	JMcD	RAH

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1996	Waste	Special Waste Regulations 1996	SI 1996/972	Replace control of Pollution (Special Waste) Regs 1996 on consignment notes for disposal of special waste. Contains a revised definition of special waste and consignment note procedure.	Consignment notes must be pre-notified to the Waste Regulation Authority where the waste is being sent.	Env Group	JMcD	RAH
1996	Waste	Special Waste (Amendment) Regulations 1996	SI 1996/2019	Amend the above regulations	Relevant for information purposes.	Ordered	JMcD	RAH
1996	Waste	The Landfill Tax Regulations 1996	SI 1996/1527	Cover aspects of the implementation of the landfill tax such as: registration procedures; credits; accounting; and the environmental trusts provisions.	Relevant for information purposes.	Env Group	JMcD	RAH
1996	Waste	Waste Management Regulations 1996	SI 1996/634	Make miscellaneous changes to Waste Management Licensing Regulations and the Environmental Protection (Waste Recycling Payments) Regulations.	Relevant for information purposes.	Env Group	JMcD	RAH
1974	Nuisance	Control of Pollution Act 1974	N/A	Several provisions on noise still remain in force including the powers of LA's in designating noise abatement zones, serving noise reduction orders and noise level registers.	The majority of provisions have been replaced by the Environmental Protection Act 1990. However some relevant provisions still remain including some regarding noise from construction sites and from plants and machinery.	Env Group	JMcD	RAH

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1974	Nuisance	Health & Safety at Work, etc Act 1974 s. 2		All employers must ensure, so far as is reasonably practicable, the health, safety and welfare of their employees and other people who are likely to be affected by their work activities.	These requirements include the protection against exposure to excessive noise.	Safety Services Dept.	G. Oliver	RAH
1975	Nuisance	Control of Noise (Appeals) Regulations 1975	SI 1983/1455	These regulations relate to appeals against a noise abatement notice served under the provisions of COPA '74 which remain in force.	These regulations may be relevant should the local authority serve a noise abatement notice under COPA '74.	Env Group	JMcD	RAH
1976	Nuisance	Control of Noise (Measurement and Registers) Regulations 1976	SI 1976/37	These regulations prescribe the methods by which noise levels from classified premises must be measured and the particulars of noise level registers which must be kept be LA's.	Relevant for information purposes.	Env Group	JMcD	RAH
1981	Nuisance	Control of Noise (Code of Practice on Noise from Audible Intruder Alarms) Order 1981 & 1987.	SI 1981/1829	This Order approves the DoE Code of Practice on noise from audible intruder alarms.	The Order may be relevant to the alarms on site.	Env Group	JMcD	RAH
1989	Nuisance	Noise at Work Regulations 1989	SI 1989/1790	Employers must assess, and protect employees against, the risks of noise at work. Action must be taken at or above certain limits. Ear protection zones have to be marked and manufacturers of plant and machinery must provide information on noise levels.	Ear protection zones must be marked on site. Risk assessment must include assessing the risk posed from noise.	Env Group	JMcD	RAH
1990	Nuisance	Environmental Protection Act 1990 s.79		Under s.79 of the Act any noise or vibration at or from any premises which is prejudicial to health or a nuisance, may be a statutory nuisance. If this occurs LA's have the power to serve an abatement notice .	The Local Authority has the power to serve an abatement notice should any noise from the site cause a nuisance. Failure to comply with an abatement notice is an offence.	Env Group	JMcD	RAH

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1990	Nuisance	Environmental Protection Act 1990 s.82		Under s.82 of the Act individuals aggrieved by a statutory nuisance can apply to a magistrates' court.	Local residents are within their rights to apply to the magistrate's court to make an order requiring the company to abate a nuisance.	Env Group	JMcD	RAH
1990	Nuisance	Town and Country Planning Act 1990		Noise from new developments can be controlled by local planning authorities granting planning permission subject to a condition imposing noise controls.	This would be relevant to any new developments.	Env Group	JMcD	RAH
1990	Nuisance	Statutory Nuisance (Appeals) Regulations 1990	SI 1990/2276	These regulations provide for appeals to magistrates' courts against a statutory nuisance abatement notice served under the EPA 1990.	Should an abatement notice be served on the company then these regulations would be relevant as they would describe the grounds for appeals.	Env Group	JMcD	RAH
1990	Nuisance	Statutory Nuisance (Appeals) (Amendement) Regulations 1990	SI 1990/2483	Ammend the 1990 Regs (SI 1990/2276)	Relevant for information purposes.	Env Group	JMcD	RAH
1992	Nuisance	Control of Noise (Codes of Practice for Construction and Open Sites) Orders 1984	SI 1984/1992	These orders approve Codes of Practice drawn up by the British Standards Institution on control of noise from construction and open sites.	May be relevant to any construction work carried out on plant.	Env Group	JMcD	RAH
1992	Nuisance	Construction Plant and Equipment (Harmonisation of Noise Emissions Standards) Regulations 1985 and 1988 (Amended 1989 & 1992) . Amended 1989 and 1992		Made under the European Communities Act 1972 to implement an EC Directive on the determination of noise emission of construction plants. They forbid the marketing of construction plant or equipment which does not meet the standards laid down by the EC.	May be relevant to any construction work carried out on plant.	Env Group	JMcD	RAH
1993	Nuisance	Noise and Statutory Nuisance Act 1993		These Act makes provisions for noise in the street, intruder alarms and recovery of expenses incurred by local authorities in abating a statutory nuisance. LA must be notified within 48 hours of installation of an alarm.	The provisions relating to intruder alarms may be relevant to alarms on site.	Env Group	J McD	RAH

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1995	Nuisance	Statutory Nuisance (Appeals) Regulations 1995	SI 1995/2644	Provide for appeals to Magistrates' Courts against a statutory nuisance abatement notice served under EPA 1990.	May be relevant if an abatement notice was served on the Company.	Env Group	J McD	RAH
1974	Hazardous Substances	Health & Safety at Work, etc Act 1974 s.2		Under Section 2 of the Act, all employers must ensure, so far as is reasonably practicable, the health, safety and welfare of their employees and others likely to be affected. This includes protection against exposure to hazardous substances.	Exposure to hazardous substances is carried out as part of the risk assessments. (see Control of Substances Hazardous to Health Regs)	Safety Services Dept.	G. Oliver	RAH
1986	Hazardous Substances	Radioactive Substances (Substances of Low Activity) Exemption Order 1986	SI 1986/1002	This order exempts the need for a) certain radioactive solids of 0.4 bq or less from the requirement to be registered b) certain waste of low radioactive activity from the requirement to be authorised.	Relevant for information purposes.	Env Group	JMcD	RAH
1990	Hazardous Substances	Environmental Protection Act 1990 s. 140		Section 140 of the Act gives the Secretary of State the power to make regulations to restrict the importation, supply, use or storage of injurious substances and articles.	Relevant for information purposes.	Env Group	JMcD	RAH
1990	Hazardous Substances	Dangerous Substances (Notification and Marking of Sites) Regulations 1990	SI 1990/304	These regulations require that where 25 tonnes or more of dangerous substances are stored on site, the fire authority and the HSE or LA must be notified. Warning signs must be displayed on site in order to warn fire fighters.	Over 25 tonnes of dangerous substances are stored on site. The appropriate authorities have been informed notified and yellow warning signs are displayed on site.	Hazards Group	M. Wass J.McD	RAH
1990	Hazardous Substances	Planning (Hazardous Substances) Act 1990		This Act requires that hazardous substances consent must be obtained from the local authority if certain substances are stored on site in, or above, the specified quantities.	The Planning (Hazardous Substances) Regs 1992 state the types of substances and quantities for which a consent is required.	Hazards Group	M. Wass	RAH

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1991	Hazardous Substances	Council Directive of 18 March 1991 on batteries and accumulators containing certain dangerous substances	91/157/EEC	Specify the correct disposal routes.	Relevant for information purposes.	Env Group	J McD	RAH
1992	Hazardous Substances	Notification of Cooling Towers and Evaporative Condensers Regulations 1992	SI 1992/2225	These regulations require anyone who has control of premises where a wet cooling tower or an evaporative condenser is installed, to notify the local environmental health department.	These regulations apply to the Warrington site and therefore the local environmental health department has been notified.	Env Group	J.McD	RAH
1992	Hazardous Substances	Road Traffic (Carriage of Dangerous Substances in Packages, etc) Regulations 1992	SI 1992/742	These regulations apply to the carriage of dangerous substances by road in the UK. The regulations cover the provision of hazard information to drivers and road operators, the marking of vehicles and roadside provision of information to officers.	These regulations apply to the transport of Solvay Interox's products which are contracted to Tank Freight Ltd.	Commercial Dept.	K. Izzard	RAH
1992	Hazardous Substances	Road Traffic (Carriage of Dangerous Substances in Road Tankers and Tank Containers) Regulations 1992	SI 1992/743	These regulations cover the design, construction, marking and operation of roadtankers and tank containers carrying dangerous substances.	These regulations apply to Tank Freight Ltd.	Commercial Dept.	K. Izzard	RAH
1992	Hazardous Substances	Road Traffic (Training of Drivers of Vehicles Carrying Dangerous Goods) Regulations 1992	SI 1992/744	These regulations require drivers of vehicles carrying dangerous substances to hold a certificate of training from an approved course.	These regulations are relevant to the employees of Tank Freight Ltd.	Commercial Dept.	K. Izzard	RAH
1993	Hazardous Substances	Chemical (Hazard Information and Packaging) Regulations 1993	SI 1993/1746	These regulations specify that substances which are dangerous for supply must be classified. Such labels must give relevant risk and safety phrases and safety data sheets which contain specified information must be supplied with the product.	Substances must be labelled correctly before leaving the site and safety data sheets must be provided with products.	Commercial Dept.	K. Izzard	RAH

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1993	Hazardous Substances	Radioactive Substances Act 1993		This Act regulates the keeping and use of radioactive substances and accumulation and disposal of radioactive waste. Anyone intending to keep or use radioactive materials must obtain a certificate of registration.	Relevant for information purposes.	Env Group	JMcD	RAH
1994	Hazardous Substances	Council Regulation (EC) on Control of Ozone Depleting Substances.	3093/94	This regulation implements the Montreal Protocol and sets phase out dates for the manufacture of a number of ozone depleting substances. The regulation also imposes controls on the use of HCFC's.	Arcton HCFC 22 Hydro Fluoro Chloro Gas is used in the refrigeration units on the Caprolactone Plant.	Env Group	J.McD	RAH
1996	Hazardous Substances	The Environmental Protection (Controls on Substances that Deplete the Ozone Layer) Regulations 1996.	SI 1996/506	Specify which substances are to be phased out of manufacture.	Relevant for information purposes and use of refrigerants on site.	Env Group	J. McD	RAH
1994	Hazardous Substances	Control of Industrial Major Accident Hazards Regulations 1984. Amended 1988, 1990 and 1994 (CIMAH)	SI 1984/1746	These apply to installations where certain quantities of specified substances are or where certain activities involving dangerous substances are carried out.	The CIMAH Regulations apply to the Warrington Site. A written report has been submitted to the HSE, an up-to-date on-site & off-site emergency plan is kept and local residents have been provided with the appropriate information.	Hazards Group	M. Wass	RAH
1994	Hazardous Substances	The Carriage of Dangerous Goods by Road and Rail (Classification, Packaging and Labelling) Regulations 1994.	SI 1994/669	Specify the arrangement for classifying, packaging and labelling of dangerous goods for carriage by road and rail.	Relevant for the transport of products and wastes by road.	Env Group	J McD /KI	RAH
1994	Hazardous Substances	Control of Substances Hazardous to Health Regulations 1994 (COSHH)	SI 1988/1657	These regulations require employers to control the exposure of employers, and anyone else likely to be affected, to substances hazardous to health.	Assessments are carried out to prevent, minimise or protect exposure to dangerous substances. See COSHH Procedures & Guidelines.	Env Group	J. McD	RAH

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1988	Planning	Town and Country Planning (Assessment of Environmental Effects) Regulations 1988	SI 1988/1199	These regulations require an environmental assessment to be undertaken in respect of certain new developments. The regulations specify two categories of development where the developer must meet the requirements before planning consent can be granted.	These regulations could be relevant for new developments.	Env Group	J. McD	RAH
1994	Planning	Town and Country Planning (Assessment of Environmental Effects) (Amendment) 1990 (SI 1990/367), 1992 (SI 1992/1494), 1994	(SI 1994/677).	These regulations amend the 1988 Regs.	Could be relevant for new developments.	Env Group	JMcD	RAH
1990	Planning	Town and Country Planning Act 1990		This Act was designed to regulate and control the use and development of land.	Relevant for information purposes.	Env Group	JMcD	RAH
1995	Planning	The Town and Country Planning (General Development Procedure) Order 1995	SI 1995/419	This Order specifies the procedures connected with planning applications, appeals to the Secretary of State. It also deals with the maintenance of registers of planning applications.	Could be relevant for new developments.	Env Group	JMcD	RAH
1995	Planning	The Town and Country Planning (Environmental Assessment and Permitted Development) Regs 1995	SI 1995/417	These regulations enable the Secretary of State to be called in to decide whether a development is Schedule 1 or Schedule 2 under the Environmental Assessment Regs.	Could be relevant for new developments.	Env Group	JMcD	RAH
1995	Planning	The Town and Country Planning (General Permitted Development) Order 1995	SI 1995/418	This Order grants planning permission for certain classes of development without any requirement for an application.	Could be relevant for new developments.	Env Group	JMcD	RAH

APPENDIX 2.6: SOLVAY INTEROX'S EMS - REGISTER OF LEGAL & OTHER REQUIREMENTS

YEAR	*TOPIC*	*ACT / REGULATION*	*NUMBER*	*DUTY / PROHIBITION IMPOSED*	*RELEVANCE TO ACTIVITIES*	*Copy Location*	*Expert Resp.*	*Exec. Resp.*
1993	General	EC Eco-management and Audit Scheme Regulation	No 1836/93	Sets out the requirements for the voluntary adoption of an environmental management system.	Relevant for information purposes.	Env Group	JMcD	RAH
1992	General	Environmental Information Regulations 1992	SI 1992/3240	These Regulations require public authorities which have responsibility for the environment to make available, on request, any information they hold relating to the environment.	Relevant for information purposes.	Env Group	JMcD	RAH
1988	General	Environment and Safety Information Act 1988		This Act covers maintenance and access to registers kept by public authorities.	Relevant for information purposes.	Env Group	JMcD	RAH
1968	General	Trade Descriptions Act 1968		This Act indirectly applies to the environment in that the environment is commonly used as a marketing tool. The Act makes it an offence for anyone to falsely describe goods.	Relevant to the marketing of the sites products.	Commercial Dept.		RAH
1974	General	Health & Safety at Work Act 1974		Section 2 and 3 of this Act place a general duty on employers to ensure the safety of employees and any others who may be affected by the activities of those at work.	Employers must keep up to date with legislation, best current practice in their industry and effective management techniques.	Safety Services Dept.	G. Oliver	RAH
1992	General	Management of Health and Safety at Work Regulations 1992		These regulations require employers to carry out systematic assessment for all risks to the health and safety of employees and others.	Employers must identify the preventative and protective measures necessary to control the risks.	Env Group	G. Oliver	RAH
1992	General	Workplace (Health, Safety and Welfare) Regulations 1992		These regulations make general requirements about the working environment provided by employers.	Relevant for information purposes.	Env Group	G. Oliver	RAH

APPENDIX 2.6: SOLVAY INTEROX'S EMS - REGISTER OF LEGAL & OTHER REQUIREMENTS

YEAR	TOPIC	ACT / REGULATION	NUMBER	DUTY / PROHIBITION IMPOSED	RELEVANCE TO ACTIVITIES	Copy Location	Expert Resp.	Exec. Resp.
1995	General	Environmental Act 1995		Introduces a national strategy air quality strategy and a national waste strategy.	Relevant for information purposes.	Env Group	JMD	RAH

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
AO	Sewer effluent to sewer pH consent compliance (ex daily spot sample)	90% in 1996 (100% in 97)	J.Massey	77%			
AO	Sewer effluent to sewer flow consent compliance (ex flow records)	99% in 1996 (100 % in 97)	J.Massey				
AO	VOC to air ex carbon beds IPC limit compliance (ex monthly sample)	90% (95% in 97)	J.Massey	76%			
AO	VOC to air ex carbon beds average conc (ex monthly samples)	< 60 mg/l in 1996 < 60 mg/l in 1997	J.Massey	86mg/l			
AO	VOC to air ex carbon beds tonnes released expressed as toluene (ex monthly sample)	< 10 te in 1996 < 10te in 97	J.Massey	14.1			
AO	IPC Notifications to HMIP	<3 in 96 (O in 97)	J.Massey	0			
AO	Environmental complaints related to plant operation	O in 96	J.Massey	0			
AO	Environmental incident severity rating reduction		J.Massey	62% Major			
AO	IPC operator performance rating by HMIP inspections	80% minimum in 96 80% minimum in 97	J.Massey	79%			
AO	Environmental auditing non compliance clear up rate		J.Massey				
AO	Sensitive hour raw material & waste HGV movements	No unjustifiable moves (see specific targets)	J.Massey	No data			
AO	River effluent consent non-compliance attributable to AO	O following 2^0 containment installation.	J.Massey				
AO	Sextate to sewer (kg/te 100% H_2O_2 produced)	To be set in future pending monitoring improvements	J Massey	N/A			

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
AO	COD to sewer (kg/te 100% H_2O_2 produced)	To be set in future pending monitoring improvements	J Massey	N/A			
AO	Waste disposal "Duty of Care" infringements	0	J Massey				
CAPA	Sewer effluent to sewer pH consent compliance (ex NWW samples)	100% in 96	I.McIntyre				
CAPA	Sewer effluent to sewer Flow consent compliance (ex flow records)	100% following reconsent	I.McIntyre				
CAPA	IPC Notifications to HMIP	2 in 96 (0 in 97)	I.McIntyre	1			
CAPA	Environmental complaints related to plant operation	0	I.McIntyre				
CAPA	Environmental incident severity rating reduction		I.McIntyre	14% Major			
CAPA	Environmental incident corrective action completion	95% completion rate	I.McIntyre				
CAPA	IPC Operator Performance rating by HMIP inspections	80% minimum	I.McIntyre				
CAPA	Environmental auditing non compliance clear up rate	N.A in 96 Target for 97	I.McIntyre				
CAPA	Sensitive hour raw material & waste HGV movements	No unjustifiable moves	I.McIntyre				

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
CAPA	River effluent consent non-compliance attributable to Capa	0	I.McIntyre				
CAPA	COD to sewer (Kg/te monomer produced)	To be set in future pending monitoring improvements	I.McIntyre				
CAPA	Residues for disposal (kg/te monomer produced)	To be determined	I.McIntyre				
CAPA	Waste disposal "Duty of Care" infringements	0	I.McIntyre				
PERSALTS	Sewer effluent pH consent compliance (ex NWW samples?)	100% following sewer connection	D.Mitchell				
PERSALTS	Sewer effluent flow consent compliance (ex flow records)	100% following sewer connection	D.Mitchell				
PERSALTS	Environmental complaints related to plant operation	< 4 in 96 (O in 97)	D.Mitchell				
PERSALTS	Environmental incident severity rating reduction		D.Mitchell	67% Major			
PERSALTS	Environmental incident corrective action completion	To be determined	D.Mitchell				
PERSALTS	Environmental auditing non compliance clear up rate	To be determined	D.Mitchell				
PERSALTS	Sensitive hour raw material & waste HGV movements	No unjustifiable moves	D.Mitchell				

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
PERSALTS	River effluent consent non-compliance attributable		D.Mitchell				
PERSALTS	Tincal sludge skips weight greater than 13 tonnes	80%	D.Mitchell				
PERSALTS	Tincal sludge water content		D.Mitchell				
PERSALTS	Waste disposal "Duty of Care" infringements	0	D.Mitchell				
PERSALTS	Boron to sewer (kg/te PBS4 produced)	To be set in future pending improved monitoring	D.Mitchell				
PERSALTS	Tincal sludge (kg/te PBS-4 produced)	To be set in future pending improved monitoring	D.Mitchell				
BP ENERGY	Sensitive hour raw material & waste HGV movements	No unjustifiable moves (see specific targets)	L.Curwen				
BP ENERGY	River effluent consent non-compliance attributable to Boiler House	0	L.Curwen	0			
BP ENERGY	IPC Authorisation Nox conc limit compliance	100%	L.Curwen				
BP ENERGY	IPC Authorisation particulate conc limit compliance	100%	L.Curwen				
BP ENERGY	IPC Authorisation opacity conc limit compliance	100%	L.Curwen				

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
BP ENERGY	Environmental complaints related to plant operation	0	L.Curwen	0			
BP ENERGY	IPC monitoring schedule for NOx complete and results forwarded to environmental group on time.	100%	L.Curwen				
BP ENERGY	I.P.C monitoring schedule for Hg & Cd on DMW & blowdown effluents complete and results forwarded to environmental group on time	100%	L.Curwen				
SITE	River effluent pH consent compliance (ex weekly samples)	100% after Sept 96	R.Haffenden				
SITE	River effluent H_2O_2 consent compliance (ex weekly samples)	100% after Sept 96	R.Haffenden				
SITE	River effluent COD consent compliance (ex weekly samples)	100% in 1996	R.Haffenden				
SITE	River effluent Sups. Solids consent compliance (ex weekly samples)	99%	R.Haffenden				
SITE	River effluent Average H_2O_2 concentration (ex weekly samples)	25mg/l after Sept 96	R.Haffenden				
SITE	River effluent Average COD concentration (ex weekly samples)	<30mg/l	R.Haffenden				
SITE	HGV Sunday moves	To be determined	R.Haffenden				
SITE	HGV Sensitive hour average number of moves per week	To be determined	R.Haffenden				

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
SITE	HGV production related moves limit compliance	100%	R.Haffenden	N/A			
SITE	Waste index	> 30% improvements on base year (1989)	R.Haffenden	41% improvement on base year			
SITE	NRA check monitoring compliance against consent limits	100%	R.Haffenden				
SITE	Total environmental complaints received	< 20	R.Haffenden	29			
ENV GROUP	IPC Returns to EA on time	100%	J.McDonagh	100%			
ENV GROUP	Ground Contamination - w/s removal	To be determined	J.McDonagh				
ENV GROUP	Ground Contamination - TOC reduction	To be determined	J.McDonagh				
ENV GROUP	Ground Contamination - free phase plume surface area	To be determined	J.McDonagh				
ENV GROUP	IPC Notifications within 24 hours	100%	J.McDonagh	100			
ENV GROUP	External environmental complaint initial response time to complainant	Within 24 hours week days	J.McDonagh	100			
CUST. CARE	Sensitive hour product HGV movements	No unjustifiable moves	R.Ireland	N/A			
PROJECTS	Waste disposal "Duty of Care" infringements and site procedure compliance infringements.	0	C.Yeardsley	N/A			

APPENDIX 2.7: SOLVAY INTEROX'S EMS: ENVIRONMENTAL MEASURES AND TARGETS

Area	Measure	Target	Manager Responsible	Previous Years Results	Actual Results	Achieved Yes/No	Comments
PROJECTS	External environmental complaints relating to project activities	0	C.Yeardsley	N/A			
SECURITY	Site Waste Disposal Procedure compliance infringements	0	G Oliver	N/A			

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
C1	Proposals to HMIP for use of drain seals for preventing releases to drain during tanker offloading.	1, 2	EG/ Process	Projects Prog Item 8.1.2	Proposals sent to HMIP 29/4/94. Procedure written by EG and sent to process area Aug 94 for implementation by area coordinators (Capa: A Horsley) by Dec 94. Formal review of implementation due Q1 1996.	Complete
C2	Proposals to HMIP for assessing likely frequency and impact of OWS overflows to river drainage system.	1, 2	EG	Projects Prog Item 8.1.7	Proposals sent to HMIP 29/4/94 dealing approach to be taken and commitment to send report of findings by 31/8/94 (see below)	Complete
C3	Produce a procedure that ensures bund waters are disposed of appropriately.	1, 2	EG/ Process	Projects Prog Item 8.1.8	Procedure sent to HMIP 29/6/94. Procedure sent to process area end June 94 for implementation by area coordinators (Capa: A Horsley) by end July 94. Flyer issued 18/8/94. Implementation review conducted Mar - May 1995 and report issued. Agreed at review	Complete
C4	Produce a procedure for tanker off-loading	1, 2	EG/ Process	IPC Imp Prog	Procedure issued Oct 95.	Complete
C5	Environmental process hazard reviews	1, 2	EG/Tech/Process/Projects	IPC Imp Prog	Report sent to HMIP. HMIP & NRA agreement received.	Complete
C6	Proposals to HMIP for improved monitoring of releases from the process.	2, 4	EG	IPC Imp Prog Item 8.1.3	Proposals sent to HMIP 29/4/94 outlining Co philosophy and current sampling & analysis regimes. Proposal outlined to install monitoring station for River effluent during Q1 1995. Continuous monitoring of effluent to sewer, eg TOC, anticipated installation	See projects prog and mins
C7	Acetic acid vapours to quench tank	1, 2	Tech/Proc	IPC Imp Prog	Installation complete. Performance assessment scheduled.	Complete

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
C8	Cyclohexanone vapour handling	1, 2		IPC Imp Prog	Currently on hold with EA agreement pending shut down of old Capa Plant.	On hold
C9	Report on impact of OWS overflows	1, 4	EG	IPC Imp Prog	Report sent to HMIP. No further action required.	Complete
C10	Waste Minimisation Reviews	4,7	EG/Tech/Proc/Proj	IPC Imp Prog	Reviews complete High priorities identified & agreed. Many items incorporated in new Capa. Priorities set on item listed below. Many items left off IPC imp. programme due to priorities and inappropriateness.	See projects prog and mins
C11	Secondary containment (modification of drainage system and installation of TOC monitors to divert effluent to a containment pit).	1, 2	Projects	Projects Prog (705/08)	Programme priorities set. Monthly review meetings established. Meeting with HMIP scheduled for Oct to agree programme timing.	See projects prog and mins
C12	Storage tank containment (containment pits for PAA, HTP and caustic storage)	1, 2	EG/Projects	Projects Prog (705/09)	On hold pending shutdown of old monomer plant - agreed with HMIP	See projects prog and mins
C13	Tanker off-loading containment	1, 2	EG/Projects	Projects Prog (705/10)	Now part of full secondary containment.	See projects prog and mins
C14	Capa process improvements (small items)	1, 2	EG/Projects	Projects Prog (705/11)	On hold pending shutdown of old monomer plant - agreed with HMIP	See projects prog and mins
C15	Primary column high pressure trip	1, 2	Projects	Projects Prog (705/11)	On hold pending shutdown of old monomer plant - agreed with HMIP	See projects prog and mins

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
C16	Target setting	2,4, 7	Tech/Proc	Waste Minimisation	Performance measures and targets procedure and schedule developed - awaiting agreement with managers before issue.	Q4 1996
C17	Re-use of monomer washings	7	Tech/Proc	Waste Minimisation	Priority 2 initiative within Tech Dept Capa priorities.	Ongoing
C18	New residues tank condenser	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C19	Improve/additional luwa evaporator	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C20	Dumping luwa column on shutdown	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C21	KOH trial	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C22	Change packing in secondary column	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C23	Monitoring equipment	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C24	Stripper extension commissioning	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C25	Filter commissioning	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C26	Cooling capacity	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
C27	Purge stream recovery	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C28	Sample recovery	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C29	Change packing in tertiary column	7	Tech/Proc	Waste Minimisation	Priority 3 initiative within Tech Dept Capa priorities.	Ongoing
C30	Consideration of the use of capa residues as a cem fuel through waste exchange company.	7	EG	Waste Minimisation		Ongoing
C31	Consider high level dispersion venting on residues tank pending.	1, 2	EG	Effects Assessment	On hold pending shut down of old Capa plant.	See projects prog and mins
C32	Investigation of the use of acid as a neutralising agent for alkaline effluent.	2	J McCormick	Effects Assessment		Q1 1996
C33	Investigate the need for temperature checks to be included as part of monitoring schedule.	2	EG	Effects Assessment	A Horsley contacted September 1995 - it is not believed that effluent reaches this temperature as no steam is observed from pit during winter. Checks required ?	Ongoing
A1	Proposals to HMIP for the use of drain seals to prevent releases of controlled waters resulting from tanker loading / off-loading.	1, 2	EG/Proc	IPC Imp Prog (item 8.1.3)	Procedure has been developed by EG for the use of bund seals. Sent to process areas for implementation by area co-ordinators.	Complete
A2	Proposals to HMIP to prevent the overflow of the effluent pit into canal.	1, 2	EG/Proc	IPC Imp Prog (item 8.1.5)	Procedure for penstock valve operation has been incorporated into plant S.O.Ps.	Complete

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
A3	Procedure to ensure that bund waters are tested and disposed of appropriately.	1, 2	EG / Proc	IPC Imp Prog (item 8.1.6)	Incorporated into plant SOPs	Complete
A4	Environmental process hazard reviews	1, 2	EG/Tech/Process/Projects	IPC Imp Prog (item 8.1.1)	Report sent to HMIP. HMIP & NRA agreement received.	Complete
A5	Proposals to HMIP for the continuous monitoring of the releases from the carbon beds.	2, 4	EG/Proc	IPC Imp prog item 8.1.4	Continuous analysers are expected to be fitted in summer / autumn 1996.	Q4 1996
A6	Proposals to HMIP for analysis of releases to controlled waters from the process, with a view to assessing the effect of these releases on the final discharge to the River Mersey.	2, 4	EG	IPC Imp prog item 8.1.2	Report written by I McLean and submitted to HMIP	Complete
A7	Proposals to HMIP for improved monitoring of releases from the process (including mercury).	2, 4	EG	IPC Imp prog item 8.1.1	Proposals sent to HMIP	Complete
A8	Procedure for waste management	2	EG/Proc	IPC Imp prog item 8.1.7	Site procedure implemented September 1995	Complete
A9	Proposals to HMIP for reducing the release of VOCs from the carbon beds, with the aim of achieving a limit of $80mg/m^3$	2	EG / Proc	IPC Imp prog item 8.1.10	Proposals sent to HMIP	Complete
A10	Effluent Control (AO pH etc)	2	EG/Tech/Proc/Proj	Projects Prog (701)	Programme has been reviewed for completion at November 1996 shutdown.	See projects prog and mins

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
A11	Crude cyclones (to handle releases from vents in hydrogenation and oxidiser area)	1, 2	EG/Proc/ Projects	Projects Prog (705/01)	Meeting to be arranged for Oct/Nov 96 between RAH and projects to determine requirements for cyclones and the design basis.	See projects prog and mins
A12	Rundown tanks (modification of drainage arrangements from the bunded area around the tanks).	1, 2	EG/Proc/ Projects	Projects Prog (705/02)	Process scopes issued for engineering department 3/09/96.	See projects prog and mins
A13	Process improvements (small items)	1, 2	EG/Process / Projects	Projects Prog (705/03)	Process scopes issued for engineering department 3/09/96.	See projects prog and mins
A14	Installation of foam level detector	2		Projects Prog (705/03)	Identification of appropriate instrument ongoing.	See projects prog and mins
A15	Tars tank loading (installation of drainage gullies around tanker loading point to drain into bund)	1, 2	EG/Process /Projects	Projects Prog (705/04)	Scope agreed and installation to be phased appropriately.	See projects prog and mins
A16	Tank farm containment (storage tanks, tanker loading/off-loading areas)	1, 2	EG/Process /Projects	Projects Prog (705/05)	Final scope complete	See projects prog and mins
A17	Tank farm containment of IBCs	1, 2	EG/Process /Projects	Projects Prog (705/06)	IBC storage relocated to front of carboys with drainage to AOC dump pit.	See projects prog and mins
A18	Peroxide instrumentation meter (to monitor effluent during washing of IBCs)	1, 2	EG/Process /Projects	Projects Prog (705/07)	Removed from programme as not deemed necessary - agreed with HMIP.	N/A
A19	AO Distillation Secondary Containment	1, 2	EG/Process /Projects	Projects Prog (705/19)	All customer/plant teams' comments incorporated into Process Scope which will be issued for engineering design by SIL engineering groups following discussion at Task Force meeting 3.10.96.	See projects prog and mins

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
A20	AO Distillation Process Improvements (small items)	1, 2	EG/Process /Projects	Projects Prog (705/20)	Review meeting held - scope ready for approval Oct 96	See projects prog and mins
A21	VOC monitoring from carbon beds	2,4		Projects Prog (705/26)	CEP for approval by Oct 96. Scope of work to be revised to enable both wet and dry sampling of A stream absorber vents. Order to be placed with Gladwell once CEP approved.	See projects prog and mins
A22	New storage facilities for raw materials	1, 2		Projects Prog (705/27)	PCAs approved subject to Armco Barrier being added around DMW Storage Tank hardstanding.	See projects prog and mins
A23	DMW effluent treatment (old and new plants) ie pH adjustment systems	2	EG/Tech/Proc/Projects	Projects Prog (705/28)	Bids have been assessed and two companies invited to bid - Haden Freeman have been chosen. Approval from RAH required to proceed.	See projects prog and mins
A24	Conversion of AO Tars to sewer	7	EG / Proc	Waste min	Original PCA approved April 1994. Temporary arrangement has operated for A stream since June 1994	End 96
A25	Use of filter cleaning equipment for cleaning centrifuge plates.	7	Process	Waste min	PCA (1236) submitted 1994, Trials 1995, PCA 1352 for permanent modifications. Report on trials included with PCA.	Ongoing
A26	Continuous addition of dequest to oxidisers (reduces levels of decomposition, influences hydrogen usage).	7	Process	Waste min	Since implementation H_2 usage has improved with £300k/annum forecast.	Complete
A27	Crude purification improvements (quality of crude, reduced solvent/working solution carryover at start-up / shut down).	7	Process	Waste min	Completed in 1996	Complete

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
A28	Winterisation improvements (to reduce bursts/freeze ups during winter).	7	Process	Waste min		Ongoing
A29	Reduced effluent flow to sewer	7	Process	Waste min	PCA to be submitted for central drainage channel seal water addition system.	Ongoing
A30	Effluent air stripper improvements	7	Process	Waste min	Modifications complete to allow preferential discharge via stripper and on line performance of stripper to be assessed.	Q4 1996
A31	Solvent recovery improvements (drying cycle on C beds)	7	Process	Waste min	Pending installation of VOC monitors and subsequent detailed investigation of bed performances.	1997/8
A32	AO Distillation mass balance (concentrating on overhead losses and loss between product sold and processed).	7	Technical	Waste min	SPC charts from May 1994 onwards. Prior to 1994 ratio was 1.2. From May 94 onwards ratio reduced to 1.4	Complete
A33	AO Crude cooling tower makeup ratio (reduction in well water needed to makeup cooling water).	7	Process	Waste min	Ongoing	Ongoing
A34	Investigation of the use of fixed installations for disposal of brine wash waste.	1, 2	?	Effects Assessment		Ongoing
A35	Reducing VOC releases from carbon beds below 80mg/m^3 future IPC authorisation limit.	2		Effects Assessment	Awaiting VOC monitoring installation and assessment of C bed performance with potential need for drying cycle.	Ongoing

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
PA1	Proposals to HMIP for reducing the releases from the reactor to air and controlled waters.	2	N/A	Projects Prog item 8.1.8	On hold pending close down of PAA	N/A
PA2	Proposals to HMIP for reducing the releases of acetic acid from the bulk storage vessels.	2	N/A	Projects Prog item 8.1.9	On hold pending close down of PAA	N/A
PA3	PAA process improvements (small items)	1, 2	N/A	Projects Prog (705/21)	On hold pending close down of PAA	N/A
PA4	HTP storage tank containment	1, 2	N/A	Projects Prog (705/22)	On hold pending close down of PAA	N/A
PA5	Bulk production (ISO tanker containment pit and drainage for storage areas).	1, 2	N/A	Projects Prog (705/23)	On hold pending close down of PAA	N/A
PA6	Acetic acid tanker off-loading containment	1, 2	N/A	Projects Prog (705/24)	On hold pending close down of PAA	N/A
PA7	Acetic acid storage tank bund upgrade	1, 2	N/A	Projects Prog (705/25)	On hold pending close down of PAA	N/A
PA8	Ventilation system	2	N/A	Projects Prog	On hold pending close down of PAA	N/A
P1	Secondary containment (including flocculent storage tanks, sludge holding tanks, glycol storage area)	1, 2	EG/Tech /Proc/Proj	Projects Prog (705/12)	Process, civil and mechanical engineering scopes completed by Sept 96	See projects prog and mins
P2	Peroxide tank containment	1, 2	EG/Tech /Proc/Proj	Projects Prog (705/13)	*Scope to be issued to project engineering* disciplines w/c 9.09.96.	See projects prog and mins

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
P3	Tanker off-loading (containment for the offloading facility for caustic and sodium silicate deliveries)	1, 2	EG/Tech /Proc/Proj	Projects Prog (705/14)	Engineering design by SIL developed during August 96	See projects prog and mins
P4	Process improvements (small items)	1, 2	EG/Tech /Proc/Proj	Projects Prog (705/15)	Engineering design by SIL developed during August 96	See projects prog and mins
P5	Diversion of PBS-4 effluent to sewer	1, 2	EG/Tech /Proc/Proj	Projects Prog (705/29)	Connection from PBS sump to new sewer is complete. SIL have completed the in house basic design and have issued an enquiry to contractors for detailed design. Quotations are due 16 October 96.	See projects prog and mins
P6	PCS Effluent Treatment	1, 2	EG/Tech /Proc/Proj	Projects Prog (228)	On hold pending decision on PCS production - PCS Plant will not be able to run without completion of this project.	See projects prog and mins
P7	Waste minimisation reviews	7	EG/Tech /Proc/Proj	Waste Min	Report complete and "high" priorities identified and agreed. Priorities set on items listed on individual plant improvement programmes. Many items left off IPC improvement programme due to priorities and inappropriateness.	See items below
P8	Assess the potential use of tincal sludge using a waste exchange company	7		Waste Min	Report complete - feasibility for rockwool manufacture good, financial viability poor. Meeting to be arranged with Rockwool to view actual processing route.	Ongoing
P9	Conversion of Line 3 scrubber system to MBS	7	Process	Waste Min	Complete	Complete

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
P10	Conversion to flocculents supplied by Allied Colloids which can be made up with process mother liquor instead of water (saving water and reducing effluent to drain).	7	Process	Waste Min	Trials by Allied Colloid taking place Oct 1996.	1997
P11	Washing of classifier screw with mother liquor rather than water (saving of water and reduction of mother liquor to drain).	7	Process	Waste Min	Design underway Oct 1996	1997
P12	Conversion from 47% to 50% peroxide (reducing costs of haulage etc).	7	Process	Waste Min	To be installed Q1 1997	Q1 1997
P13	Investigation into alternative reactor conditions to reduce use of peroxide.	7	Process	Waste Min	Continuous improvements made.	Ongoing
P14	Incorporate boron releases into performance measures and targets once monitoring is established.	7	EG	Effects Assessment	Pending improvements to monitoring	N/A
P15	Investigate improvements to line 4 drier exhaust (eg silencer ?)	5	EG	Effects Assessment		Ongoing
G1	Produce a written report of a full environmental hazard review with proposals for improvements.	1, 2	EG/Tech/Proc/Proj	IPC imp prog item 8.1.6 & 8.1.11(705)	Report agreed by HMIP & NRA.	Complete
G2	Outfall monitoring station	4	EG	Projects Prog (235/03)	Scope has been clarified, letters sent to contractors requesting clarified bids by 11.10.09. CEP to be issued Oct 96, order should be placed early November.	See projects prog and mins

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
G3	DMW chemical off-loading (caustic and sulphuric acid)	1, 2	EG/Tech/Proc/Proj	Projects Prog (705/16)	Scope agreed and installation to be phased appropriately.	See projects prog and mins
G4	Pickling plant nitric acid off-loading	1, 2	EG/Tech/Proc/Proj	Projects Prog (705/17)	Process scope to be finalised w/c 9.9.96	See projects prog and mins
G5	Pickling plant effluent treatment and monitoring	1,2,4	EG/Tech/Proc/Proj	Projects Prog (705/18)	Awaiting development of process scope. A sum of money ie £25 had been set aside.	See projects prog and mins
G6	Waste oil spillage containment	1, 2	Eng	Projects Prog (705/30)	Discrete collection tanks located around site, old system removed Q3 96.	Complete
G7	Cooling water treatment chemicals containment	1, 2	EG/Tech/Proc/Proj	Projects Prog	Estimate CEP issued to J Massey (5/08/96) for H_2SO_4 storage for cooling water treatment for consideration of justification statement.	See projects prog and mins
G8	DMW H_2SO_4 tank bunding	1, 2	EG/Tech/Proc/Proj	Project Prog (702)	Intermediate tank fed from Memcor H2SO4 tank installed Q1 96. Old tank removed Q3 96.	Complete
G9	Firewater ponds / interceptor pits	1, 2	EG/Tech/Proc/Projects	Projects Prog	*Location feasibility studies actioned. Timescale for* implementation has been put back.	See projects prog and mins
G10	Internal overall site monitoring	4	EG/Tech/Proc/Projects	Projects Prog	Monitoring equipment scoped for inclusion in relevant projects. AO crude flow proportional sampler discrete project. Procedure under development for sewer consent sampling, analysis and cost allocation.	See projects prog and mins
G11	Ground contamination	1, 2	EG	See separate programme	AO hydraulic containment system currently being installed. EA meeting held Sept 96 and remediation programme approved. Full CEP to be sought Q4 96/Q1 97.	1997/1998

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
G12	North West Water pumping station	2	EG/NWW	Projects Prog	Upgrade planned for completion March 97. Legal agreement on costs being progressed.	March 97
G13	New sewer system	2	Projects		New system installed Q3 96. Pump capacity under review - mods needed to reduce potential flow and consent breach.	Ongoing
G14	Investigate potential leaks from old DMW effluent pit	1,2	EG			Ongoing
G15	Waste minimisation reviews	7	EG/Tech /Proc/Proj	IPC imp prog item 8.1.6 & 8.1.11	Report complete and "high" priorities identified and agreed (see individual items above - many items left off IPC improvement programme due to priorities and inappropriateness).	Complete
G16	Office recycling schemes	7	Recycling reps		Office paper recycling centre set up August 1996.	Ongoing
G17	Environmental management system	3	E Goodchild	See separate Programme	Policy, register of regulations, effects assessment, management manual, objectives and targets and improvement programme complete.	Sept 97
G18	Landscaping of derelict land at Junction of Eastford Road and Taylor Street.	5	EG		Mersey Valley Partnership commissioned to carry out works pending referendum by residents on appropriateness of such a scheme. £10 budget agreed shared between Solvay Interox Ltd, Vinamul and Crossfield	Ongoing
G19	Support local community project to develop Walton Lock area of the River Mersey.	5	Communic. Manager		£20k donation offered. Awaiting progress by Water Watch.	Ongoing

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
G20	Involvement in the implementation of Agenda 21via roundtable groups.	5, 6	EG		Ongoing	Ongoing
G21	Publish publicly available environmental reports every two years.	5, 6	EG		Report published in 1993-1994. Second report for 1994-1995 in draft form.	Ongoing
G22	Ongoing programme of regular resident liaison meetings.	5	EG		Ongoing	Ongoing
G23	HGV Monitoring & Targeting	5	EG	See specific HGV targets	HGV logging and targeting procedures issued August 1996. Targets established to be agreed with Operations Managers.	Q4 96
G24	Reduction in HGV Movements	5	EG		Group Project set up with Salford University to investigate alternative transport. Report to be complete Dec 96.	Ongoing
G25	Monitoring and targeting of electricity usage by site utilities management.	7	Eng	Effects Assessment	Electrical distribution is now being monitored.	Ongoing
G26	Monitoring and targeting of water usage by site utilities.	7	Eng	Effects Assessment	Metres now installed on two incoming sources of towns water (although can't measure individual site usage). Savings of £80,000 a year through conversion of powerhouse compressors from towns water to well water.	Ongoing
G27	Monitoring and targeting of steam usage by site utilities.	7	Eng	Effects Assessment	Fairly good existing monitoring although some minor uses can not presently be individually measured.	Ongoing
G28	Monitoring and targeting of gas usage by site utilities.		Eng	Effects Assessment	Therm gas (Persalts burners) and interuptable gas (boiler house) being monitored. Therm gas usage has decreased as less mono is produced.	Ongoing

APPENDIX 2.8: SOLVAY INTEROX'S EMS - ENVIRONMENTAL MANAGEMENT PROGRAMME

No	Target	Objective No	Progressed By	Reference	Comments / Status	Anticipated Completion Date
G29	Monitoring and targeting of compressed air usage by site utilties.		Eng	Effects Assessment	Diagramme prepared of requirements of monitoring prepared.	Ongoing
G26	Review use and legal obligation of halon use across tbe site (refrigerant and fire extinguishers).	1	EG	Effects Assessment		Q4 1996

KEY: Proc = Process, EG = Env Group, Tech = Technologists, Proj = Projects, C= Capa A = AO Plant, PA = Peracetic Acid Plant, P = Persalts Plant, G = General

APPENDIX 2.9: SOLVAY INTEROX'S EMS - RCLP MANUAL CONTENTS

4.1.2	Senior & Middle Management Participation	ISRS 1.3
4.1.3	Established RCLP Performance Specifications	ISRS 1.4
4.1.4	Participation in RCLP Activities	ISRS 1.5
4.2	**R C L P Co-ordinator (s)**	ISRS 1.2 BS 7750 4.3.3 ISO 14001 4.3.1
4.3	**Resources**	BS 7750 4.3.2
4.4	**Communications**	BS 7750 4.3.4 ISO 14001 4.3.3
4.4.1	HSE Committees & Representatives	ISRS 1.11
4.4.2	Reference Library	ISRS 1.13
4.4.3	Personal Communications	ISRS 15
4.4.4	Group Communications	ISRS 16
4.4.5	General Promotion	ISRS 17
4.4.6	Process Safety Information	PSM 1
4.4.7	External Communications	ISRS 1.16 BS 7750 4.4.1 ISO 14001 4.3.3
4.5	**Training**	
4.5.1	Leadership Training	ISRS 2 BS 7750 4.3.4 ISO 14001 4.3.2 PSM 4 HS(G)65 Insert 8
4.5.2	Knowledge and Skill Training	ISRS 10 BS 7750 4.3.4 ISO 14001 4.3.2 PSM 4 HS(G)65 Insert 8
4.5.3	Hiring and Placement	ISRS 18
4.6	**Documentation; Document & Data Control**	
4.6.1	RCLP Management Manual	ISRS 1.7 BS 7750 4.7.1
4.6.2	Maintenance of Records	BS 7750 4.9
4.6.3	Documentation Content	
4.6.4	Document and Data Control	ISRS 1.14 BS 7750 4.7.2

APPENDIX 2.9: SOLVAY INTEROX'S EMS - RCLP MANUAL CONTENTS

5.0	**IDENTIFYING HSE REQUIREMENTS**	
5.1	**Legislative, Regulatory & Policy Requirements**	ISRS 1.16 BS 7750 .4.4.3
5.2	**Critical Task Analysis and Procedures**	ISRS 4 HS (G) 65 Chapter 4
5.3	**Environmental Effects Assessment & Register**	BS 7750 4.4.2 ISO 14001 4.2
5.4	**Environmental Process Hazard Reviews**	BS 7750 4.4.2
5.5	**Process Hazard Analysis**	PSM
6.0	**SET TARGETS AND PLAN**	
6.1	**Prioritising & Setting Targets for Improvement**	BS 7750 4.5 ISO 14001 4.2 HS(G)65 Section 4 BS 7750 4.6
6.2	**Planning Control Requirements**	BS 7750 4.8.2 ISO 14001 4.3.6 HS(G)65 Section 4
6.3	**Identification of Performance Criteria & Indicators**	BS 7750 4.5
6.4	**Emergency/Incident Control**	ISRS 7 BS 7750 4.8.2 PSM ISO 14001 4.3.7
6.4.1	Leadership & Administration of Emergency Procedures	
6.4.2	Scope of the Emergency Plan	
7.0	**IMPLEMENTATION & CONTROL**	
7.1	**Commitment of People**	HS(G)65 p20
7.2	**Controls of Special Effects**	
7.2.1	Health and Hygiene Control	ISRS 12
7.2.2	Personal Protective Equipment	ISRS 11
7.2.3	Safe Work Practices	PSM 8
7.2.4	Off-the-job Safety	ISRS 20
7.3	**Purchasing & Contractor Control**	HS(G)65 Section 4

APPENDIX 2.9: SOLVAY INTEROX'S EMS - RCLP MANUAL CONTENTS

7.3.1	Procurement of Goods	BS 7750 4.8.2 ISO 14001 4.3.6-c ISRS 19
7.3.2	Contractor Selection and Management	ISRS 19.2 & 19.3 BS 7750 4.3.5 PSM
7.4	**Process Control**	
7.4.1	General	BS 7750 4.8.2 PSM ISO 14001 4.3.6 HS(G)65 Section 4
7.4.2	Maintenance	
7.4.3	Rules and Work Permits	ISRS 8
7.4.4	Mechanical and Safety System Integrity	PSM
7.5	**Management of Change**	ISRS 14, PSM
7.5.1	Design and Pre Start-up Safety Review	PSM
7.6	**Outputs from the Manufacturing Process**	BS 7750 4.8.2
7.7	**Storage and Transportation**	BS 7750 4.8.2 ISO 9000 4.15
8.0	**MONITORING**	ISO 14001 4.4
8.1	**Verification, Measurement & Testing**	BS 7750 4.8.3
8.2	**Planned Inspections and Maintenance**	ISRS 3
8.3	**Task Observation**	ISRS 6
8.4	**Auditing & Systems Evaluations**	ISRS 1.8 BS 7750 4.10 PSM 11 ISRS 13
8.5	**Non-Conformances**	
8.5.1	Corrective & Preventive Actions	BS 7750 4.8.4 ISO 14001 4.4.2
8.5.2	Accident / Incident Investigations	ISRS 5 PSM 10
8.5.3	Accident / Incident Analysis	ISRS 9

9.0 MANAGEMENT REVIEW

9.1	Management Review Meetings	ISRS Element 1.6 BS 7750 4.11 ISO 14001 4.5

APPENDICES

1 Solvay Group's Responsible Care Guidelines
2 CIA's Responsible Care HSE Principles
3 Organisation Structures
4 Responsible Care & Loss Prevention Document Levels
5 Index to Procedures / Manuals
6 Cross References including BS 7750, ISRS etc.
7 Amendment History
8 Current HSE Objectives
9 Suggestions for Improvement Form
10 Current Policy Statement

APPENDIX 2.9: SOLVAY INTEROX'S EMS - RCLP MANUAL CONTENTS

9.0 MANAGEMENT REVIEW

9.1 Management Review Meetings — ISRS Element 1.6; BS 7750 4.11; ISO 14001 4.5

APPENDICES

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APPENDIX 2.10: SOLVAY INTEROX'S EMS - SUPPLIER ASSESSMENT QUESTIONNAIRE

<table>
<tr><th colspan="3">SUPPLIER ENVIRONMENTAL QUESTIONNAIRE</th></tr>
<tr><td colspan="3">SECTION A: GENERAL INFORMATION</td></tr>
<tr><td colspan="3">Name of organisation</td></tr>
<tr><td colspan="2" rowspan="3">Address of organisation</td><td>Telephone Number</td></tr>
<tr><td>Facsimile Number</td></tr>
<tr><td>Number of employees</td></tr>
<tr><td colspan="2">Names and titles of those responsible for environmental matters.</td><td>Products supplied to Solvay Interox</td></tr>
<tr><td colspan="3">Are any of these director/board level appointments? Y/N</td></tr>
<tr><td colspan="3">Please supply the name of a contact person for verification purposes.</td></tr>
<tr><td colspan="3">Is your company certified to the Quality Standard BS 5750? Y/N</td></tr>
<tr><td colspan="3">Is your company affiliated to a Trade Association? Y/N
If, yes which one?</td></tr>
<tr><td colspan="3">SECTION B: ENVIRONMENTAL MANAGEMENT</td></tr>
<tr><td>1.</td><td colspan="2">Do you have an Environmental Policy? If "Yes", please supply a copy. Y/N</td></tr>
<tr><td>2.</td><td colspan="2">Does your organisation have an Environmental Management System? Y/N
Is this custom designed by your organisation or based on BS 7750, EMAS, ISO 14000 series, CIA's: "Integrated Health, Safety and Environment Management Systems" guidance?</td></tr>
<tr><td>3.</td><td colspan="2">Are you intending to achieve certification to any environmental management standard within the next 5 years? Y/N
If "Yes", please state which standard e.g. BS 7750 and EMAS in the U.K.</td></tr>
<tr><td>4 a.</td><td colspan="2">Do you have registers of the environmental effects of your activities? Y/N
If "Yes" do these include inventories of: - emissions to air? Y/N
- discharges to water? Y/N
- waste? Y/N
- resource usage? Y/N
- nuisance effects? Y/N
- indirect effects? Y/N</td></tr>
<tr><td>4 b.</td><td colspan="2">Do you have formal procedures to assess these effects / risks? Y/N</td></tr>
<tr><td>4 c.</td><td colspan="2">Do you have comprehensive formal waste management procedures? Y/N</td></tr>
</table>

APPENDIX 2.10: SOLVAY INTEROX'S EMS - SUPPLIER ASSESSMENT QUESTIONNAIRE

4 d.	Do you have formal procedures in place for responding to emergency situations?	Y/N
5.	Do you have formal procedures for keeping a register of relevant regulatory, legislative and policy requirements?	Y/N
6.	Do you undertake regular environmental training of your personnel? If "Yes", can you provide details of the nature and frequency of this training.	Y/N
7.	Do you have an environmental management programme for the site? If "Yes", does your environmental management programme include: - waste minimisation initiatives ? - the consideration of the recycling and reuse of waste ? - energy efficiency initiatives ? - improved monitoring ? - improved containment ? - effluent treatment ? - any others? Please indicate with a ✓ which of these are being driven by legislation e.g. through an Integrated PollutionControl Improvement Programme.	Y/N Y/N Y/N Y/N Y/N Y/N Y/N
8.	Have you conducted a Baseline Review/Audit within the last 5 years?	Y/N
9.	Do you undertake regular environmental audits? If "yes", do these environmental audits include: - site audits? - supplier assessment? - waste contractor assessment? - any others?	Y/N Y/N Y/N Y/N
10.	Has your organisation been prosecuted for an environment related offence within the last 5 years? If "Yes", please supply details.	Y/N

APPENDIX 2.10: SOLVAY INTEROX'S EMS - SUPPLIER ASSESSMENT QUESTIONNAIRE

SECTION C: PRODUCTION PROCESS	
If you supply more than one product to Solvay Interox, please photocopy this page and complete accordingly for each product. Product Name ________________________________	
1.	Please briefly describe the process by which you manufacture the named product you supply to Solvay Interox.
2.	Is this process subject to control by enforcing authorities e.g. HMIP's Integrated Pollution Control in the U.K.? Y/N
3.	Please describe the main environmental releases from your process e.g. COD, VOCs, special and non special wastes. An indication of the order of magnitude compared to production would be helpful.
4.	Please describe the environmental protection installed to mitigate the effects of the manufacturing process.
5.	Please specify any intended technical environmental improvements for the manufacturing process.

APPENDIX 2.10: SOLVAY INTEROX'S EMS - SUPPLIER ASSESSMENT QUESTIONNAIRE

For validation purposes, would it be possible for us to verify the responses to this questionnaire by such methods as requesting further information and/or site visits and meetings?	Y/N
Name of person who completed questionnaire	
Position	
Thank you for your time and co-operation. Please return the questionnaire, your environmental policy (if applicable) and any comments to: MS E. GOODCHILD P.O. BOX 7 SOLVAY INTEROX LTD WARRINGTON CHESHIRE WA4 6HB	

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Acrol Ltd	Everite Road, Widnes, Cheshire WA8 8PT	Tinstab BL277	CAPA	4.8.95 + reminder 1.9.95	23.10.95		N/A	Acrol Ltd act as an agent for Akcros Chemicals UK Ltd.
Akcros Chemicals UK Ltd	Meresa Bate, P.O. Box 1, Silk Street, Eccles, Manchester M30 OBR	Tinstab BL277	CAPA					
Air Products Ltd	Gareth Crowther, Chemical Division, Clayton Lane, Clayton, Manchester M11 4SR.	Dabco T9	CAPA	4.8.95 + reminder 1.9.95				Telephone Call - 12/10/95. Questionnairre promised.
Akzo Nobel Surface Chemistry	A Pearson, 23 Grosvenor Rd, St Albans, Herts AL1 3AW	Glycerine	CAPA	4.8.95 + 1.9.95 + 8.10.95				Reports provided - no questionnaire.
Albright And Wilson Ltd	Phosphates Division, P.O. Box 3, Hagley Road, West Oldbury, Warley, West Midlands.B68 0NN	Albright C1XN, Sodium Acid Pyrophosphate, Sodium Hexametaphosphate.	AO, AO, Persalts	4.8.95		70%	B	Questionnaire completed by the Head Quarters.
Alcohols Ltd	Charringtons House, The Causeway, Bishops Stortford, Hertfordshire. CM23 2EW	Di - Ethylene Glycol; Neopentyl Glycol: IMS	CAPA	17.8.95	17.8.95	NA	N/A	Alcohols Limited are the distributors and passed the questionnaire to BP Chemicals and Hoechst UK Ltd.

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Allied Colloids	P.O. Box 38, Clecheaton Road, Low Moor, Bradford, Yorkshire BD12 0JZ	Magnafloc E24	PERSALTS	17.7.95	27.7.95	60%	C	
BASF U.K. Ltd	P.O. Box4, Earl Road, Cheadle Hulme, Cheadle Cheshire. SK9 6Q9	Ethyl Anthraquinone Neopentyl Glycol Sodium Polyacrylate	AO, Capa, Persalts	17.7.95	26.7.95	79%	B	Completed by Head Office as manufacture of products often occurs on different sites.
Bayer U.K. Ltd	Dr Speck, Bayer House, Strawberry Hill, Newbury, Berkshire. RG13 1JA	1,2,3 Benzotriazole (only used in one-off development project) Stabaxol 1 + Stabaxol P	AO CAPA	4.8.95	28.7.95	68%	C	
BDH Chemicals Ltd	Poole, Dorset. BH12 4NN	Dipiclonic Acid Methyl Red	AO, PAA AO	4.8.95 + reminder 1.9.95				
Berk Ltd	Berk House, P.O. Box 56, Basing View, Basingstoke, Hants. HR21 2EG	Magnesium Sulphate	PERSALTS				N/A	Products manufactured by Kali & Salz (part of the Berk Group)

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	***Contact Name & Address***	***Product(s) Supplied***	***Plant***	***Date Sent***	***Date Rec***	***Score***	***Grade***	***Comments***
Borax Consolidated Ltd	Gorsey Lane, Widnes, Cheshire. WA8 0RP	Pentahydrate Borax	PERSALTS	17.7.95	9.8.95 - letter			Questionnaire promised.
BP Chemicals Ltd	Poplar House, Chertsey Road, Sunbury, Surrey.+ Hull Research and Tech. Centre, Salt End, Hull HU12 8DS	Acetic Acid; IMS (via Alcohols Ltd)	CAPA,PAA	17.7.95	17.8.95	91%	A	
Brunner Mond + Co Ltd	P.O. Box 4, Mond House, Northwhich, Cheshire CW8 4DT	Sodium Carbonate	PERSALTS	4.8.95 + reminder 1.9.95	12.9.95	81%	A	Audits just started.
Bush Boake Allen Ltd	Fragrances Division, Blackhorse Lane, London. E17 5QP	Perfume LK30524	PAA	17.7.95	28.7.95	33%	F	Little at present - although a commitment to BS 7750. Progress to be monitored.
Carbon Link	Sterling House, 2 Park Street, Wigan. WN3 5HE	Activated Carbon	AO	17.7.95	28.7.95	25%	F	Stated that the process does not result in releases to the environment. The company only has 10 employees.
Ciba Geigy Plc	Hulley Road, Macclesfield, Cheshire. SK10 2NX	Irganox 1010	CAPA	4.8.95 + reminder 1.9.95	3.11.95	89%	A	

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Collinda Ltd	25 Ottways Lane, Ashtead, Surrey KT21 2PZ	Dipiclonic Acid	AO, PAA	17.7.95 + reminder 23.8.95		90%	A	
Condea Chemie GmbH		Cetyl Alcohol	CAPA	8.10.95				Information provided - no questionnaire.
Courtaulds Chemicals Ltd	Leek Works, Macclesfield Road, Leek, Staffordshire. ST13 8UZ	Orthosextate	AO	17.7.95 + reminder 23.8.95	13.10.95	82%	A	
Crosfields Chemicals	P.O. Box 26, Warrington, Cheshire, WA5 1AB	Sodium Silicate	PERSALTS	17.7.95	28.7.95	72%	B	
Crosmill Flocculants Ltd	85E Main Road, Goostrey, Cheshire. CW4 4DT	Millfloc D34	PERSALTS	17.7.95	28.7.95	27%	F	The questionnaire was completed by SNF SA in France. No policy although claims of improvements - has been prosecuted.
Croxton & Garry Ltd	Smith, Curtis Road, Dorking, Surrey RH14 1XA	Santoflex IP; Santowhite Powder	CAPA	17.7.95 + 23.8.95 + 8.10.95	Letter 3.11.95			Distributors of Flexsys products until Nov 1995. Requested a delay in completing the questionnaire due to product changes.

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
DSM (U.K.) Ltd	Kingfisher House, Kingfisher Walk, Redditch, Worcestershire. B97 4EZ	Cyclohexanone	CAPA	17.7.95	17.8.95	98%	A	Achieved Certification to BS 7750 through ISO 9000 (BVQI) in April 1994.
Du Pont U.K. Ltd	Wedgewood Way, Stevenage, Hertfordshire. SG1 4QN	Polytetrahydrofuran Glycol	CAPA	4.8.95 + reminder 1.9.95	17.8.95		N/A	See Du Pont de Nemours (Nederland) BV.
Du Pont de Nemours (Nederland) BV	G J Klijn, PO Box 145, NL-3300 AC Dordrecht, The Nethlands	PTMEG (Terathane)	CAPA		13.9.95	81%	A	The company has been prosecuted but not concerning the manufacture of Terathane.
Efkay Chemicals Ltd (Distributor)	158 Kilburn Arch Road, London. NW6	Cetyl Alcohol	CAPA	4.8.95 + reminder 1.9.95			N/A	Cetyl Alcohol is supplied to Efkay from RWE-DEA.
Elf Atochem SA	Ms Leburgue de Oliveira, 4 Cours Michelet, Cedex 42, 92091 Paris La Defense, France.	Sodium Chlorite		4.8.95	15.08.95	88%	A	

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Ellis & Everard Chemicals Ltd	Pickerings Road, Hale Road Industrial Estate, Ditton, Widnes, Cheshire. WA8 8XW	Acetic Anhydride Dequest 2010 Sulphuric Acid Synperonic 91/B Ammonia Benzoic Acid Orthophosphonic Acid	PAA PAA,AO PAA PAA AO AO AO, PERSALTS	4.8.95 + reminder 1.9.95				
Enichem U.K. Ltd	Enichem House, 111 Upper Richmond Road, Putney, London. SW15 2TJ	Cyclohexanone - have not supplied for 2 years.	CAPA	4.8.95 + reminder 1.9.95			N/A	
Exxon Chemicals Ltd	Dr A Holton, P.O. Box 122, 4600 Parkway, Fareham, Hampshire. PO15 7AP	Aromatic Hydrocarbon	AO	4.8.95 + reminder 1.9.95	14.9.95	89%	A	
Fisons Ltd	Bishops Meadow Road, Loughborough, Leicestershire. LE11 0RG	Ammonia	AO	4.8.95 + 1.9.95 + 8.10.95				Information provided - no questionnaire.
Hays Chemicals Ltd	Westinghouse Road, Trafford Park, Manchester. M17 1QB	Ammonia Dequest 2010 Nitric Acid	AO PAA,AO AO	17.7.95		42%	E	All their products are only stored and repackaged on this site.

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Heraeus Silica + Metals Ltd	Unit A, Cinder Hill Industrial Estate, Weston Coyney Road, Longton, Stoke-on-Trent.ST3 5LB	Palladium on Silicalit 2%	AO	4.8.95 + reminder 1.9.95	18.8.95			Phone call 3.11.95 will fax questionnaire.
Hoechst U.K. Ltd	Chemicals Division, Hoechst House, Salisbury Road, Hounslow, Middlesex TW4 6JH	Neopentyl Glycol; Di-ethylene Glycol	CAPA	4.8.95		92%	A	
ICI Chance and Hunt (Distributors)	D Bruce, Alexander House, Crown Gate, Runcorn, Cheshire. WA7 2UP	Topanol	CAPA	4.8.95 + reminder 1.9.95	4.8.95	85%	A	The Group has been prosecuted but not Chance & Hunt.
ICI Chemicals & Polymers (passed from Alcoholds Ltd)	Distribution Department, P.O. Box 14, The Heath, Runcorn.WA7 4QC	Nitric Acid; Di - n - Butylamine; Sulphuric Acid; Caustic Soda;	AO AO AO PAA, AO, PERSALTS, CAPA	4.8.95	11.9.95	76%	B	
Ingetra AG	Steingraben 28, 4051, Basel, Switzerland	Sodium Chloride Tincal	AO Persalts	4.8.95 + reminder 1.9.95	Letter 24.8.95 -	72%	C	
ISP (G.B.) Co. Ltd	Tilson Road, Wythenshawe, Manchester. M23 9PH	1,4 Butanediol	CAPA	17.7.95 + 23.8.95 + 8.10.95				

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Johnson Matthey Plc	AC Evans, Materials Technology Division, Orchard Road, Royston, Hertfordshire. SG8 5HE	Palladium Chloride	AO	17.7.95 + reminder 23.8.95		82%	A	
K + K Greef Chemicals Ltd	Argyle House, Stanley Green Industrial Estate, Handforth, Wilmslow. SK9 3RN	Di - n - Butylamine	AO	4.8.95	29.8.95	46%	E	Distributors
Kali und Salz GmbH	Mr Landsrath, Postfach 10 20 29, D-34111 Kassel.	Magnesium Sulphate	PERSALTS	17.7.95 + reminder 23.8.95	5.9.95 - letter+ 8.10.95			Information Provided - No time to complete the questionnaire
L'Air Liquide	Department Chimique, 75 Quay D'Orsay, 75321 Paris. Cedex 07 France	Sillicalit	AO	4.8.95 + reminder 1.9.95				
Laporte Absorbents Ltd (do not manufacture)	B Massey, P.O. Box 2, Moorfield Road, Widnes, Cheshire WA 8 0JU	Sulphuric Acid	AO	4.8.95 + 1.9.95 + 8.10.95		56%		Sulphuric Acid is not manufactured on their Site - requested questionnaire is passed to manufacturer.
Merck Ltd	W G Blakey, Merck House, Sheldon Road, Poole.	Methyl Red			1.11.95	71%	B	Prosecuted in 1990 for disposal of hazardous waste to unlicensed tip. Products manufactured in Germany.
Mitsui + Co. U.K. Plc	20 Old Bailey, London.EC4M 7QQ	Ethyl Anthraquinone	AO	4.8.95		65%	C	

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
MG Gas Products Ltd	P Gallimore, Station Road, Coleshill, Birmingham, B46 1JY	Nitrogen				32%	F	Although the company has a policy there appears to be no follow up action or improvements planned.
Perstorp Ferguson Ltd	Roland Derkow, Aycliffe Industrial Estate, Newton, Aycliffe, County Durham. DL5 6EF	Pentaerithnitol Tri methylolpropane	CAPA	4.8.95 + reminder 1.9.95	23.10.95	67%	C	
Peter Whiting (Chemicals) Ltd	5 Lord Napier Place, Upper Mall, London. W6 9UB	Sodium Acid Pyrophosphate; Sodium Hexametaphosphate	AO, Persalts	17.7.95		32%	F	The company has no policy although states they have an improvement programme - only 15 people are employed.
PGP Industries	European Sales Office, Bishops Court, 17A The Broadway, Old Hatfield, Hertfordshire. SG8 5HE	Palladium Chloride	AO	4.8.95 + reminder 1.9.95	20.7.95			
Prolabo	Liverpool Road, Eccles, Manchester. M30 7RT	Ammonium Nitrate; Acetic Acid; Sulphuric Acid	AO	4.8.95 + 8.10.95		10%	F	Plans to implement BS 7750 by 1996. (Requested that questionnaire sent to Prolabo France the manufacturers).

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Raschig U.K. Ltd	Dock Office, Trafford Road, Salford Quays, Salford. M5 2XB	Dipiclonic Acid	PAA	4.8.95 + reminder 1.9.95	21.8.95			
Raschig AG	Dr Loscher Mundenheimer Str. 100 D-67061 Ludwigshafen	Topanol / BHT	CAPA		11.12.95	60%	C	Manufacturers of Topanol which is distributed by ICI Chance & Hunt.
Rhone Poulenc U.K. Ltd - now known as Prolabo.	See Prolabo Details.			17.7.95			N/A	See Prolabo
RWE-DEA Aktiengesellschaft	Dr. Thomas Rappert, Uberseering 40, 22297 Hamburg.	Cetyl Alcohol	CAPA	9.10.95	23.10.95	92%	A	Committed to EMAS.
Salt Union Ltd	Kay Monaghan; Mersey View Road, Weston Point, Runcorn, Cheshire. WA7 4HB	Sodium Chloride (PDV & Thawrox"	PERSALTS	4.8.95 + reminder 1.9.95	21.8.95.	45%	D	
Shell Chemicals U.K. Ltd	Nancy McKee, Heronbridge House, Chester Business Park, Chester.CH4 9QA	Aromatic Hydrocarbon Di Ethylene Glycol	AO CAPA	4.8.95 + reminder 1.9.95	1.11.95	75%	B	

APPENDIX 2.11: SOLVAY INTEROX'S EMS - RESULTS OF SUPPLIER ASSESSMENTS

Supplier	*Contact Name & Address*	*Product(s) Supplied*	*Plant*	*Date Sent*	*Date Rec*	*Score*	*Grade*	*Comments*
Sutcliffe Speakman	Guest Street, Leigh, Lancashire.WN 7 2HE	Activated Carbon	AO	4.8.95 + reminder 1.9.95				
Tennants Ltd (Distributors)	C McKenzie, Hazelbottom Road, Cheatham, Manchester. M8 7GR	Ammonia; Industrial Methylated Spirits; Acetic Anhydride;	AO CAPA PAA	17.7.95 + reminder letter 23.8.95	25.08.95	42%	E	
Union Carbide		Diethylene Glycol ?					?	
William Blythe + Co Ltd	Holland Bank Works, Church, Accrington, Lancashire. BB5 4PD	Sodium Stannate Magnesium Sulphate	AO Persalts	4.8.95		57%	D	

Total Sent = 51

APPENDIX 2.12: SOLVAY INTEROX'S EMS - EMISSION INVENTORY CHECKLIST

YEAR ________

EMISSION INVENTORY CHECKLIST			
Information Required	**Procedure**	**Resp.**	✓
EFFLUENTS			
River Mersey:			
Average C.O.D (mg/l)	8.1 EI 2		
Average H_2O_2 (mg/l)	8.1 EI 2		
Average B_2O_3 (mg/l)	8.1 EI 2		
Average Boron (t/a)	8.1 EI 2		
Tonnes C.O.D (t/a)	8.1 EI 2		
Tonnes H_2O_2 (t/a)	8.1 EI 2		
Tonnes Boron (t/a)	8.1 EI 2		
Consent Fails (%)	8.1 EI 2		
Breakdown of C.O.D ex Well Water (te/a)	8.1 EI 2		
Caprolactone to Sewer:			
Total Flow (m^3/a)	8.1 EI 2		
Average C.O.D (mg/l)	8.1 EI 2		
Tonnes C.O.D (t/a)	8.1 EI 2		
Tonnes Suspended Solids (t/a)	8.1 EI 2		
Consent Fails (%)	8.1 EI 2		
Effluent Charges (£/a)	8.1 EI 2		
AO to Sewer:			
Total Flow (m^3/a)	8.1 EI 2		
Average C.O.D (mg/l)	8.1 EI 2		
Average Suspended Solids (mg/l)	8.1 EI 2		
Tonnes of C.O.D (t/a)	8.1 EI 2		
Tonnes of Suspended Solids (t/a)	8.1 EI 2		
Consent Fails (%)	8.1 EI 2		
Effluent Charges (£/a)	8.1 EI 2		
Tonnes Quinone & Derivatives (t/a)	8.1 EI 2		
Tonnes Di-n-Butylamine	8.1 EI 2		
Persalts to River			
Tonnes of COD ex PBS-4	8.1 EI 2		
Tonnes of COD ex PCS	8.1 EI 2		
Mercury & Cadmium Releases			

APPENDIX 2.12: SOLVAY INTEROX'S EMS - EMISSION INVENTORY CHECKLIST

EMISSION INVENTORY CHECKLIST			
Information Required	**Procedure**	**Resp.**	✓
Persalts NaOH usage	8.1 E1 4		
AO Plant NaOH usage	8.1 E1 4		
Boiler House Effluent Av Hg & Cd (mg/l)	8.1 EI 2		
Boiler House Effluent Flows (m^3/a)	8.1 EI 2		
New DMW Plant NaOH usage	8.1 E1 4		
New DMW Effluent Average Hg (mg/m^3)	8.1 EI 2		
New DMW Effluent Flow (m^3/a)	8.1 EI 2		
Average Hg & Cd in well water	8.1 EI 2		
Average Hg in NaOH	8.1 EI 2		
Hg ex Old DMW Plant (g/a)	8.1 EI 2		
Cd ex Old DMW Plant (g/a)	8.1 EI 2		
Hg ex Boiler House (g/a)	8.1 EI 2		
Cd ex Boiler House (g/a)	8.1 EI 2		
Hg ex New DMW Plant (g/a)	8.1 EI 2		
Hg to River ex Perborate (g/a)	8.1 EI 2		
Hg to River ex Well Water (g/a)	8.1 EI 2		
Total Hg to River (g/a)	8.1 EI 2		
Breakdown of COD Releases	8.1 EI 2		
Site COD Release	8.1 EI 2		
Chloride Ions (te/a)	8.1 EI 2		
NRA & HMIP Charges	8.1 EI 2		
WASTE			
Tincal Sludge (t/a)	8.1 EI 3		
Tincal Sludge Disposal Costs (£/a)	8.1 EI 3		
Tincal Slurry (t/a)	8.1 EI 3		
Tincal Slurry Disposal Costs (£/a)	8.1 EI 3		
Capa Residues (t/a)	8.1 EI 3		
Capa Residues Disposal Costs (£/a)	8.1 EI 3		
Capa IMS/Caustic	8.1 EI 3		
Capa IMS/Caustic Disposal Costs (£/a)	8.1 EI 3		
AO Tars (t/a)	8.1 EI 3		
AO Tars Disposal Costs	8.1 EI 3		
Lab Waste Solvents (t/a)	8.1 EI 3		
Lab Waste Solvents Disposal Costs	8.1 EI 3		
Misc. Special Wastes (t/a)	8.1 EI 3		

APPENDIX 2.12: SOLVAY INTEROX'S EMS - EMISSION INVENTORY CHECKLIST

EMISSION INVENTORY CHECKLIST			
Information Required	**Procedure**	**Resp.**	✓
Misc. Special Wastes Disposal Costs (£/a)	8.1 EI 3		
Misc. Non-Special (t/a)	8.1 EI 3		
Misc. Non-Special Disposal Costs (£/a)	8.1 EI 3		
Capa Polymeric Waste (t/a)	8.1 EI 3		
Special Incinerated Waste (t/a)	8.1 EI 3		
Physico-chemical Treatment (t/a)	8.1 EI 3		
Special Waste Landfilled (t/a)	8.1 EI 3		
Municipal Waste Landfilled (t/a)	8.1 EI 3		
Boilers:			
Gas Consumed	8.1 EI 4		
Oil Consumed	8.1 EI 4		
Tonnes Steam Produced	8.1 EI 4		
Average NO_x mg/Nm^3	8.1 EI 1		
Average SO_2 mg/Nm^3 (Gas Oil Only)	8.1 EI 1		
Average Dust mg/Nm^3	8.1 EI 1		
Average CO mg/Nm^3	8.1 EI 1		
Average CO_2 mg/Nm^3	8.1 EI 1		
NO_x Factor (g/te steam)	8.1 EI 1		
SO_2 Factor (g/te steam - oil only)	8.1 EI 1		
Dust Factor (g/te steam)	8.1 EI 1		
CO Factor (g/te steam)	8.1 EI 1		
CO_2 Factor (g/te steam)	8.1 EI 1		
Tonnes SO_2	8.1 EI 1		
Tonnes NO_x	8.1 EI 1		
Tonnes Dust	8.1 EI 1		
Tonnes CO	8.1 EI 1		
Tonnes CO_2	8.1 EI 1		
Gas Energy	8.1 EI 1		
Oil Energy	8.1 EI 1		
AO Off-Gas			
Average VOC as Toluene (mg/Nm^3)	8.1 EI 1		
Total Flow through Beds (Nm^3/a)	8.1 EI 1		
Tonnes VOC as Toluene	8.1 EI 1		
Tonnes VOC as Carbon	8.1 EI 1		

APPENDIX 2.12: SOLVAY INTEROX'S EMS - EMISSION INVENTORY CHECKLIST

EMISSION INVENTORY CHECKLIST			
Information Required	**Procedure**	**Resp.**	✓
Tonnes Hydrocarbon	8.1 EI 1		
PAA Plant:			
Tonnes PAA Produced ex Reactor	8.1 EI 4		
Tonnes HAC used (Reactor & Bulk)	8.1 EI 4		
HAC released ex storage (g/te HAC used)	8.1 EI 1		
Tonnes of HAC released ex storage (te/a)	8.1 EI 1		
HAC released ex reactor (kg/te batch)	8.1 EI 1		
Tonnes of HAC released ex reactor (te/a)	8.1 EI 1		
Tonnes of VOC ex reactor as toluene (te/a)	8.1 EI 1		
Total Tonnes of HAC released	8.1 EI 1		
Total Tonnes VOC expressed as Carbon	8.1 EI 1		
Capa Plant:			
Tonnes of HAC Used (te/a)	8.1 EI 4		
Tonnes of Cyclohexanone Used (te/a)	8.1 EI 4		
Cyclohexanone Released (g/te used)	8.1 EI 1		
Tonnes of Cyclohexanone Released (te/a)	8.1 EI 1		
Tonnes of ketone as toluene (te/a)	8.1 EI 1		
HAC Released (g/te used pre quench tanks)	8.1 EI 1		
HAC Released (g/te used post quench tanks)	8.1 EI 1		
Tonnes of HAC released (te/a)	8.1 EI 1		
Tonnes of HAC released as toluene	8.1 EI 1		
Persalts:			
Tonnes of PBS-4 Produced	8.1 EI 4		
Tonnes of PBS-1 Produced	8.1 EI 4		
Tonnes of PCS Produced	8.1 EI 4		
Tonnes of Dust ex PBS-4	8.1 EI 1		
Tonnes of Dust ex PBS-1	8.1 EI 1		
Tonnes of Dust ex PCS	8.1 EI 1		
Tonnes of CO2 ex PBS-1 Burners	8.1 EI 1		
Tonnes of CO ex PBS-1 Burners	8.1 EI 1		
Tonnes of NOx ex PBS-1 Burners	8.1 EI 1		
	8.1 EI 1		
CIA RETURNS			

APPENDIX 2.12: SOLVAY INTEROX'S EMS - EMISSION INVENTORY CHECKLIST

EMISSION INVENTORY CHECKLIST			
Information Required	**Procedure**	**Resp.**	✓
Data on Environmental Spending	8.1 EI 5		
Safety Information - Lost Time Accidents	8.1 EI 5		
Environmental Information	8.1 EI 5		
Distribution Information	8.1 EI 5		
Energy Consumption Information	8.1 EI 5		
Communication	8.1 EI 5		
Occupational Health Information	8.1 EI 5		
Management Systems	8.1 EI 5		
Product Stewardship	8.1 EI 5		
AO (H_2O_2 @ 100%)	8.1 EI 5		
Capa (Monomer Production)	8.1 EI 4		
PAA	8.1 EI 4		
PBS -1	8.1 EI 4		
PBS - 4	8.1 EI 4		
PCS	8.1 EI 4		
Steam Produced	8.1 EI 4		
Total te/a of Product Produced	8.1 EI 4		

APPENDIX 2.13: SOLVAY INTEROX'S EMS - INTERNAL AUDIT SCHEDULE

ACTIVITY	*Clause**	*JAN*		*FEB*		*MAR*		*APR*		*MAY*		*JUNE*		*JULY*		*AUG*		*SEPT*		*OCT*		*NOV*		*DEC*	
Environmental Policy	4.1	G																							
Environmental Effects	4.2.1			G																					
Legal & Other Requirements	4.2.2					G																			
Objectives & Targets	4.2.3							G																	
Environmental Programme(s)	4.2.4									G															
Structure & Responsibility	4.3.1											G													
Training, Awareness & Competance	4.3.2													G											
Communication	4.3.3															G									
EMS Documentation	4.3.4																	G							
Document Control	4.3.5																			G					
Operational Control	4.3.6	P	C		A		L	P	C		A		L	P	C		A		L	P	C		A		L
Emergency Preparedness & Response	4.3.7	L	P	C		A		L	P	C		A		L	P	C		A		L	P	C		A	
Monitoring & Measurement	4.4.1		L	P	C		A		L	P	C		A		L	P	C		A		L	P	C		A
Bund Emptying	4.3.6	A		L	P	C		A		L	P	C		A		L	P	C		A		L	P	C	
Waste Management	4.3.6		A		L	P	C		A		L	P	C		A		L	P	C		A		L	P	C
Tanker Offloading	4.3.6			A		L	P	C		A		L	P	C		A		L	P	C		A		L	P
Corrective and Preventative Action	4.4.2		G																						
Records	4.4.3				G																				
EMS Audit	4.4.4						G																		
Management Review	4.5								G																

* Based on BS EN ISO 14001 1996
P = Persalts, C = Capa, A = AO, L = Labs, B = Peracetic Acid Plant, G = Environment Group

APPENDIX 2.14: SOLVAY INTEROX'S EMS - ONGOING MAINTENANCE REQUIREMENTS

ENVIRONMENTAL MANAGEMENT SYSTEM SCHEDULE															
	Frequency	Time	Resp	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Update Emission Inventories	1 year	4 weeks	EG												
Update Effects Assessment	1 year	2 weeks	EG												
Waste Minimisation Reviews	1 year	2 weeks	EG												
Update Objectives & Targets	1 year	2 weeks	EG												
Update Improvement Programme	1 year	2 weeks	EG												
Update Register of Regs	1 year	1 week	EG												
Develop Audit Schedule	1 year	0.5 day	EG												
Environmental Audits	2 weeks	0.5 day	Auditors												
Environmental Training	1 year	2 weeks	EG												
Management Review Meetings	6 months	0.5 day	EG			*						*			
Enviro-Hazop Reviews	5 years	4 weeks	Harards												
Review Manual & Procedures	2 years	2 weeks	EG												
Review S.O.Ps & Task Instructions	2 years	2 weeks	Plants												
Supplier Assessments	2 years	1 week	EG												

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