

UNIVERSITY OF STRATHCLYDE
Department of Architecture and Building Science

THE DESIGN AND
IMPLEMENTATION OF A GENERIC
ENVIRONMENTAL MANAGEMENT
SYSTEM

By

KENNETH M'DONACH

July 2000

A thesis submitted as fulfilment of the requirements for the
Degree of Doctor of Philosophy

The copyright of this thesis belongs to the author under the terms of the United Kingdom Copyright Acts as qualified by University of Strathclyde Regulation 3.49. Due acknowledgement must always be made of the use of any material contained in, or derived from, this thesis.

Abstract

In the early 1990s, environmental management systems were a new concept for the vast majority of organisations. Some specialist bespoke systems existed but were very specific to their particular organisation and did not conform to any common standard other than that laid down by legislation.

In 1992, the British Standards Institute introduced BS 7750 the world's first environmental management system standard which was subsequently superseded by the International Organisation for Standardisation standard ISO 14001 in 1996. These standards were the new and evolving models for management of the environment by any organisation.

The fundamental questions addressed by this research:

1. What are the underlying hurdles that any organisation will need to overcome in order to successfully implement ISO 14001 and achieve certification?
2. Can the mechanisms and/or methodologies used to address these hurdles be made generic such that they can travel without modification and be independent of context?

Early in the research programme, the opportunity arose to develop this concept with the involvement of the National Health Service in Scotland. The NHS in Scotland offered an excellent opportunity to research, develop and test a system to address the above questions. The NHS in carrying out its range of activities and services encompasses a large variety of impacts on the environment and therefore offered an appropriate vehicle for study.

This thesis will describe the process by which an environmental management system (i.e. GREENCODE™) with generic characteristics came to be designed and successfully implemented.

It will also demonstrate how the principles of an ISO 14001 system can be used as an effective engine for change in other management areas and how the generic nature of the unique solutions and innovative methodologies developed within the GREENCODE™ system could be used to address other site management issues such as Occupational Health and Safety.

GREENCODE™ is a registered trademark of the NHS in Scotland Property & Environment Forum. Copyright of the system is owned by the Borders General Hospital Trust on behalf of the NHS in Scotland Property & Environment Forum.

Acknowledgements

Firstly, I would like to thank my supervisor Dr Paul Yaneske of the Department of Architecture and Building Science for his unwavering commitment and support throughout this research. There is no doubt in my mind that without this support during some difficult times this research would never have been completed. It has been an absolute pleasure to work with someone so willing to approach problems with an open mind and engage in stimulating discussions whilst still possessing the skill of systematically guiding and encouraging you to achieve your objective.

I am indebted to the Executive of the NHS in Scotland Estates Environment Forum (now Property & Environment Forum) for their support in funding of the GREENCODE research and development programme.

I would like to thank all the members of the Safety & Environmental Management Unit within the Department of Architecture and Building Science, in particular Andy Sloey and John McLachlan for their support and commitment during this research.

Finally, I would like to express my sincere thanks to my family for their commitment, encouragement and support. I would like to thank my brother for being the pioneer of higher education within the family and for showing me, through his own achievements, what was possible. I would particularly like to thank my mother and my late father for their encouragement and support throughout my education, and for their visionary approach to life and sacrifices they made which enabled me to pursue this higher level of education.

List of Tables

Figure 1:	Screen 1 – Audit Performance	64
Figure 2:	Screen 2 – Audit Performance	65
Figure 3:	Screen 3 – Audit Weaknesses & Action Details	66
Figure 4:	GREENCODE Main Prioritisation Screen	67
Figure 5:	Significant Environmental Aspects Worksheet	68
Figure 6:	Environmental Aspects Risk Assessment Worksheet	69

Contents

<u>Abstract</u>	i
<u>Acknowledgements</u>	iii
<u>List of Tables</u>	iv
<u>Contents</u>	v
Chapter 1	1
Background	1
The Fifth Environmental Policy and Action Programme	3
The Intergovernmental Panel on Climate Change (IPCC)	5
The Role of Environmental Management Systems	6
BS 7750 'Specification for Environmental Management Systems'	7
ISO 14001 Environmental Management System	8
ISO 14001 and Sustainable Development	10
Chapter 2	12
Review of Environmental Management Systems and Tools	12
Environmental Management Systems	13
Chemical Manufacturers Association (Responsible Care®)	13
EQS - Environment Quality and Safety systems software	15
Confederation of British Industry Scheme (Environment Business Forum)	17
Environmental Management System Tools	19
NHS Sector Application Guide	20
NHS in Scotland Common Approach to Environmental Management	21
Review Conclusions	21
Chapter 3	24
Initial Environmental Review	24
The Project Management Process	26
Identification of Environmental Aspects and Level of Management Control	28
Register of Legislative, Regulatory and Other Policy Requirements	30
Selection of Environmental Aspects by the User on Site	34
GREENCODE Management Audits (Profile)	34
Background to 'Profile'	35
Responses and Scoring System	37
Audit Reports	37
GREENCODE Question Set Structure	39
'Significant' Environmental Aspects	41
Collation of Records	44
Initial Strategic Objectives	44
Accompanying Documentation and System Documentation Structure	45

Chapter 4	51
GREENCODE Phase 1 Pilot Programme Case Study	51
Progress Meeting 1 (1st October 1996)	53
Progress Meeting 2 (22nd October 1996)	55
Progress Meeting 3 (12th November 1996)	57
Progress Meeting 4 (26th November 1996)	58
Final Progress Meeting (10th December 1996)	59
Review of Findings and Implementation of Solutions	60
Chapter 5	63
New Environmental Significance Rating and Prioritisation Methodology	63
GREENCODE Audits	64
Significant Environmental Effects	68
New Significant Aspects Module	73
Management Factor & Pollution Factor	75
Significance Rating	78
New Prioritisation Module	79
Chapter 6	84
Development of Documentation and ISO 14001 Certification Pilot	84
Documentation Development	84
(MP) Setting Objectives & Targets (GREENCODE Document 3.1.6)	85
(MP) Generating Management Programme (GREENCODE Document 3.1.7)	86
(MP) Training Identification & Co-ordination (GREENCODE Document 3.1.8)	87
(MP) Monitoring & Measurement (GREENCODE Document 3.1.9)	88
(MP) Incident Reporting (GREENCODE Document 3.1.10)	89
(MP) Communication (Internal & External) (GREENCODE Document 3.1.11)	89
(MP) Emergency Preparedness & Response (GREENCODE Document 3.1.12)	90
(MP) Operational Control (GREENCODE Document 3.1.13)	91
(MSP) Format of Documents (GREENCODE Document 3.2.1)	92
(MSP) Document Control (GREENCODE Document 3.2.2)	92
(MSP) Auditing & Audit Programme (GREENCODE Document 3.2.3)	93
(MSP) Non-conformance Reports (GREENCODE Document 3.2.4)	95
(MSP) Control of Records (GREENCODE Document 3.2.5)	95
(MSP) Environmental Management Review (GREENCODE Document 3.2.6)	96
The ISO 14001 Pilot	97
Chapter 7	108
Summary	108
Conclusions	111
Future Research	117
References	119
Appendices	122

Chapter 1

Background

Since the early 1970s, there has been a dramatic increase in international cooperation to address both global and local environmental issues. This is reflected in the adoption of a large number of international conventions. Environmental issues are now prominent within the work programmes of the European Union (EU) and all the major organisations such as the United Nations, the Organisation for Economic Co-operation and Development and the World Trade Organisation.

International co-operation has culminated in such things as the 'Montreal Protocol on Substances that Deplete the Ozone Layer (1987)⁽¹⁾' and 'The United Nations Conference on Environment and Development, held in Rio de Janeiro in June 1992' (Rio Earth Summit⁽²⁾). The Montreal Protocol began to address the problem of world wide contribution to ozone depletion. The Rio Summit also dealt with the issue of ozone depletion but widened the scope of areas to be addressed to such topics as biodiversity, deforestation etc.

As stated in the UK Government's White Paper on the environment 'This Common Inheritance 1990⁽³⁾', "There is now international consensus that degradation of natural resources, poverty and unsustainable patterns of production and consumption are not separate issues but are in fact closely linked".

The Rio Summit involved the participation of some 130 heads of state or government and resulted in the adoption of:

- The Rio Declaration, which is a charter of basic principles on environment and development;
- Two new major conventions on Climate Change and Biodiversity;

- Agenda 21 which establishes a set of practical action programmes in all relevant areas to be followed by countries in their environment and development policies towards the 21st century;
- Agreement on a statement of principles on forests as a precursor to a more comprehensive international convention; and
- Agreement on the commencement of negotiation for a convention on desertification which has since been concluded.

Through the adoption of such conventions and action programmes, the European Union (EU) has become a leading force for progress at international level in efforts to deal with global environmental problems and to promote the pursuit of sustainable development.

The EU has developed a comprehensive approach to the protection of the environment through its Fifth Environmental Policy and Action Programme (Towards Sustainability)⁽⁴⁾. When reading this document it becomes clear that its successful implementation depends on the proper integration of environmental considerations into other policies including industry, agriculture, energy, transport and tourism.

The major developments that have taken place in environment policy at European level during recent years have been:

- The strengthening of the provisions relating to environment policy in the Treaty on European Union;
- The adoption of the Fifth Environmental Policy and Action Programme (Towards Sustainability); and
- The establishment of the European Environment Agency.

The Treaty on European Union⁽⁵⁾, which came into effect on 1 November 1993, introduces as a principal objective the promotion of sustainable growth respecting the environment (Article 2). It requires that environmental protection requirements be

integrated into the definition and implementation of other community policies (Article 13OR(2)).

The EU's Fifth Environmental Policy and Action Programme (Towards Sustainability)⁽⁴⁾ has moved community environment policy away from a reliance on regulatory/control systems in preference to the achievement of sustainable development by ensuring the integration of environment considerations into other policy areas.

The programme is based on shared responsibility on the part of all "principal actors" in society. It aims at promoting such sharing through implementation of a broad range of instruments including legislation, market related measures, financial support mechanisms, information, education and training.

The European Environment Agency undertook a review of the Fifth Action Programme in November 1995. The report, 'Environment in the European Union'⁽⁶⁾, concluded that insufficient progress is being made to reduce pressures on the environment and that there is need for policy acceleration.

The Fifth Environmental Policy and Action Programme

Recognition of the need to develop bottom-up approaches in pursuit of sustainable development is built into the EU's main framework for environmental policy, the Fifth Environmental Policy and Action Programme (Towards Sustainability).

The Fifth Environmental Policy and Action Programme constitutes a turning point for the Community. In the 1980s the emphasis was firmly on the completion of the internal market. The reconciliation of environment and development is one of the principal challenges facing the Community and the world in the 1990s and the millennium. The Fifth Environmental Policy and Action Programme is not a programme for the European Commission alone, nor one geared towards the environmentalists alone. It provides a framework for a new approach to the

environment and to economic and social development. It requires input at all levels of the political and corporate arena, and the involvement of all members of the public in order to make it work.

The Fifth Environmental Policy and Action Programme⁽⁴⁾, which sets the environmental agenda for the period 1993 to 2000 and beyond, was officially adopted in February 1993. In contrast to previous environment programmes, the Fifth Action Programme seeks to address the root cause of environmental problems rather than treating the symptoms. It seeks to initiate change in current trends and practices and ultimately to achieve change in patterns of human consumption and behaviour.

Through the Fifth Environmental Policy and Action Programme, the EU recognises that the previous top down approach to environment policy based on legislation, was characterised by a considerable gap between those who formulated policy and those who implemented it. The essential elements of the new approach involve internal integration between the various environmental issues and external integration of environmental objectives into other EU policies. The concept of joint and shared responsibility for the environment between the EU and member states, along with other relevant partners, including local governments is also an essential element of the new approach.

The involvement of individual members of the public in the Fifth Environmental Policy and Action Programme is problematic since it relies on individuals being aware of their rights and responsibilities and on the provision of mechanisms to facilitate their involvement. Implementation of the directive on the 'Freedom of Access to Environmental Information'⁽⁷⁾ may go some way towards filling information gaps and providing basic rights. However, the development of local mechanisms for citizen involvement is likely to prove more effective.

Further policy areas picked out for detailed treatment in the Fifth Environmental Policy and Action Programme identify transport and industry amongst the important

sectors for which integrated approaches to sustainable development must be adopted. The programme also places considerable emphasis on the role of land use and strategic planning to achieve many of the programme objectives.

The European Union has for some time been considering the extension of the principle of environmental assessment to the preparation of policies, plans and programmes. Currently the environmental impact assessment directive⁽⁸⁾ applies only to major development projects.

In many ways, the Fifth Environmental Policy and Action Programme⁽⁴⁾ exemplifies an approach to sustainable development that is becoming widely accepted. It is a strategic programme, setting objectives and targets, identifying those responsible for implementation and indicating a range of techniques originally targeted at the manufacturing industry. To achieve the goals in terms of sustainability there needs to be a change in attitude away from traditional economic growth to that of sustainable development.

The Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC), which was established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO), set up three working groups and issued a highly influential First Assessment Report in 1990⁽⁹⁾. Working Group I concentrated on science, Working Group II studied impacts, and Working Group III analysed possible response options. The First Assessment Report, and the 1992 Supplement, have been widely hailed as the most authoritative statements on climate change made by the scientific and expert community so far.

The Second Assessment Report⁽¹⁰⁾ published in 1995 by Working Group II, details 18 potential areas that could be affected by climate change e.g. weather patterns, human health, oceans and deforestation. Due to the estimated damage which can be caused by changes in crop growth, freak storms and rising tides the international community

is beginning to adopt a more sustainable economic approach to its operations and way of life.

What is encouraging over recent years is that such issues are being discussed at the very highest levels. The international community is beginning to think in line with the recognised definition of sustainable development offered by the Brundtland Commission⁽¹¹⁾, which states that sustainable development is:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

No matter what business operations or living patterns exist within different international communities, impacts on the environment are inevitable. Energy is used in homes, in the workplace or for travelling to and from these and other locations. To facilitate these living and working habits there is a demand on the use of land for homes, workplaces and recreational facilities. Each day water is utilised, at some stage, wastes are produced, and to sustain this level of existence raw materials and products are purchased from others.

The Role of Environmental Management Systems

Environmental management systems tend to focus not only on the above issues but on other issues such as use of natural resources and pollution to air, land and water.

The use of explicit environmental management systems in the workplace can facilitate the raising of awareness of employees about environmental issues such as those mentioned above. Such systems also encourage a sense of ownership by employees and can improve relationships within the organisation. Furthermore, these employees then take these concepts home and implement them as parents and/or members of the community thus proliferating the concept of a more sustainable approach to every day life.

BS 7750 'Specification for Environmental Management Systems'

In response to a perceived need for guidance in the area of environmental management, the British Standards Institution (BSi) developed a standard addressing this problem. BSi has a long and distinguished history of providing technical standards and other services to industry and it has responded to the needs of British industry and the consumer since the beginning of the century. In response to this need for guidance, BSi started its own environmental initiative.

As part of this initiative, BSi published a new standard BS 7750 'Specification for environmental management systems'⁽¹²⁾, the world's first standard in this area. BS 7750 provided the basis upon which organisations could establish, develop and maintain effective environmental management systems. The standard complemented BS/ISO 9000⁽¹³⁾ Quality Systems and the European Community (EC) Regulation 'Eco-Management and Audit Scheme' (EMAS)⁽¹⁴⁾.

Before introducing BS 7750, BSi decided to run a pilot programme. The first step in this process was to invite interested parties to take part. BSi initially aimed for 100 organisations with 40 of them implementing the standard. When entry to the pilot programme was officially closed, there were 490 participating organisations with 228 of them implementing the standard. It was the most successful uptake of any quality-based system in the history of BSi.

The pilot programme had three objectives, which were to obtain feedback on:

- Proposed changes to the text of BS 7750;
- Experiences of the implementation of BS 7750; and
- Views on the need for a sector application guide.

BS 7750 was designed to enable any organisation to establish an effective management system as a foundation both for sound environmental performance and for participation in environmental auditing schemes. The adoption of such a system

assists organisations to ensure and demonstrate compliance with stated environmental policies and objectives.

In October 1997, BS 7750⁽¹²⁾ was formally withdrawn in favour of the international standard ISO 14001 'Environmental management systems – Specification with guidance for use'⁽¹⁵⁾, and is consequently no longer in print.

ISO 14001 Environmental Management System

The International Organisation for Standardisation (ISO) is a world-wide federation of national standards bodies from some 130 countries, one from each country. ISO is a non-governmental organisation established in 1947. The mission of ISO is to promote the development of standardisation and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing co-operation in the spheres of intellectual, scientific, technological and economic activity. ISO's work results in international agreements which are published as International Standards. One such standard is ISO 14001 for environmental management systems.

Since the Rio Earth Summit in 1992, the concept of sustainable development has been unfolding throughout the world. Businesses have recognised that there should be a common goal, not a conflict, between economic development and environmental protection, both now and for future generations. Organisations of all types have been finding it difficult to identify a set of practical tools to implement strategies supporting this concept.

ISO 14001 is designed to help organisations put in place the necessary structures to ensure that their operations comply with environmental laws and that the major environmental risks and liabilities are properly identified, minimised and managed.

There are five main elements to ISO 14001⁽¹⁵⁾ as listed below.

- **An environmental policy statement.** This should commit an organisation to legislative and regulatory compliance, continual improvement, the prevention of pollution and to appropriate objectives and targets based on their significant environmental aspects;
- **Planning.** This covers a review of environmental aspects, legal and other requirements and objectives and targets plus the setting up of an environmental management programme to achieve them;
- **Implementation and operation.** This includes management structure, training, communications, documentation, operational control and emergency preparedness. It entails providing resources, defining who does what, identifying training needs, communicating effectively and exerting effective control over the activities relevant to the organisation's significant environmental aspects;
- **Checking and corrective action.** This entails using accurate measurement methods to regularly check that progress towards objectives and targets is on course and taking action to rectify any non-conformances relating to the environmental policy, objectives & targets or legal requirements. It also entails recording the operation of environmental management systems and conducting audits to identify problems and to prove conformity with the organisation's requirements; and
- **Management review.** This is necessary to close the loop and is where the organisation takes a step back to determine if the system is still suitable, adequate and effective in delivering the policy commitments and achieving the stated objectives and targets.

Put simply, ISO 14001⁽¹⁵⁾ provides a mechanism for ensuring that the organisation:

- Considers the environment;
- Decides what needs to be done about its impact on the environment;
- Identifies how this will be done;
- Implements a plan of action;
- Corrects deviations from the plan; and
- Reviews its directions for the future so that it can improve its overall environmental performance.

External certifiers, who are formally accredited under the scheme run by the UK Accreditation Service (UKAS), carry out certification for compliance with the standard in the UK.

UKAS is recognised by the British Government as the UK national body responsible for assessing and accrediting the competence of organisations in the fields of calibration, measurement, testing, inspection and the certification of systems, personnel and products. UKAS was formed by the merger of NAMAS (National Measurement Accreditation Service) and NACCB (National Accreditation Council for Certification Bodies).

ISO 14001 and Sustainable Development

As has been stated earlier, one of the main ingredients of the Fifth Environmental Policy and Action Programme⁽⁴⁾ is the changing of behaviour. Other important aspects of the programme are, making people within the European Union more aware of their impact on the environment, helping them change their attitudes towards the environment and contribute to the ultimate goal of reducing the amount of pollution entering the environment.

ISO 14001 puts in place the beginnings of a sustainable system. It does this by identifying the environmental impacts of an organisation, making individuals aware

of the environmental impacts caused by the activities they carry out or have responsibility for and giving a commitment to continual improvement.

Through clause 4.3.1 of ISO 14001⁽¹⁵⁾ an organisation is required to “establish and maintain procedures to identify the environmental aspects of its activities, products or services that it can control... to determine those which have, or can have, a significant impact on the environment”.

Once furnished with this information, under clause 4.4.2 ‘Training, awareness and competence’ the organisation is required to “establish and maintain procedures to make its employees or members at each relevant functions and level aware of the significant environmental impact, actual or potential, of their work activities....”.

Through clause 4.2 ‘Environmental Policy’ the organisation is required to give a commitment to continual improvement in environmental performance and a commitment to the prevention of pollution.

Thus, ISO 14001 provides a foundation for sustainability and the use of such environmental management systems can therefore have an advantage for any organisation and can assist with the educational process to facilitate the change in behaviour and reduction of pollution sought by the Fifth Environmental Policy and Action Programme.

It must be stressed however, that ISO 14001 offers only a foundation upon which more must be built to create a more comprehensive sustainable development system, but it is an excellent starting point.

The use of environmental management systems is likely to become more widespread. This has certainly been the case within the UK where over recent years the British Standard BS 7750⁽¹²⁾ and now ISO 14001 have been adopted widely within industry.

Chapter 2

Review of Environmental Management Systems and Tools

Before 1992, the literature available on the environment predominantly discussed global issues such as disruption of the eco-system, crop growth and the failure of food supplies, the exhausting of natural resources and the destabilising of global economies. All of these were linked in some major way to the ultimate collapse of society and/or the world economy⁽¹⁶⁾⁽¹⁷⁾⁽¹⁸⁾.

In the 1980s, scientists were responsible for bringing to the attention of the world evidence of global warming, of the depletion of the earth's ozone layer and of other environmental problems such as the loss of agricultural land to desert, all of which were claimed to threaten the very foundation of survival. There was a marked change in the tone of the literature during this time towards sustainable development and into areas about the true implementation of remedial action. However, this only dealt with action at government level⁽¹⁹⁾.

None of this early literature discussed in any way the role of environmental management systems at the level of organisations/companies and offered little more than background information in a global context.

In fact, there was no recognised national or international standard for environmental management systems until 1992. However, the UK led the world with the publication of BS 7750⁽¹²⁾ in that year, the world's first national standard for environmental management systems. Of itself, such a standard does not guarantee a generic system since any organisation is free to interpret its requirements in its own context. A truly generic system would have the following characteristics:

- A common and consistent approach;
- Be independent of context;
- Provide mechanisms to gather and analyse data in a consistent manner; and
- Allow migration of data to form corporate, regional and national overviews.

Environmental Management Systems

A review was undertaken to ascertain what was available at this time which could inform or indeed assist with the development of a generic environmental management system.

Environmental management systems were in existence within a number of large organisations around the world and were regarded as models of good practice. One such approach within the chemical industry was called "Responsible Care^{®(20)}".

Late in 1991, BS 7750 was published in Draft form and from then on other systems/tools began to appear to help users address the requirements of the standard. BS 7750 identified the important issues and areas to be addressed with respect to environmental management systems and formed the basis for a common and consistent approach to environmental management.

Systems such as EQS - Environment, Quality and Safety⁽²¹⁾ by Grannhern International, which was at this time the only software based system available, were building on the concepts they had adopted for health and safety. The Confederation of British Industry (CBI) environment initiative⁽²²⁾ was another option available to industry to show a responsible approach to environmental management.

Chemical Manufacturers Association (Responsible Care[®])

In 1988, the Chemical Manufacturers Association (CMA) launched Responsible Care^{®(20)} to respond to public concerns about the manufacture and use of chemicals. Through Responsible Care[®], member companies are committed to supporting a continuing effort to improve the industry's responsible management of chemicals.

There are 10 elements to the chemical industries' Responsible Care[®] system, two of which contain specific requirements relating to environmental management. These are Guiding Principles and six Codes of Practice.

The guiding principles behind Responsible Care^{®(20)} outline each member's commitment to Environmental, Health and Safety issues. Members make a pledge to manage the system according to these principles. There are four guiding principles that relate directly to the environment.

- Make health, safety and environment considerations a priority in their planning for all existing and new products and processes;
- Report promptly to officials, employees, customers and the public, information on chemical related health or environmental hazards and to recommend protective measures;
- Operate plant and facilities in a manner that protects the environment and the health and safety of employees and the public; and
- Participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.

At the heart of the Responsible Care[®] initiative are the six Codes of Management Practices. The Codes focus on management practices in specific areas of chemical operations. Members and Partners must make continuous progress in attaining the goals of each Code. Of the six, three codes relate directly to the environment.

1. The Community Awareness and Emergency Response Code – this code demands a commitment to openness and community dialogue. There are two major components to the Code.
 - Ensure that member facilities that manufacture, process, use, distribute or store hazardous materials initiate and maintain a community outreach program to openly communicate relevant, useful information responsive to the public's questions and concerns about safety, health, and the environment; and
 - Help protect employees and communities by assuring that each facility has an emergency response programme to respond rapidly and effectively to emergencies.

2. The Pollution Prevention Code - commits industry to the safe management and reduction of wastes; and
3. The Product Stewardship Code - makes health, safety and environmental protection an integral part of designing, manufacturing, marketing, distributing, using, recycling and disposing of products. The Code provides guidance as well as a means to measure continuous improvement in the practice of product stewardship.

The Responsible Care⁽²⁰⁾ system goes into great depth and covers more than just environmental issues. The system concentrates heavily on the health and safety aspects of the Chemical Industry's products but also takes account of the environmental implications associated with these products and their use, production and disposal.

The system was sector specific and was one of self-assessment with no national or international body that issued certification to the system. Therefore, it did not comply with the first two characteristics for a generic environmental management system. There are however, local groups and professional bodies around the world, which required their members to adopt the Responsible Care[®] system as a mandatory element to qualify for membership.

EQS - Environment Quality and Safety systems software

EQS⁽²¹⁾ is a customised database developed in Microsoft Access by Grannhern International and is available for purchase in separate modules. This means that a user of one module may add one or more of the additional modules at a later stage. Within this structure the management model contains items that are shared by the other modules, namely safety, environment and quality.

The environment module is designed to be used with the management module to facilitate the implementation and adoption of an effective environmental

management system. It is intended to be used by all levels of staff who should then be encouraged to share ownership of the information and ideals contained in it.

The user is expected to enter details on customer complaints, audit information, details of the environmental effects of the activities carried out by the company, and progress towards the agreed targets and objectives promoted by the management. In general, the bulk of the work is in the setting up of the system and this will mainly be carried out by the environmental manager and their assistants.

The quality module is designed to operate in conjunction with the management module to facilitate implementation and maintenance of an effective quality based management system in accordance with the ISO 9000⁽¹³⁾ series.

The users are expected to enter details of deviations from expected quality, complaints and observations from customers, the results of audits and the number of similar items. The main bulk of the implementation work will probably be carried out by the quality manager and their assistants inputting and developing quality procedures and associated documents.

The Safety module is again designed to be used in conjunction with a management model to look after all the information relating to health and safety at work for the company. The inputs to the Safety module include records of incidents, accidents and near misses, risk assessments and information relating to the management of control measures.

A substantial amount of data on substances is available with the software. This can either be supplied with or added to from other databases, but the user is expected to input details of the substances and products particular to the business that may not be found in the supplied data.

This package, as its title describes, deals with quality, safety and environmental management. It does not however, instruct the user how to manage a quality, safety or environmental management system. For this reason it is simply a software tool which provides empty forms and databases to be filled by the users and therefore it will never be independent of context.

Confederation of British Industry Scheme (Environment Business Forum)

The Confederation of British Industry (CBI) realised, as did many others, that environmental pressures from shareholders, customers, insurers and bankers etc. are ever-increasing for all UK companies. Added to this is the pressure of present and future environmental legislation.

The CBI Environment Business Forum is an initiative that is open to all organisations, large or small, within the manufacturing or service sector, whether or not they are members of the CBI itself. In order to gain membership to the Forum certain criteria have to be met by the company or institution.

The CBI Environment Business Forum is designed with the intent of helping companies by:

- Establishing a national network of organisations committed to the pursuit of environmental excellence in achieving competitive advantage;
- Providing up-to-date information on environmental issues;
- Demonstrating to legislators the effectiveness of business-led voluntary actions;
- Encouraging partnerships between large and small companies to assist these smaller companies to improve their environmental performance.

In order to gain membership to the Forum certain criteria have to be met by the company or institution. These criteria are as follows:

- Designating a board level director with responsibility for the environment;

- Publishing a corporate environmental policy statement;
- Setting clear targets and publishing objectives for achieving the policy;
- Measuring current performance against targets;
- Implementing improvement plans;
- Communicating company environmental policy and objectives to employees, seeking their contribution to improvement and providing appropriate training;
- Reporting publicly on progress in achieving objectives;
- Establishing partnerships, where appropriate, to extend and promote the objectives of the forum, particularly with smaller businesses.

At first glance the criteria for membership appear very prescriptive. However, the CBI initiative recognises that many companies have not established their own environmental performance baseline and, for this reason, a certain amount of latitude is allowed when first applying for membership. In order to set objectives and targets, an organisation must first establish this baseline. Thus, an initial application for membership can largely be structured to meet the membership criteria through the process of self-assessment.

The CBI initiative is not as prescriptive as BS 7750⁽¹²⁾ requirements but requires a certain level of commitment from management to maintain membership. Its overall objective is similar to that of BS 7750. It requires its members to continually improve their overall environmental performance year on year and to make available to the public information on how they have achieved what they said they would achieve. It therefore follows the same basic principles of Quality Systems, which can be summarised as;

- Say what you do;
- Do what you say; and

- Record the fact that you have done it.

Continuing membership of the Forum requires a written progress report to be submitted to the CBI as evidence of continual improvement. Again, this approach is largely one of self-assessment and is not in itself a management system but merely a set of criteria which need to be met.

The CBI took the approach of stipulating requirements for membership to their Forum which although not as prescriptive as BS 7750 contained the main elements for successful implementation of environmental management systems. Like any other standard which sets out requirements this does not guarantee a generic system.

Environmental Management System Tools

Once BS 7750 had been piloted, several sector application guides (SAGs) and other publications began to appear giving either guidance on specific issues relating to the implementation of BS 7750 or how organisations could become more environmentally aware/responsible. One such publication was 'The Green Manager's Handbook'⁽²³⁾, which described how organisations could integrate environmental issues into such areas as Purchasing, Production, Land & Buildings, Marketing, and Public Relations. However, it offered only very limited information on constructing environmental procedures and standard forms necessary for the implementation of an environmental management system.

One of the most widely used information sources at the time was Croner's Environmental Management⁽²⁴⁾ which was published in 1992 and which concentrated on the legislative issues relating to the environment. Although, at this time it was Croner's intention that other areas of environmental management systems would be addressed in future publications (e.g. Waste Management⁽²⁵⁾ and Environmental Management Policy and Procedures⁽²⁶⁾) these were not available to influence the project in its early stages.

Of particular interest to the present research was the SAG for the NHS developed by David Bellamy Associates⁽²⁷⁾.

NHS Sector Application Guide

Sector application guides (SAGs) are documents that explain how environmental management systems, such as BS 7750⁽¹²⁾ and subsequently ISO 14001⁽¹⁵⁾, can be implemented in an organisation from a particular industrial sector. They have been developed because the environmental management systems standard is non-sector specific and initiatives found that they required additional guidance on how to put in place such environmental management systems.

During the extensive pilot project of BS 7750, completed in April 1993, a number of pilot working groups developed sector application guides. Some trade associations have continued this work, with support from industry and interested parties, for example, associations from the textile, food, oil and chemical sectors.

The real value of sector application guides can only be determined if they successfully aid organisations in the process of implementing an environmental management system. Sector application guides need to demystify standards by providing practical ways of successfully implementing these initiatives. They should shorten the learning process an implementer has to go through and limit the potential implementation mistakes.

The sector application guide developed for the NHS was produced by David Bellamy Associates in association with the Northern Health Authority in England. To the user, it offers little more than an explanation of the then Standard BS 7750 and the terminology contained therein. It did not explain what an environmental effect was or how to identify them and gave few examples of environmental effects. It only offered relevant codes of practice in relation to legal and other requirements with very limited consideration given to legislation and regulations. It offered no actual procedures to assist a hospital or other health service site to implement the environmental management system requirements.

Therefore, this sector application guide offered very little value to the health service and its users as it did not demystify BS 7750⁽¹²⁾ effectively. It did not shorten implementation or the learning curve associated with BS 7750 by its failure to offer detailed guidance and example procedures that the user could implement immediately or integrate into their existing management structure and practices. Due to these observations it can be concluded that the use of this SAG would not result in the production of any characteristics necessary for the development of a generic system. In general, this applied to all of the SAGs of the time.

NHS in Scotland Common Approach to Environmental Management

Environmental management within the NHS in Scotland dates back to the publication in 1993 of the document 'A Strategic Guide to Environment Policy for General Managers and Chief Executives'⁽²⁸⁾. The NHS in Scotland Management Executive published this document. The document was the NHS's response to the publication of the British Standard for environmental management systems, BS 7750, and effectively made environmental management within the UK National Health Service government policy. However, this document was even less informative than the NHS sector application guide described earlier.

Review Conclusions

The evident outcome of this review was that the only standard worth taking cognisance of was BS 7750. As systems based on this standard were in their infancy there were no examples of systems that match even the first characteristic of a generic system identified earlier. Therefore, in order to develop a generic system one would have to begin from first principles.

It was recognised that an appropriate vehicle was required for the purposes of this research. Fortunately, the document 'A Strategic Guide to Environment Policy for General Managers and Chief Executives' had precipitated the NHS in Scotland to take action in this area. It was realised that the NHS in carrying out its range of

activities and services encompasses a large variety of impacts on the environment and therefore offered an appropriate vehicle for study.

This idea was developed in a report commissioned from the University of Strathclyde⁽²⁹⁾ in 1993 and presented to a meeting of interested parties from within the NHS in Scotland where it was decided to proceed with the setting up of a formal Estates Environment Forum.

An important recommendation from this meeting was that a common approach should be taken to enable both NHS Purchasers and Providers to take a consistent line on environmental matters. This provided the opportunity to develop the first characteristic of a generic environmental management system.

The Forum was launched in November 1993 with the mission to develop a common and consistent approach to environmental management throughout the NHS in Scotland, with the initial requirements for an environmental management system as follows:

- To create a comprehensive list of environmental aspects for the health service;
- To develop a comprehensive database of environmental legislation;
- To design a series of audits to measure strengths and weaknesses in environmental management; and
- To ensure that the management system structure should be developed and documented to comply with a recognised environmental management system standard.

To achieve the mission of the NHS in Scotland, it was recognised that the eventual system would need to be sufficiently generic to make it applicable to all healthcare buildings. In doing this all the essential characteristics of a generic system would need to be addressed.

At a very early stage, it was realised that a software solution would have a number of advantages. It would allow a degree of expertise to be built into the system such that those using it need not have prior in-depth expertise in environmental management. Repetitive tasks could be automated and information such as abstracts of legislation and guidance incorporated into the software, greatly reducing the time required for implementation. Errors in implementation could be reduced by providing the structure of the management system within the system, so removing much of the interpretation which would otherwise be necessary in developing and implementing a system from scratch.

Thus, the Forum commissioned the University of Strathclyde to research and develop a system to meet their initial requirements and any additional requirements necessary to implement a successful environmental management system for the NHS. It was also stipulated that the system must be capable of certification to current national and international standards in environmental management.

This thesis will describe the process by which an environmental management system with generic characteristics came to be designed and successfully implemented.

Initial Environmental Review

An initial environmental review is the process by which an organisation first identifies its interactions with the environment. The aim of an initial environmental review is to:

- Help an organisation understand the current and potential impacts of its activities;
- Help develop an environmental policy statement;
- Enable the organisation establish a plan of action on the environment;
- Assist it in the setting of priorities; and
- Provide a framework for effective environmental management commensurate with the size and management objectives of the organisation.

BS 7750⁽¹²⁾ was the first document to introduce the concept of an environmental review of an organisation. It defined this process as a ‘Preparatory Environmental Review’. With the subsequent introduction of ISO 14001⁽¹⁵⁾, the title was changed to ‘Initial Environmental Review’ with further changes in terminology in relation to ‘Environmental Effects, which were changed to ‘Environmental Aspects’. From this point forward the author will adopt the new terminology.

Although not a certifiable part of the standard, BS 7750 recommended that an initial environmental review be the first course of action undertaken by any organisation embarking on the development and implementation of an environmental management system.

Both BS 7750 and ISO 14001 identified that the initial environmental review should cover three key areas:

1. Legislative and regulatory requirements;
2. An evaluation of significant environmental aspects; and
3. An examination of existing practices and procedures.

The initial environmental review is usually conducted as a one-off exercise, which simply confirms what experienced and knowledgeable managers already suspect about their site. Conducted in this manner, the initial environmental review is a very uneconomical use of resources and offers little to the ongoing process of environmental management.

To offer the maximum benefit to the National Health Service and any other users of the system, it was felt that a systematic generic approach was required which could offer added value to the overall process of environmental management on any site and be adopted on any site. It should, therefore, be capable of using the information gleaned from this exercise in a constructive manner both immediately in terms of identifying a way forward and in the future by laying down the baseline of performance against which future improvement could be measured.

To this end, the following seven steps were identified as a generic approach taking the user from identification of aspects through to the generation of an environmental policy statement viz.:

1. Identification of aspects;
2. Identification of appropriate legislation and regulation;
3. Evaluation of significant aspects;
4. Examination of all existing environmental management practices and procedures;
5. Collation of records;
6. Setting initial objectives; and
7. Generating an environmental policy statement.

In identifying the above steps for completing an initial environmental review, it became apparent that a number of procedures and manuals would require to be written to assist the users to carry out the necessary steps. It was envisaged at the outset that these documents would begin forming part of the environmental management system documentation in support of BS 7750⁽¹²⁾.

Subtle changes were made to this methodology as time passed to bring it into line with ISO 14001⁽¹⁵⁾ and other accreditation considerations. These changes will be highlighted and explained later in the thesis.

The Project Management Process

At the very start of the project, it was realised that in order for the project to be successful a significant amount of input would be required from experienced members of the NHS over a prolonged period. Therefore, an appropriate mechanism for bringing these people together, for coordinating their input and for keeping them on board throughout the development of the system would have to be designed and implemented.

With this in mind, prior to the official launch of the Forum in November 1993, it was decided to form six specialist subgroups in relevant environmental areas, with remits as shown below, in order to encourage a sense of ownership and influence throughout the development of the environmental management system (which became known as GREENCODE).

1. Energy - to look at the environmental issues relating to energy use;
2. Waste - to look at the environmental issues of clinical, pharmaceutical, special, and general wastes;
3. Pollution - to look at the environmental issues of pollution to air, land and water;
4. Natural resources - to look at the environmental issues in relation to the use and reuse of non-renewable resources;
5. Procurement - to look at the issue of environmental purchasing within the NHS; and
6. External relations - to look at the issue of promoting the project to NHS staff and raising environmental awareness.

The formation of subgroups was a positive way for Forum members to take ownership of the system and to bring the researcher into close contact with the

requirements of the users. All subgroup members took part on a voluntary basis. Each group was chaired by a senior estates manager with the remaining membership being made up of estates professionals with a wide variety of management experience.

The NHS in Scotland along with HSS in Northern Ireland was large enough (i.e. 62 Trusts at the time) to contain the necessary breadth of expertise and data whilst still remaining manageable in size with good communication links despite the geographical size of the area covered. As a result each Trust felt part of a common body and freely associated themselves with it.

The roll of the University of Strathclyde was a crucial part of the development process in not only developing the overall system but, more importantly, in keeping everyone on board. In addition, the operational issues of processing the information and data supplied by the subgroups coupled with the presentation of subsequent research findings and feedback had to be delivered in a sufficiently professional manner to establish confidence and credibility in the output.

It was important that the University of Strathclyde was seen in the roll as undertaking independent research and not consultancy. Equally important was the ability to take on board the comments made by subgroup members in a way that made the individuals feel that their opinions were being heard and taken into account.

This was achieved by attending all subgroup meetings and generating and analysing minutes to ascertain the requirements of each subgroup. Any subsequent research and development work that was undertaken on behalf of a subgroup was presented in such a manner as to identify how individual issues had or had not been addressed at this time.

It was extremely important to the success of the project that this approach encouraged a sense of ownership and influence within the subgroups and their membership without which the project would almost certainly have faltered.

Identification of Environmental Aspects and Level of Management Control

The first tasks assigned to the subgroups were to help overcome two of the problem areas within the initial environmental review process:

1. Identification of environmental aspects; and
2. Examination of existing management practices and procedures.

To this end, each of the subgroups was assigned two main tasks. The first was to help identify a comprehensive list of environmental aspects which could exist on any NHS estate. The second was to help identify the questions necessary to create a series of audits which could be utilised to determine the level of environmental management control being exercised on a site.

By achieving these objectives, the information would then become available for the manipulation and integration into a system capable of addressing two of the main areas of an initial environmental review: evaluation of significant environmental aspects and examination of existing management practices and procedures. The third, legislative and regulatory requirements could only be addressed once the environmental aspects had been identified.

In order for this part of the process to progress in a structured way, each subgroup was issued with some headings which had been researched previously by the author as part of the University of Strathclyde's early initiative in environmental management⁽³⁰⁾⁽³¹⁾. The headings were as follows:

- Controlled Emissions to Atmosphere;
- Uncontrolled Emissions to Atmosphere;
- Controlled Discharges to Water;
- Uncontrolled Discharges to Water;

- Solid and other Wastes;
- Natural Resources;
- Controlled Discharges to Land;
- Uncontrolled Discharges to Land;
- Miscellaneous; and
- Psychological & Social Factors.

Each Group was then asked to identify as many environmental aspects as they could think of and categorise them under one of the above groupings. Each of the subgroups completed this task and submitted their results for further consideration and rationalisation.

Initially there were over 250 aspects submitted by the subgroups. Since the subgroups were submitting their data separately without any consultation with other subgroups, many of the aspects listed were duplicated but simply described differently. After the first round of rationalisation, over 100 separate environmental aspects were identified.

This was considered too many and so a second round of rationalisation took place which reduced the list further. This was achieved by describing aspects such that several of the 100 could be included under one aspect. The simplest example of this was waste where there were originally separate entries for paper, cardboard, packaging etc., which were eventually categorised as 'Commercial Waste'.

This list was circulated around all the subgroups several times for consideration and agreement as part of an iterative process to ensure that during the rationalisation exercise nothing had inadvertently been omitted. A final list of 69 aspects and headings was accepted at the end of this process.

With the list of environmental aspects accepted and agreed, consideration could now be given to a methodology on how to identify the legal and other requirements

associated with each aspect and how to determine the 'Significant' environmental aspects as required by BS 7750⁽¹²⁾ under clauses 4.4.1 'Register of legislative, regulatory and other policy requirements' and 4.4.3 'Environmental aspects evaluation and register'.

Register of Legislative, Regulatory and Other Policy Requirements

In order to complete this task in accordance with BS 7750⁽¹²⁾ and offer a user-friendly interface, a number of issues had to be addressed:

1. The development of a suitable database structure to hold all the necessary information about UK and EC legislation;
2. Access to environmental legislation, both UK and EC;
3. The identification of territorial applicability - how to filter the information such that the user sees only the legislation applicable for their area of the country i.e. Scotland, England, Northern Ireland & Wales; and
4. The development of the software application which would link to the database and assist the users to identify legislation applicable to the 69 environmental aspects.

As a result of Crown Immunity being removed from the National Health Service in 1991, the author became involved in a research programme to develop a tool to identify all the Health & Safety legislation and measure the level of legislative compliance within the NHS. This tool became known as SAFECODE⁽³²⁾.

One of the modules within SAFECODE was a database which held reference information about each piece of Health & Safety legislation. The SAFECODE application provided users with quick access, through a software search engine, to almost 2,000 references on legislation, European Directives, HSE/C guidance, Her Majesty's Inspectorate of Pollution (HMIP) reports, British Standards, and other relevant or potentially relevant legislation, guidance and information.

With this application already owned by the Crown, permission was sought and granted to use it as the basis for developing an environmental management database. With permission gained to use it for this purpose, the first task was to identify a suitable source of reference data from which all relevant environmental legislation and other information could be drawn.

There were very few companies capable of supplying a complete list of current UK and EC environmental legislation. One such company was Barbour Index⁽³³⁾, which was the same company which supplied the source data for the SAFECODE database module and which, after further investigation, was the only company with a comprehensive list and a record of accomplishment in the marketplace of supplying good quality data of this kind. Indeed, at that time, they were the only company capable of supplying access to full text albeit with a rather dated microfiche system.

Once a suitable source of information had been identified, all the health and safety related information and references were removed from the adopted database and replaced with approximately 2000 items of environmental management information and references.

The structure of the database and the associated software had to be changed to encompass the new functions necessary to identify environmental aspects and associated legislation. Since SAFECODE was developed using Visual Basic 3 (VB3)⁽³⁴⁾ as the software development tool and Microsoft Access⁽³⁵⁾ as the database engine, it was decided to continue with this method of development in order to make maximum use of both the functionality already existing within SAFECODE and the existing skills profile of the development team members.

As mentioned earlier, the primary reason for developing the GREENCODE database module was to assist the users to identify both the environmental aspects and applicable legislation associated with these aspects. For this to be achieved, a new database structure had to be developed such that the 69 aspects could be included

within it and a linking methodology had to be developed such that all 69 aspects could be associated with the appropriate legislation references.

Firstly, an aspects table had to be generated and inserted into the database. The aspects table simply contained all 69 aspects sequentially numbered from 1 to 69 thus giving each aspect its own unique reference number within the database structure. The linking methodology employed was designed with two criteria in mind:

1. Ease of updating - any system developed had to be easily kept up to date by the person allocated the responsibility of maintaining the database; and
2. Speed of linking - any methodology developed for use by the users had to offer a fast and efficient user interface.

It became apparent at this time that a new database field was required within the main 'Citation' table contained in the database. The 'Citation' table holds all the reference information for each document contained within the database and all other tables within the database link to and make use of the information contained within the 'Citation' table. This new field would perform the function of linking each aspect to the relevant legislation reference. A new field called 'Aspects' was added to each record in the 'Citation' table and was designed to contain the unique reference numbers associated with the aspects contained in the new 'Aspects' table.

By designing the database in this way, the aspects linking could be kept up to date by simply adding or removing a number between 1 and 69 in the 'Aspects' field and the speed of operation to the user would be fast and efficient since the software would only require to search one field, 'Aspects', in the 'Citation' table and link it to the 'Aspects' table.

For the methodology to operate correctly, all the environmental legislation (approximately 800 pieces) had to be read and the necessary information extracted and entered into the appropriate fields of the 'Citation' table along with the relevant

unique aspects number from the new 'Aspects' table. The necessary linking and graphical user interface would then be left for the software to perform.

It was decided that the reading of legislation, extracting of relevant information, data entry into the database, the assigning of unique aspect numbers and the maintenance of an up-to-date database would be the responsibility of one person for all users. It was further decided that this person would be located within the Safety & Environmental Management Unit in close proximity to the author. Due to the number of potential users of the system within the NHS, this was viewed as a justifiable use of resources both then and in the future to avoid these tasks being duplicated on each site.

This extraction and data entry of information along with the assigning of aspects was necessary to allow the GREENCODE Database to present the appropriate information on legislation to the user such that they could determine if it was applicable to them or not.

However, there was another concern for this module. Since GREENCODE would be available for use within all areas of the UK, a user in England would not wish to see irrelevant information, which was applicable in other areas of the UK such as Scotland, Ireland and Wales and vice versa for the other areas. Therefore, some form of early filtering process had to be incorporated at the very start of the review function.

This was addressed by asking the user, at the beginning of the review process, to identify their 'Territorial applicability', i.e. where they are within the UK, so enabling the software to utilise existing fields within the database to filter and present only legislation relevant to that region.

Selection of Environmental Aspects by the User on Site

Having identified how the 69 aspects could be linked efficiently to the applicable legislation and having entered all the necessary information into the modified Microsoft Access Database, the next step was to develop the Graphical User Interface (GUI) that the users would interact with to perform the necessary tasks of identifying environmental aspects and associated applicable legislation for their hospital site.

Many of the intended users were already familiar with the SAFECODE⁽³²⁾ tool and for this reason Version 1.0 of the GREENCODE Database module and the new functions were designed to follow a similar look and format.

For a detailed description of how the product looked and operated from a user's point of view see Appendix 1 'GREENCODE Database & Audit Software Manual'. This manual was issued as part of the documentation released with the first version of GREENCODE during a national launch in July 1995. The manual describes the basic functionality of both the GREENCODE Audit and the GREENCODE Database modules including the two 'Initial Review' functions dealing with the generation of an environmental aspects list, the identification of applicable legislation and the printing of the significant aspects worksheet.

GREENCODE Management Audits (Profile)

The information submitted previously by the six subgroups on management questions could now be collated and analysed to determine a methodology and structure for examining all the existing management practices and procedures.

The obvious way to determine the level of management control was through some form of audit. Therefore, an audit system had to be developed to:

1. Store the audit questions;
2. Analyse the audit responses; and
3. Report on the audit strengths and weaknesses.

The author had already developed an audit package called 'Profile' with the Safety & Environmental Management Unit, which, if suitable, would be an economical option for inclusion within GREENCODE.

Background to 'Profile'

In 1992, Dr Terry Robson, Safety Adviser at the University of Northumbria in Newcastle, was invited to produce guidance on a suitable auditing scheme for Universities by the Committee of Vice Chancellors and Principals (CVCP - the central body that oversees the activities of UK Universities). Consequently, Dr Robson established the CVCP Safety Audit Topic Group. The membership of the group was drawn from three areas of expertise: full time University safety professionals, the Health and Safety Executive's Education National Interest Group and their Accident Prevention Advisory Group plus the Safety and Environmental Management Unit at the University of Strathclyde who had considerable experience in auditable management systems.

The group quickly realised that it had two principal options. To use a commercially available proprietary safety audit scheme or to develop an in-house scheme specifically for higher education. In carrying out the evaluation of a number of commercially available audit schemes, the Group concluded that:

1. The systems and the associated user experiences were mainly industrial based and therefore did not easily relate to the unique culture and management style of a university environment; and
2. As a result, any proprietary scheme would need to be significantly adapted before it could successfully be used within a university environment.

These factors in addition to the hardware, licensing, training and accreditation costs associated with the commercial schemes made them an expensive option.

In parallel with the evaluation of proprietary schemes, the topic group undertook to examine the feasibility of developing a safety management audit scheme, both software and hard copy, specifically for higher education.

One of the first tasks of the group was to identify a standard or standards on which to base the audit scheme. Formal International Standard (ISO) specifications existed for the development and implementation of quality systems (ISO 9000)⁽¹³⁾ and environmental management systems (BS 7750)⁽¹²⁾ but no such formal standard existed for health and safety management.

The HSE's Accident Prevention Advisory Unit (APAU) had, however, conducted much research into successful organisations and had developed a comprehensive guidance document entitled 'Successful health and safety management' (SHSM)⁽³⁶⁾. This document was used by the Safety Audit Topic Group as the Standard against which health and safety management systems should be measured.

After much debate, and extensive piloting in a number of Universities, the Safety Audit Topic Group devised a set of 82 key audit questions from SHSM. This was produced from an original list of 180 questions. These audit questions aim to give an overall impression, or 'Profile' of how well a University department (or, indeed, the whole institution) is performing with respect to the HSE's 'Successful health and safety management' document. The audit questions are collectively referred to as 'Safety Management Profile'.

The author researched and developed a computer audit package called 'Profile' to:

1. Facilitate the use of the safety management question set and any others produced in the future;
2. Produce comprehensive reports quickly; and
3. Enable users to generate their own question sets and therefore undertake their own audits.

Responses and Scoring System

The questions within any 'Profile' audit can be answered in four different ways, 'Yes', 'No', (Q) 'Qualified' or (X) 'Not Applicable'. It was found during the development of 'Profile' that a simple Yes/No response was not sufficient for a number of circumstances. Therefore, the (Q) 'Qualified' and (X) 'Not applicable' responses were introduced. The (Q) 'Qualified' response allowed the auditor to give credit where some work had been carried out but not completed to the stage where a 'Yes' response could be awarded. The (X) 'Not Applicable' response was introduced to allow the auditor to exclude questions, which may not be applicable in particular circumstances.

When a question is answered 'Yes', this means that the auditee (i.e. the person being asked the question) fully complies with all aspects of the question and 2 points are awarded. When a question is answered 'No', this means that the auditee does not comply with any part of the question and is awarded 0 points.

If, however, the response given by the auditee lies somewhere between 'Yes' and 'No', the auditor can enter a 'Qualified' (Q) response which awards 1 point. If it is decided by the auditor that a particular question is 'Not Applicable' then they should enter a 'Not Applicable' (X) response, which will remove all possible scoring associated with that question from any subsequent analysis.

Audit Reports

The 'Profile' Audit software can print out reports based on the responses given during an audit. If a question is answered, 'Yes' this is regarded as a strength. If a question is answered either 'No' or 'Qualified' (Q) this is regarded as a weakness.

As referred to previously, the production of records is very important to serve as evidence that a task has been completed satisfactorily. The users of 'Profile' during its pilot phase had also stipulated that it must be capable of identifying strengths and

weaknesses in relation to any question set. The ‘Profile’ Audit package addressed all these issues through the production of the following reports:

1. Full Report - This report outlines all the details of the audit in one report highlighting strengths, weaknesses, not applicable questions and a numerical analysis resulting in an overall percentage score for the audit.
2. Analysis Report - This is a subset of the ‘Full Report’ above which only prints the Analysis section;
3. Strengths Report - This is a subset of the ‘Full Report’ above, which only prints details of the audit strengths i.e. those questions answered ‘Yes’;
4. Weaknesses Report - This is a subset of the ‘Full Report’ above, which only prints details of the audit weaknesses i.e. those questions answered ‘No’ or ‘Qualified’; and
5. Not Applicable Questions - This is a subset of the ‘Full Report’ above, which lists those questions determined as ‘Not Applicable’ by the auditor.

The ‘Profile’ audit package was subsequently made available to all Universities. Currently, over 80% of all Universities in the UK have purchased a licence to the ‘Profile Audit Package’. ‘Profile’ has also been licensed in the insurance, pharmaceutical, local council and broadcasting sectors.

Based on the success of the ‘Profile’ pilot in a number of universities, which validated ‘Profile’ as a useful tool, and the subsequent uptake of the commercial package under licence to the University of Strathclyde in other industry sectors, a proposal was then put to the Estates Environment Forum by the University of Strathclyde that the audit package be licensed into GREENCODE to serve as the GREENCODE Audit module. This proposal was accepted and the appropriate licence agreement was put into effect.

One of the functions within ‘Profile’ allows the user to generate their own questions sets and use them during audits. Since the GREENCODE system would have fixed question sets covering particular areas, this function was removed when the package

was integrated into GREENCODE. For a detailed description of how the product looked and operated from a user's point of view see Appendix 1 'GREENCODE Database & Audit Software Manual'.

GREENCODE Question Set Structure

The problem remained of identifying the appropriate questions and the structure around which to base the GREENCODE question sets. It was decided that the question sets should be structured as much as possible around a quality based system as this was the underlying system of BS 7750⁽¹²⁾ and that of the question sets developed for health and safety in the development of 'Profile'. Therefore, it was decided to structure the question sets as follows:

- 1. Policy Statement** - These questions would identify if a policy statement existed, that it was communicated to all staff and carried the appropriate level of authorisation;
- 2. Organisation and Personnel** - These questions would identify if personnel had been given the responsibility for this topic, responsibility was cascaded down through the organisation and staff received appropriate training;
- 3. Practices and Procedures** - These questions would identify if the site under question was operating in the appropriate manner in relation to the topic in question on a day-to-day basis; and
- 4. Programme and Corrective Action** - These questions would identify if the site was operating to an agreed action programme with objectives & target on the environment and identify if appropriate actions would be taken in the event of a non-conformance.

These areas were considered as the minimum that should be in place to control any environmental management topic area. Almost all of the questions submitted by the six subgroups related to practices and procedure on a day-to-day basis.

Again, as with the exercise on identifying the environmental aspects, there were a number of questions submitted which overlapped heavily with questions submitted by other groups. Some of the topic areas naturally overlapped in subject matter and, therefore, this was inevitable. The subgroups tended to produce individual focused question sets on issues such as clinical waste, general waste, procurement/batteries, use of natural resources/recycling.

The number of questions submitted was approximately 350, but as mentioned above, these all related to day-to-day practices and procedures and did not include many questions on policy, organisation and personnel and programme and corrective action. The number of original questions was reduced by producing new questions, which were worded to include the points raised by several original questions.

On analysis, the questions began to fall into general topic areas such as energy, land, water, waste, purchasing and the organisational structure of personnel. Several of the topic areas had potentially two sets of questions relating to them. An example is land, which included land management and land contamination. Similarly, water included issues relating to its use and the issue of what was discharged to it.

After further analysis and some compiling of draft question sets, it became apparent that all questions could be accommodated within 9 topic areas. These were as follows:

1. Emissions to atmosphere;
2. Energy management;
3. Land management;
4. Land contamination;
5. Organisation;
6. Procurement;
7. Waste management;
8. Discharges to drain; and
9. Water consumption.

For each of the above question sets, new questions had to be generated and added to the sections on Policy, Organisation & Personnel plus Programme and Corrective Action. At the final count, the number of questions covering all the topics was approximately 270. To view the detailed questions generated see Appendix 2 'GREENCODE Audit Question Sets'.

'Significant' Environmental Aspects

The significant aspects worksheet referred to earlier was the worksheet developed to address the identification of significant aspects as required by BS 7750⁽¹²⁾ under clause 4.4.3 'Environmental aspects evaluation and register'. Under this clause, not only is the user required to generate a list of aspects but they must also determine which are significant.

This process of identifying significance helps to determine those issues, which should be attended to first and further helps with the generation of initial strategic environmental management objectives within the GREENCODE initial environmental review process.

However, the topic of significance has tended to be described in publications such as BS 7750, ISO 14001⁽¹⁵⁾ and Croner's Policy & Procedures⁽²⁶⁾, in very vague language, which has resulted in no firm methodology being written to explain to managers how to assess the significance of an aspect. An initial methodology (the significant aspects worksheet) was developed for use within GREENCODE Version 1.0, which allowed the user to assess each of the identified aspects against pre-determined criteria.

These criteria were identified during a series of workshops in March 1994 in which over 30 NHS estates professionals took part. The original intention of these workshops was to discuss the issue of Prioritisation. It was recognised by all the delegates that implementing all the potential improvements identified during an initial environmental review would not be possible mainly due to financial

constraints. Therefore, a process of prioritisation would need to take place before they would be able to sanction work to be carried out.

During the three days, a short presentation was given to the delegates to bring them up-to-date with current thinking as regards environmental management systems. The participants were then split up into groups and asked to identify the criteria they would use to prioritise their actions on the environment. The following rank ordered list of criteria was generated at the end of the three days:

1. Legal Compliance;
2. Health and Safety;
3. Cost;
4. Frequency;
5. Environmental Impact;
6. Customer Pressure; and
7. Public Perception.

By this time, it had become apparent to the delegates and the author that a number of these criteria could be used to identify the significant aspects in line with the requirements of BS 7750⁽¹²⁾. However, it was unclear which ones would be best suited to this task. It was envisaged by the delegates that by addressing the issue of significant environmental aspects first, the remaining issue of prioritisation would become a simpler process at a later stage.

The author was therefore assigned the task, on behalf of the Forum, of generating a methodology to address the issue of identifying significant aspects using as far as possible the criteria identified during the workshops.

The Forum members identified the first and most important of these criteria as legal compliance. It was therefore decided that, if an aspect had a piece of legislation applicable to it, then it should be identified as being of the highest significance. It was further decided that if the organisation had a policy or a code of practice relating

to the aspect in question, then it should also be identified as being of the highest significance. If an aspect had any of these criteria associated with it, it was awarded a significance score of 100 points and the remaining criteria were ignored.

However, there remained the problem of how did the user then assess the significance of an aspect when it did not have any of these criteria attached to it. To address this question a number of the remaining criteria identified during the workshops were utilised and the following additional criteria devised:

1. Effect on human health;
2. The weight of scientific evidence;
3. The level of public perception or outcry; and
4. Purchaser criteria.

The first three criteria are common mechanisms used to measure and justify why legislation, policies or codes of practice should be developed and enforced. The fourth criterion was very specific to the make-up of the NHS at this time when the NHS had two elements to it;

1. Purchasers (health boards, GP's etc.); and
2. Providers (Hospitals, Clinics etc.).

This criterion was there to help the user take account of any Purchaser environmental criteria that may have been contained within any contractual agreements between the parties.

All of the criteria mentioned above could subjectively be assigned a score between 1 and 25 which, when added together, allowed each aspect to be scored on a scale of 1 to 100 points. See Appendix 3 for an example of a 'Significant Aspects Worksheet'.

To help the users quickly identify the significance of aspects, the GREENCODE database module was designed to print a significant aspects worksheet. Before printing the worksheet however, the database was designed to identify those aspects,

which had previously been identified as having legislation applicable to them to and automatically complete the worksheet for that aspect by entering a score of 100 in the last column. To complete the task of identifying the significance of environmental aspects, the user was instructed to print the worksheet and complete it manually, using the criterion outlined above, for those aspects that did not automatically receive a score.

For a detailed description on how the user was instructed to complete the significant aspects worksheet see Appendix 4 (GREENCODE procedure ‘Identification of Significant Environmental Aspects’).

Collation of Records

A very important function of this and many other elements of an environmental management system is the production of records, which can be used as documentary evidence that a task has been completed satisfactorily. It was identified that the production of the following records would be necessary in order to verify that the previous steps in the initial environmental review process had been completed satisfactorily and to provide the necessary information in order to complete the next step of ‘Setting Strategic Objectives’.

1. Selected Aspects (Database Module);
2. Associated Legislation (Database Module);
3. Significant Aspects Worksheet (Database Module); and
4. Strengths and weaknesses Reports (Audit Module).

Initial Strategic Objectives

Based on the information produced in the above-mentioned records, it was envisaged that the users would be furnished with the appropriate information to identify the way forward at a strategic level and be able to produce a suitable environmental policy statement for their site.

Accompanying Documentation and System Documentation Structure

As referred to earlier, it was necessary to produce documentation that would guide the users on how to implement the environmental management system elements. The first series of documents that had to be produced were those for the implementation of the GREENCODE Initial Environmental Review.

However, it was recognised that many more documents would need to be produced in the coming years as GREENCODE developed and for this reason a structure for the complete management system had to be developed within which the Initial Environmental Review documentation could sit. Based on experience gained in the development of an environmental management system for the University of Strathclyde, the structure outlined in Appendix 5 was devised for the GREENCODE system.

The first few pages provided some basic information for the users relating to Acknowledgements, Background and Computer requirements & Software support. These were then followed by seven main sections of the GREENCODE documentation system:

1. **Initial Review** - This section contained a detailed description of the seven steps necessary to successfully complete an Initial Environmental Review. This document made reference to individual procedures, audits and software manuals contained within other sections of the GREENCODE documentation;
2. **GREENCODE environmental management systems (EMS)** - This section was included to hold any future documentation that may be developed outlining how the complete GREENCODE system operated and how it could link to other management systems within a user's site;
3. **GREENCODE Environmental Management Manual** - This section was included to contain all procedures relating to the operation of the complete GREENCODE management system. It was designed to hold many different sections but was issued originally with only two.
 1. Management Procedures; and

2. Management System Procedures

The first section was intended to contain all environmental procedures relating to site operations with the second section containing the procedures necessary to operate and maintain the environmental management system;

4. **GREENCODE Guidance & Assessments** - This section was included to hold any detailed guidance documents or assessment methodologies produced from pilot studies, case studies etc.;
5. **GREENCODE Audits** - This section was included to hold hard copies of the audit documents produced for GREENCODE;
6. **GREENCODE Software Manuals** - This section was included to hold the software manuals for the users to refer to when using the GREENCODE software; and
7. **Initial Review Records** - This section was included to give the users somewhere to retain their first set of records on the Initial Environmental Review and use as proof of completion in the future.

With a suitable structure now in place to hold all the documents that were thought necessary, the next task was to write all the accompanying documents to assist the users to complete an Initial Environmental Review.

In the light of a similar exercise carried out whilst designing and implementing the environmental management system for the University of Strathclyde, it was identified that the following types of documents would be necessary:

1. **Implementation Guidance Document** - This document guides the user through the process of implementing GREENCODE to complete an Initial Environmental Review. It explains each of the seven steps of the process and refers the user to the appropriate procedures when necessary;
2. **Written Procedures** - These documents introduce the task to be undertaken and identify the individual steps necessary to complete the task in a satisfactory manner;

3. **Hard Copy Audit Documentation** - These documents introduce the topic area which is being audited and outline the questions that need to be answered and how; and
4. **Software Manuals** - These manuals give instruction to the users on how to operate the different modules contained within the GREENCODE software.

Now that the necessary documents had been identified, the next task was to produce them in a clear and concise user-friendly format. The first document produced was the initial environmental review guidance document, which would be contained in Section 1 of the GREENCODE Documentation. (See Appendix 6).

The next set of documents addressed the Management Procedures that the users would need. In looking at the seven steps within the GREENCODE Initial Environmental Review process and having written the guidance document referred to above, it was identified that four Management Procedures would be required in the following areas:

1. Identification of Environmental Aspects;
2. Identification of Applicable Legislation;
3. Identification of Significant Aspects; and
4. Generating an Environmental Policy Statement.

Experience gained in the development of previous environmental management systems had shown, that individual users liked to know why they were being asked to carry out particular tasks and how, by completing these tasks, they would contribute to the overall implementation of the system. For this reason the following structure to individual procedures was adopted:

1. **Summary of Procedure** - This section consists of a short paragraph giving a brief description of why this procedure is necessary and what is involved in completing it;
2. **Purpose of Procedure** - This section briefly describes the overall purpose of the procedure and how it links to other procedures where necessary;

3. **Implementation of Procedure** - This section briefly describes who is responsible for implementing the procedure;
4. **Verification** - This section describes how the successful completion of the procedure will be measured;
5. **Records** - This section describes what records should be produced in completing the procedure;
6. **Selected References** - This section outlines any additional reference material the users may wish to consult before implementing the procedure;
7. **Appendices** - This section outlines any additional documentation or standard forms that will be required to complete the procedure successfully; and
8. **Work Instructions** - This section describes in detail the individual steps necessary to complete the procedure successfully.

Each of the four procedures referred to above, and any associated documents, are contained within Appendix 7 'GREENCODE Initial Review Procedures'.

Two of the above procedures, 'Identification of Environmental Aspects' and 'Identification of Applicable Legislation' offer detailed guidance on how to use particular functions within the GREENCODE Database module to complete those steps of the Initial Environmental Review. For this reason, a User Manual was produced in order to describe these and all the other functions contained within that module.

Step four of the Initial Environmental Review methodology requires the users to conduct audits on their site using the GREENCODE Audit module. Again, for this reason, the need for a user manual for this module was also identified.

In the initial release of GREENCODE, both of these manuals were combined into one manual entitled 'Database & Audit'. For a detailed description of how the system looked and operated from a user's point of view see Appendix 1 'GREENCODE Database & Audit Software Manual'.

In discussion with members of the Forum, it was recognised that these audits would be completed in hard copy first with the results being input manually into the software at a later date due to lack of appropriate portable computer technology being available in most cases. For this reason, a hard copy audit format had to be developed to facilitate this.

The same strategy used for procedures (i.e. that individual users liked to know why they were being asked to carry out particular tasks and how, by completing these tasks, they would contribute to the overall implementation of the system) was adopted to develop the format for the hard copy audits. With this in mind the following structure to individual audits was adopted:

1. **Introduction** - This section offers a brief description of the topic area being audited and draws the user's attention to some of the more important factors that should be considered when auditing that area;
2. **Legislation** - This section outlines the main pieces of legislation relating to this topic area;
3. **Primary References** - This section outlines the primary reference material the users may wish to consult before carrying out the audit; and
4. **Audit Questions** - This section contains the audit questions themselves split into Policy, Organisation & Personnel, Practices & Procedures and Programme & Corrective Action.

All nine audits developed for GREENCODE are contained in Appendix 2 'GREENCODE Audit Question Sets'.

Once the entire documentation necessary for the users to implement the GREENCODE Initial Review had been identified and developed, the next task was to compile it into a format for distribution to all users. It was decided, after consultation with the Forum members, that this would be best accomplished by inserting all the documentation into a suitable folder appropriately sectioned off showing the individual sections as per the contents outlined in Appendix 5.

Once all the necessary folders had been compiled, the GREENCODE Initial Review was released as Phase 1 of GREENCODE at Ministerial launches to all members of the National Health Service in Scotland and Northern Ireland in the summer of 1995.

In order to verify that the GREENCODE Phase 1 methodology delivered all that it was designed to, it was decided to run a controlled pilot of the system and to produce an exemplar guidance document based on the pilot study.

Chapter 4

GREENCODE Phase 1 Pilot Programme Case Study

The purpose of the case study was to determine if the outcome from the GREENCODE Phase 1 methodology produced a satisfactory initial environmental review and, thereafter, produce a guidance document for users based on actual implementation examples.

In order to determine if the GREENCODE Phase 1 methodology delivered this outcome the following criteria were used:

1. Does the methodology produce the appropriate documentation? - Does it produce the documentation to verify that the three main areas of an initial environmental review have been addressed e.g. Legislative and regulatory requirements, an evaluation of significant environmental aspects and an examination of existing practices and procedures?
2. Does it allow the user to produce the necessary documentation in a user-friendly manner? - Is the documentation and accompanying software easy to understand, implement and use?
3. Does the methodology allow the user to implement the initial environmental review in a timely manner? - Does it help the user complete the necessary tasks in a quick and efficient way?
4. Does the methodology offer added value? - Does the methodology achieve one of its original design criteria of offering added value to the overall process of environmental management by using the information gleaned from this exercise in a constructive manner both immediately in terms of identifying a way forward and in the future by laying down the baseline of performance against which future improvement could be measured?

In order to determine the success or otherwise of the system against these criteria, Trusts were invited to elect one of their sites to participate in the pilot to implement an initial environmental review. The programme was co-ordinated and supported by the author and the staff at the Safety & Environmental Management Unit.

The following eight Trusts were selected, seven from Scotland and one from Northern Ireland:

1. Down Lisburn HSS Trust;
2. East & Midlothian NHS Trust;
3. Glasgow Dental Hospitals and School NHS Trust;
4. Hairmyres and Stonehouse NHS Trust;
5. Lanarkshire Healthcare NHS Trust;
6. Perth & Kinross Healthcare NHS Trust;
7. South Ayrshire Hospitals NHS Trust; and
8. West Glasgow Hospitals NHS Trust.

The first meeting of those representing the Trusts was held on the 12th of September 1996. At that meeting, it was agreed that the group should work to a tight schedule in an attempt to prove that the Initial Review could be completed in a timely manner.

In order to report progress at each stage of the Initial Review, further meetings were arranged to coincide with the completion of each of the seven steps of the GREENCODE Initial Review process. These meetings were set up at approximately fortnightly intervals with the final meeting being set for the 10th of December 1996.

The purpose of these meetings was to provide a forum through which the members could exchange information and experiences gained during the implementation process.

The timeframe for completion of individual steps in the initial environmental review process was as follows with progress meetings being held at the end of each step:

12 Sept. - 1 Oct.	Formulate an Environmental Management Team and generate a list of Environmental Aspects for the pilot site. (See <i>GREENCODE Doc No 1 'Preparatory Environmental Review'</i> - STEP 1).
1 Oct. - 22 Oct.	Identify Applicable Legislation for Environmental Aspects on the pilot site. (See <i>GREENCODE Doc No 1 'Preparatory Environmental Review'</i> - STEP 2).
22 Oct. - 12 Nov.	Generate completed Significant Aspects Worksheet and begin the GREENCODE Audits on the Pilot Site. (See <i>GREENCODE Doc No 1 'Preparatory Environmental Review'</i> - STEPS 3 and 4).
12 Nov. - 26 Nov.	Complete all 9 GREENCODE audits on the pilot site, collate all Preparatory Environmental Review records and generate some strategic objectives. (See <i>GREENCODE Doc No 1 'Preparatory Environmental Review'</i> - STEP 4, 5 and 6).
26 Nov. - 10 Dec.	Generate Draft Environmental Policy Statement. (See <i>GREENCODE Doc No 1 'Preparatory Environmental Review'</i> - STEP 7).

Progress Meeting 1 (1st October 1996)

As outlined above, the objective in this part of the schedule was to formulate a management team and then identify the environmental aspects present on the site. The first task of formulating the management team followed a similar process on each of the pilot sites. However, two distinct approaches were adopted in the utilisation of the management team members.

Membership of the management team largely revolved around those people capable of answering the 9 GREENCODE audits accompanied by other representatives of prominent activities present on the site such as laboratories, theatres, radiography, pharmacy and nursing.

Since most of the audits would be addressed by the estates department more often than not, the Environmental Management Representative (i.e. the person assigned the responsibility under BS 7750⁽¹²⁾ for co-ordinating the environmental management system) was a member of that department.

Based on the experiences of the pilot group to this point a typical team would comprise of the following departmental representatives:

- Estates;
- Procurement;
- Radiography;
- Pharmacy;
- Services (Hotel, Domestic, Transport and Portering);
- Health and Safety;
- Laboratories; and
- Theatres.

Identification of Environmental Aspects

Once the teams had been identified, each member was issued with a copy of GREENCODE document 3.1.1 SF/01 (see Appendix 8). This list contained all the 69 aspects identified by the subgroups of the Estates Environment Forum as possibly being present on a hospital site.

The members were then asked to indicate on the GREENCODE document which aspects were present within their area of responsibility and if they could identify any aspects which they thought were not addressed and to add such aspects to the list.

As mentioned earlier, two distinct approaches were adopted in the utilisation of the members of the management team. One approach was to bring together all the members on a regular basis to address particular issues, such as aspects identification, with the other approach involving the Environmental Management Representative individually coordinating the output of individual members with the

whole team meeting infrequently to report only on progress. Based on the pilot group experience, both methods produced satisfactory results suggesting both approaches were equally applicable.

Furthermore, based on the pilot group experience, the list of 69 aspects appeared to adequately describe the environmental aspects of a hospital site since no suggestions were forthcoming for new aspects to be added.

Once the aspects present on the site were identified, they were collated and entered into the GREENCODE database software module. Although no formal feedback was recorded, the users expressed a high degree of satisfaction with the software in both its user interface and the production of the necessary reports in relation to the identified environmental aspects.

At the end of this part of the schedule, several things had been confirmed by this pilot group:

1. It was possible to identify the environmental aspects of a site using a small team of personnel with the appropriate background, experience and knowledge of the site;
2. The management team could elect to meet frequently to address issues or meet infrequently and have the Environmental Management Representative play a more coordinating role;
3. The list of 69 aspects was adequate to describe the environmental aspects of a hospital site: and
4. The GREENCODE database software usability and output was excellent for the purposes of identifying the environmental aspects present on a site.

Progress Meeting 2 (22nd October 1996)

The objective in this part of the schedule was to identify the applicable legislation for the aspects present on a site. This required the user to build on the work they had previously completed (identification of aspects).

From within the GREENCODE database software module it was possible for the users to identify the legislation that may be applicable. It was then left up to the Environmental Management Representative and their committee to determine if a particular piece of legislation was applicable on their site or not by using their professional judgment and local knowledge of the site.

The pilot group members concluded that this task of identifying applicable legislation was one that could not be undertaken by any one individual. It was necessary for a number of people to be involved in this identification process. Ideally, it would be beneficial if the members of the existing management team could carry out this process. However, it became apparent that to have all those people necessary to identify the applicable legislation on the management team would be both unreasonable and unmanageable due to the size of group that would be needed.

Therefore, it inevitably fell upon the Environmental Management Representative to contact the necessary personnel outwith the management team to complete this task. After identifying all the applicable legislation for all the environmental aspects, the database module could print out a report entitled 'Associated Legislation' based on all the decisions made.

Again, although no formal feedback was recorded, the users expressed a high degree of satisfaction with the software in both its user interface and the production of the necessary report. Nevertheless, it was felt by the pilot group that improvements could be made to the reporting function. Suggestions were made at this point that additional reports be generated by the software to present the findings in relation to applicable legislation in different ways. The following suggestions were made:

1. That the software module should produce a composite list of legislation i.e. a single list of legislation which represents all the legislation a site needs to comply with in relation to the environment; and

2. That the software module should produce a composite list of legislation linked to associated aspects in addition to the existing report which generated aspects linked to associated legislation.

At the end of this part of the schedule, it became apparent to the pilot group that:

1. The process of identifying all the applicable legislation could not be completed by the members of the management team alone. They would be able to identify most legislation but would require the input of other individuals to complete the task satisfactorily; and
2. The GREENCODE database software usability and output was excellent for the purposes of identifying applicable legislation present on a site but could be further enhanced and more useful on a day-to-day basis if it could print out the information in several different ways.

Progress Meeting 3 (12th November 1996)

The objective in this part of the schedule was to identify those aspects, which were the most significant. In order to do this each aspect was evaluated subjectively by the management team against a number of criteria using the GREENCODE significant aspects worksheet (see Appendix 3).

When carrying out this task, the pilot group found it to be a very straightforward and quick process. They reported that the methodology for identifying significant aspects, in the absence of any other recognised method, was satisfactory. However, concerns were raised that the way in which the records were produced was not satisfactory for several reasons, which are outlined below:

1. There was no way of recording, within the software, how or why certain evaluations were made against each of the criteria;
2. The worksheet details were not stored electronically as there was no software interface for this part of the process i.e. no software based form as part of the software; and

3. The significant aspects worksheet had to be produced mostly by hand whereas, up until now, most of the work had been completed and stored within the software. Electronic completion of the significant aspects worksheet would be more desirable rather than completion by hand.

Progress Meeting 4 (26th November 1996)

The objective in this part of the schedule was for the Environmental Management Representative and their team to investigate the current management practices by completing all 9 GREENCODE audits on the pilot site, collate all the initial environmental review records and generate some strategic environmental objectives.

As anticipated, the pilot group reported this as the most labour intensive part of the whole process with the exception of Lagan Valley hospital in Northern Ireland who decided to complete the audits in one half day meeting by identifying all personnel necessary to answer the audit questions and have them attend. All of the pilot group members reported that the audits were coordinated and/or conducted by the Environmental Management Representative.

With regards to the GREENCODE Audit module, which was designed to assist the management team to complete this task, all the group members expressed a high degree of satisfaction with the software and the subsequent reports that it generated.

The collating of environmental records was reported by the group members as a very simple and quick process. This was due to the GREENCODE software being deliberately designed to produce most of them at the press of a button.

Due to the amount of information that had been gathered and the number of relevant reports that were generated, the pilot group found the process of identifying initial strategic objectives a relatively simple one. Most of the initial objectives submitted by the group related to improving the audit results they had achieved and

implementing further the requirements of the environmental management system standard.

Final Progress Meeting (10th December 1996)

By this meeting, the group were expected to have produced a draft environmental policy statement for their own pilot site based on the information they had gathered during the initial environmental review process. All of the members of the group managed to produce their draft policy statements therefore completing the initial environmental review process on schedule.

GREENCODE contained a ready-made procedure and draft policy (see Appendix 7) that had been designed to assist the users with the process of producing an environmental policy statement. As was the intention of the procedure, the members simply adapted the contents of the GREENCODE draft environmental policy statement to suit their site based on the findings of their initial environmental review.

Again, the users expressed a high degree of satisfaction with the GREENCODE procedure for the production of an environmental policy and found it to be a relatively simple task to alter the contents in line with the findings on their site whilst still maintaining the basic principles of a good environmental policy statement.

At the beginning of the process, 12 weeks earlier, many of the group felt that the timetable was very ambitious. By the end of the process, all the members came to appreciate how a structured approach to an initial environmental review in conjunction with some intelligent software could enable them to complete the process in a surprisingly short period of time whilst still carrying out their other duties.

At each of the progress meetings, the group was asked to estimate how long it had taken them to complete each of the tasks with the following results:

Learning the System	3 days
Organisation/Administration	7 days
Identifying Aspects	½ day
Identifying Applicable Legislation	4 days
Identifying Significant Aspects	½ day
Management System Audits	2 days
Setting Initial Objectives	1 day
Generating a Policy Statement	1 day

However, several of the group members expressed concerns that, given the amount of time spent carrying out the audits, and notwithstanding that they could see the benefit of completing them, they felt that the results could be better used in the process of initial environmental review.

Review of Findings and Implementation of Solutions

The findings and comments passed on by the pilot group confirmed that the GREENCODE Phase 1 methodology largely addressed all of the criteria that had been set. However, as was expected there was room for improvement in certain areas which are outlined in the following recommendations.

1. That the Database software module produce a composite list of legislation i.e. a single list of legislation which represents all the legislation a site needs to comply with in relation to the environment;
2. That the Database software module produce a composite list of legislation linked to associated aspects in addition to the existing report which generated aspects linked to associated legislation;
3. That the significant aspects worksheet be in electronic format within the database module facilitating the recording of how and why certain evaluations were made against each of the criteria and facilitating automatic report generation; and
4. That the results of the audits be better integrated into the initial review process.

Upon the successful completion of the initial environmental review pilot programme, the GREENCODE initial environmental review process was improved in line with the above recommendations. It was decided that any guidance forming part of GREENCODE should be issued after all the above recommendations were addressed.

The first two recommendations were achieved by adding the following two new reports to the GREENCODE database module:

1. Legislation (Composite List) - This report was added to extract the relevant information from the user database such that it would produce a single list of all Environmental Legislation that had been identified by the user as applicable to a site; and
2. Legislation (Composite & Aspect) - This report was designed to produce the same list as the previous report but with each of the relevant environmental aspects associated with a piece of legislation identified and listed alongside it.

The third recommendation was addressed by producing an electronic form, utilising the same layout, using the same database, programming language and tools such that it could become an integrated part of the existing software. It was made available to the users through a 'Utilities' menu within the GREENCODE database module. An accompanying report was also generated and integrated into the existing 'Print' menu to record and print the data entered by the user.

The fourth recommendation proved to be more difficult to address but had been highlighted at an appropriate time. For a number of months before the pilot programme, surveillance of the literature had revealed an assessment system being proposed by Her Majesty's Inspectorate of Pollution (HMIP) called 'Operator and Pollution Risk Appraisal' (OPRA) Version 1⁽³⁷⁾ which outlined an assessment methodology where management performance was being utilised.

It was decided to research this methodology further and to examine how it might be developed for the purposes of integrating the management audit results more closely into the GREENCODE process as requested by the pilot programme group.

Chapter 5

New Environmental Significance Rating and Prioritisation Methodology

As outlined in the previous chapter, the problem of how best to use the audit information during the initial environmental review now had to be investigated and there was evidence that others were looking at methodologies where management performance was being utilised. It was only when looking at a later issue of identifying priorities that a possible solution was realised.

Many of the prominent publications e.g. BS 7750⁽¹²⁾ and Croner's Environmental Policy and Procedures⁽²⁶⁾, were at this time advocating that prioritisation of environmental impacts be carried out using some form of risk assessment.

When considering the environmental management of a site, the organisation must consider the environmental impact of the site in addition to how well it is managed such that those impacts which are inevitable due to the type of business involved are minimised as far as possible.

In conducting an initial environmental review, it was recognised by BS 7750 that four basic steps must be completed.

1. Identification of environmental aspects;
2. Identification of applicable legal and other requirements;
3. Identification of significant environmental aspects; and
4. Examination of existing management practices and procedures.

Whilst conducting the initial environmental review, weaknesses will undoubtedly be identified in both the operation of plant & services and management of the site in relation to the environment. Therefore, any prioritisation methodology must be capable of prioritising these issues on an equal basis.

Risk assessment, which is advocated by ISO 14001⁽¹⁵⁾ as the preferred methodology for prioritisation, is invariably concerned with parameters such as consequences, probability, likelihood, outcomes and frequency. These parameters are more easily applied to the operation of plant & services than to managerial issues. Therefore, an equivalent filter had to be developed through which managerial issues could be passed before being considered alongside operational & service issues.

The first attempt at developing a methodology to address these issues, and thereby address prioritisation, was made in the initial development of the GREENCODE Prioritisation Module. This module was designed to prioritise information in a spreadsheet format and receive information from two distinct sources, Audits and Significant Environmental Aspects.

GREENCODE Audits

The Audit route considered the results of GREENCODE audits and presented the results in the format shown in Figure 1 below.

Audit	Significance Value	Section 1 Score (%)	Section 2 Score (%)	Section 3 Score (%)	Section 4 Score (%)
Emissions to Atmosphere	5	40	25	90	25
Energy Management	5	50	60	80	35
Land Management	2	60	40	70	60
Land Contamination	4	70	25	60	75
Organisation	3	75	30	50	25
Procurement	3	65	60	40	35
Waste Management	2	45	75	30	40
Discharges to Drain	2	35	25	20	55
Water Consumption	2	20	90	10	65

Consider all audits with a significance value of **3** and higher

Your Minimum Acceptable Level of Performance (MALP) in each audit section is **40** %

Cancel	Get Notes	Get Details
---------------	------------------	--------------------

Figure 1: Screen 1 – Audit Performance

When all the audit results are generated, there could be a considerable amount of work required to bring the performance in all areas up to an acceptable standard. For this reason the priority module was designed to allow the user to allocate subjectively a **Significance Value** to each audit. It was then possible to determine which audits would require corrective action by entering a number in the box at the bottom of the audit table. If a **Significance Value** of 3 was entered, this indicated that all Audits with a **Significance Value** of 3 or higher would be addressed first.

The Priority module was designed to automatically set a **Minimum Acceptable Level of Performance (MALP)** for each of the audit sections. The MALP was determined by adding 5% to the lowest sectional score in the selected audits. The addition of 5% to the lowest score was introduced to encourage the concept of continual improvement which was consistent with the principles of ISO 14001⁽¹⁵⁾. However, the MALP was not allowed to fall below 40% as this was considered to be the minimum level at which no emergency action would be necessary.

Based on the above selections (**Significance Value** = 3 and **MALP** \geq 40%), a reduced matrix similar to the one shown in Figure 2 below could then be generated.

Significance Value	Audit	Audit Section	Performance (Before) %	Performance (After) %	Improvement (%)	Cost (£)
5	Emissions to Atmosphere	2	25			
5	Emissions to Atmosphere	4	25			
5	Energy Management	1	35			
4	Land Contamination	2	25			
3	Organisation	2	30			
3	Organisation	4	25			
3	Procurement	4	35			

Consider all audits with a significance value of **3** and higher

Your Minimum Acceptable Level of Performance (MALP) has been set to **40** %.

Cancel

Save & Exit

Figure 2: Screen 2 – Audit Performance

Figure 2 identified those audit sections that failed to meet the selected criteria (i.e. Significance Value = 3 and MALP \geq 40%). From here, the user was required to address the specific weaknesses that were identified during the audits. By double clicking on a particular audit section a screen similar to that shown in Figure 3 below could be generated detailing the weaknesses within the particular section of the audits which failed to meet the selected criteria.

Emissions to Atmosphere - Section 2 'Organisation'				
Weaknesses	Potential Improvement (%)	Cost to Correct (£)	Action Y/N ?	
A Manager with overall responsibility for emissions to atmosphere has not been appointed.	N	16.6	1000	N
The duties of personnel with devolved responsibilities are not documented.	N	16.6	1000	N
There are no arrangements for identifying instruction and training needs on emissions to atmosphere.	N	16.6	2000	Y
Collaboration on emissions to atmosphere does take place but does not involve every department.	Q	8.3	NIL	N
There are no arrangements for carrying out identified instruction and training.	N	16.6	10,000	N
Minimum Acceptable Level of Performance (MALP) = 40%		Performance (Before) = 25%		
		Performance (After) = 41.6%		
		Improvement = 16.6%		

Figure 3: Screen 3 – Audit Weaknesses & Action Details

From this screen, it was possible to see what the individual weaknesses within the section were, the response given during the audit and the potential improvement in performance if corrective action was fully implemented. By double clicking on a weakness, corrective actions for each weakness could be added with the associated costs and estimated timescale for completion. The user could identify which corrective actions would be implemented immediately by placing a 'Y' or 'N' in the action column.

At the bottom of the screen, there was a reminder of the **MALP** set earlier and indicators showing **Performance (Before)**, **Performance (After)** and **Improvement**. These indicators were dynamic and altered depending on what weaknesses were selected for corrective action. The ‘User Notes’ button was added to allow the user to insert any additional information about decisions made during the process for future reference.

When it was decided which weaknesses were going to be addressed to achieve the **MALP**, the user could select the ‘Save & Return’ button which would return them to Figure 2 where the results of the decisions made would be represented in the ‘Performance Score (After)’, ‘Improvement’ and ‘Cost’ columns.

This process was then repeated for each Audit Section with scores less than the **MALP**. Once all the audit sections had achieved or exceeded the **MALP** value (in this case 40%), selecting ‘Save and Exit’ would transfer all the relevant information into the main ‘Prioritisation Screen’ as shown in Figure 4 below.

Audit/Environmental Effect	Improvement	Cost (£)	Cumulative Cost (£)	Cost/Improvement Ratio	Timescale (Weeks)
Emissions to Atmosphere Section 2 - ‘Organisation’	16.6%	2000	2000	120.5	1
Boiler flue Emissions	50	500	2500	10	1
Cancel	User Notes			Save & Exit	

Figure 4: GREENCODE Main Prioritisation Screen

Significant Environmental Effects

The second route through which the Priority Module accepted information was from the Significant Effects Worksheet. On selecting 'Import Significant Effects' from the 'Utilities' menu of the Priority Module, the aspects were presented on a screen similar to that shown in Figure 5 below.

Figure 5: Significant Environmental Aspects Worksheet

Double clicking on a ‘Significant Aspect’ activated a risk assessment worksheet as shown in Figure 6 overleaf. The objective of the risk assessment approach was to determine the possible improvement that could be achieved if corrective action was taken to prevent or reduce the possibility of the identified problem occurring.

As was mentioned earlier, risk assessment is often advocated as part of prioritisation. Risk assessment is not a new concept, it has been used for many years now and is accepted as the basic approach to quantifying the level of risk a particular issue may present to an organisation thus allowing it the opportunity to put in place contingency plans to prevent the potential consequences that may follow if no action were to be taken.

Environmental Effect			
Identified Problem			
Corrective Action			
Cost: £		Time scale:	Action:

<i>Potential Consequences of identified problem. (Table 1)</i>		SCORE
• Purchaser relations		
• Organisational image		
• Operational delay		
• Prosecution		
• Property loss/damage		
• Compensation		
• Clean-up cost		
• Loss of Accreditation		
Consequence totals:		Ct

<i>Frequency. (Table 2)</i>	Before	After
• Frequency of operation associated with identified problem	FB	FA
<i>Probability. (Table 3)</i>		
• Likelihood of identified problem occurring	PB	PA
OVERALL SCORE (OS) = Ct x F x P		OSB
OSA		

IMPROVEMENT (I) = OSB - OSA

TABLE 1: POTENTIAL CONSEQUENCES

	SCORE					
	0	1	2	3	4	5
Purchaser relations	None N/A	Minor	Moderate	Significant	High	Major
Organisational image	None N/A	Minor	Moderate	Significant	High	Major
Operational delay	None N/A	Minor	Moderate	Significant	High	Major
Prosecution	None N/A	Minor	Moderate	Significant	High	Major
Property loss/damage	None N/A	Minor	Moderate	Significant	High	Major
Compensation	None N/A	Minor	Moderate	Significant	High	Major
Clean-up cost	None N/A	Minor	Moderate	Significant	High	Major
Loss of Accreditation	None N/A	Minor	Moderate	Significant	High	Major

TABLE 2: FREQUENCY

	SCORE					
	0	0.5	1.0	1.5	2.0	2.5
Frequency of operation	Infrequent	Monthly	Weekly	Daily	Hourly	Continuous

TABLE 3: PROBABILITY

	SCORE					
	0	0.2	0.4	0.6	0.8	1.0
Likelihood of effect occurring	None N/A	Remote	Low	Moderate	High	Certain

Figure 6: Environmental Aspects Risk Assessment Worksheet

It was decided that the risk assessment methodology would use the well-known risk assessment elements ‘Consequences’, ‘Probability’ and ‘Frequency’⁽³⁶⁾⁽³⁸⁾. Frequency and Probability invariably have graduated scales measuring a range of conditions from ‘Infrequent’ to ‘Continuous’ for frequency and ‘Unlikely’ to ‘Certain’ for probability. The most important aspect of any scoring system employed alongside these conditions is that it is applied consistently and not what the individual values are⁽³⁹⁾⁽⁴⁰⁾. It was decided that the following conditions would be used for ‘Frequency’ and ‘Probability’.

Frequency	Probability
Infrequent	None N/A
Monthly	Remote
Weekly	Low
Daily	Moderate
Hourly	High
Continuous	Certain

At this point, it became apparent that suitable indicators were needed to represent the maximum foreseeable consequences that the organisation could incur should the potentially damaging environmental impact of an aspect be realised. A series of indicators were initially identified and are outlined below:

1. Loss of reputation;
2. Effect on public perception;
3. Operational delay;
4. Property loss;
5. Damage to property;
6. Prosecution;
7. Loss of accreditation;
8. Clean-up costs;
9. Liabilities;
10. Compensation; and
11. Purchaser’s perception.

It was decided that the above list was too long and would need to be reduced to a useable size of between 7 and 9 indicators. In the light of the views of the GREENCODE user groups, some further work was carried out on the indicators and the subsequent scoring system.

The list was finally reduced to the following with their associated descriptions:

	Indicator	Description
1	Purchaser Relations	A measure of the impact on the organisation's relationship with its customers who buy their products or services.
2	Organisational Image	A measure of the impact on the organisations image in the eyes of their customer or the wider public.
3	Operational Delay	A measure of the length of operational delay that may be incurred by the organisation.
4	Prosecution	A measure of the level of prosecution that may be incurred by the organisation.
5	Property Loss/Damage	A measure of the amount of property loss or damage that may be incurred by the organisation.
6	Compensation	A measure as to the level of compensation that may be payable by the organisation.
7	Clean-up Costs	A measure as to the level of clean-up costs for which the organisation may be liable.
8	Loss of Accreditation	A measure as to the impact the loss of any accreditations may have on the organisation.

As the scoring system employed by the GREENCODE Audit module generated a score between 1 and 100 for each audit it was decided that, for ease of development, a similar scoring system should be developed. Therefore, the following scoring scales were selected for use with 'Consequences', 'Frequency' and 'Probability' which would generate the desired scoring range:

Consequences		Frequency		Probability	
Score	Description	Score	Description	Score	Description
0	None	0	Infrequent	0	None N/A
1	Minor	0.5	Monthly	0.2	Remote
2	Moderate	1.0	Weekly	0.4	Low
3	Significant	1.5	Daily	0.6	Moderate
4	High	2.0	Hourly	0.8	High
5	Major	2.5	Continuous	1.0	Certain

Details of all the graduated scores used in the Risk Assessment Form and their associated descriptions are outlined in Figure 6.

On activating the risk assessment form, the user was asked to describe the problem associated with the selected aspect. This being done, they were then asked to suggest some form of corrective action, identify the associated costs, timescale and who would be responsible for carrying out the corrective action.

It was then left to the user to subjectively score the '**Potential Consequences of Identified Problem**' i.e. the worst possible consequences if the identified problem were to occur.

Following this, they were asked to evaluate subjectively the '**Frequency of operation**' associated with the identified problem (e.g. a boiler that emits black smoke each time it starts up may be given a score of 2.5 (Continuous) from Table 2 as it happens very frequently). In addition, they were asked to subjectively evaluate the '**Probability**' by estimating the '**Likelihood of effect occurring**'. In the example of the boiler emitting black smoke, it is certain that it will do it every time and thus a score of 1.0 will be entered. In both of these instances, the user was asked to assess the **Frequency** and **Probability** both before and after the corrective action has been taken.

The overall scores associated with an identified aspect were calculated as follows:

$$\begin{aligned}\text{Overall Score}_{(\text{Before})} &= \text{Consequences} \times \text{Frequency}_{(\text{Before})} \times \text{Probability}_{(\text{Before})} \\ \text{OS}_B &= C_t \times F_B \times P_B \\ \text{Overall Score}_{(\text{After})} &= \text{Consequences} \times \text{Frequency}_{(\text{After})} \times \text{Probability}_{(\text{After})} \\ \text{OS}_A &= C_t \times F_A \times P_A\end{aligned}$$

The most important parameter was the potential improvement in operational performance i.e. Improvement Score or, considering it another way, the potential reduction in risk. The Improvement Score was calculated as follows:

$$\text{Improvement Score} = \text{Overall Score}_{(\text{Before})} - \text{Overall Score}_{(\text{After})} \text{ (i.e. OS}_B - \text{OS}_A\text{)}$$

Due to the scoring system employed, the improvement score would always lie between 1 and 100 thus making it a compatible scoring system to that employed for the GREENCODE Audit weaknesses identified earlier.

The environmental aspect's 'Improvement Score' and associated 'Costs' were then ready to be imported into the main prioritisation model along with the Audit 'Improvement Score' and 'Costs' identified earlier. All the necessary information having been imported from the two available sources (Audits and Database), it was now possible to prioritise all the issues on a common set of criteria and scoring systems i.e. Improvement, Cost, Cost/Improvement Ratio and Timescale as shown in the Main Prioritisation Screen in Figure 4.

New Significant Aspects Module

During development of the initial prioritisation methodology and subsequent testing, it became apparent that as the management score in any one of the 9 GREENCODE audits improved then the probability and possible severity of any environmental impact was reduced. Furthermore, since there were only 9 GREENCODE audits and 69 individual aspects, it became apparent that the results of one audit could potentially influence the significance and subsequent level of priority of more than one aspect.

Consequently, the level of management control was no longer an independent element to be considered alongside each environmental aspect but was a factor in determining their significance and subsequent level of priority. In the light of these findings, the methodology of measuring management performance alongside

individual aspects was dropped in favour of developing a new methodology that took account of the influencing nature of management performance upon many aspects.

This line of thinking, where management performance was an influencing factor when determining significance or severity of impact, was further vindicated with the publication of a document entitled 'Operator and Pollution Risk Appraisal' (OPRA Version 1.0)⁽³⁷⁾ issued by the Environment Agency. This was a methodology devised to help them, amongst other things, direct the Agency's resources in a more effective way.

The methodology effectively measured all industry sectors against two criteria, Operator Performance and Pollution Hazard. Both of the criteria were subjectively scored and weighted based on the experience gained by the Environment Agency over the years of inspecting industry. This scoring system produced a scatogram which was then used to determine which industry sectors represented a very high, high, average, low and very low risk to the environment. From this the Agency could determine which sectors would be called upon for inspection.

By taking into account the findings of the initial prioritisation methodology during early development and testing plus the content of OPRA, it was decided to abandon the significant aspects worksheet currently in use within the GREENCODE database module as the sole mechanism for determining significance. It was decided that there should be a new module added to GREENCODE which would integrate with the existing modules (Database and Audit) and extract the relevant information to assist the users to determine a significance rating for each aspect and would account for the influencing nature of management performance.

However, the original significant aspects worksheet was still thought to have some useful purpose. The thinking behind the decision to keep the worksheet at the time was that any aspect which had legislation applicable to it did so because in the eyes

of the regulator it needed to be controlled to avoid unnecessary environmental damage. Thus, this criterion could also be used to help determine significance.

By abandoning the original significant aspects worksheet as the sole mechanism for determining significance, but retaining it as part of the system, its title required to be changed to reflect more accurately its modified function. It was decided to upgrade the worksheet to an electronic form contained within the GREENCODE Database module and to call it the ‘Environmental Importance Worksheet’.

As the research and development continued along this path, it became clear that the new methodology would have three elements, Environmental Importance Score, generated from the new electronic ‘Environmental Importance Worksheet’, and two new elements, Management Factor and Pollution Factor.

The environmental importance would be determined using the new ‘Environmental Importance Worksheet’. The results generated by this worksheet would be imported into the new Significant Aspects module and it would generate a score between 1 and 100.

Management Factor & Pollution Factor

The development of the two new elements, Management Factor and Pollution Factor, was heavily influenced by the OPRA⁽³⁷⁾ methodology highlighted earlier. As outlined previously, the OPRA system was based around an evaluation of risk that contained two elements. The first was Operator Performance Appraisal (OPA), which was a methodology used to determine “the probability of an occurrence of an undesirable event” and the second was Pollution Hazard Appraisal (PHA), which was a methodology used to determine “the consequences of the event”.

Both of these appraisal methodologies had several elements within them that were measured on a scale of 1 to 5 with each element being weighted and the overall score

associated with each appraisal being determined by a combination of the scores and the attributed weightings.

The Operator Performance Appraisal elements were:

- Compliance with limits and adequacy of records;
- Knowledge of authorisation requirements and implementation;
- Plant maintenance and operation;
- Management training;
- Procedures and instructions;
- Frequency of incidents and justified complaints; and
- Auditable environmental/management system.

The Pollution Hazard Appraisal elements were:

- Hazardous substances;
- Techniques for prevention and minimisation;
- Techniques for abatement;
- Scale of process;
- Location;
- Frequency of operation; and
- Offensive substances in the process;

Since the OPRA⁽³⁷⁾ methodology was developed for Integrated Pollution Control (IPC) processes, these elements and their associated descriptions did not easily translate into an NHS system that was being developed to evaluate far more than just IPC processes. However, it offered sufficient evidence that management issues could certainly influence the significance of individual environmental aspects within a site.

Therefore, new ways of measuring similar elements could now be researched and developed and be integrated into a new methodology for determining the environmental significance of aspects within GREENCODE.

Management Factor

As the management audits within GREENCODE measured how well each site managed its operations in 9 key environmental areas, it was decided that the structure and questions contained within the GREENCODE audits and the associated scores adequately measured elements similar to that of the Operator Performance Appraisal element within OPRA⁽³⁷⁾ (which in risk terms represented the probability). Therefore, it was decided to use the audit score as a measure of probability, which later became known as the GREENCODE Management Factor (MF).

In order to link the probability of occurrence to each aspect within the GREENCODE Database, each of the 69 aspects within the database module had to be associated with the appropriate audit contained within the GREENCODE Audit module. This was achieved by assigning each of the 69 aspects to the audit that would best represent its performance in terms of management. The Management Factor (MF) value for a particular ‘Environmental Aspect’ was determined by the score achieved in its associated audit using the following equation:

$$\text{Management Factor (MF)} = 100 / \text{Audit Overall Score}$$

The software was designed to output a value between 1 and 5.

The one remaining element that needed to be addressed was the pollution factor.

Pollution Factor

The OPRA methodology for Pollution Hazard Appraisal (PHA) heavily influenced the development of the GREENCODE Pollution Factor (PF). The attributes of the PHA were largely applicable, but their titles and associated scoring descriptions did not easily translate into an NHS hospital context. Therefore, new criteria and scoring descriptions needed to be developed which were more generic and could easily be interpreted irrespective of context. The following criteria and scoring/rating descriptions were developed.

Criteria	Rating 1	Rating 5
Impact/Hazard	Low intrinsic toxicity, negligible potential to cause harm to people and/or environment.	High intrinsic toxicity, potential to cause serious harm to people and/or environment.
Amount/Scale	Very small amount/scale involved compared to sector average.	Very large amount/scale involved compared to sector average.
Minimisation	Every practical effort has been made to minimise the amount released into the environment or the depletion of natural resources.	No attempt at minimisation.
Frequency	Infrequent occurrence.	Extremely frequent occurrence.
Nuisance	Inoffensive	Extremely offensive/unpleasant.

The GREENCODE Pollution Factor is a subjective measure made by the user based on the above five criteria, which were scored between 1 and 5. The average of these scores represented the overall Pollution Factor score and was adjusted to result in a value between 1 and 5 thus making it compatible with the Management Factor value.

In the OPRA⁽³⁷⁾ methodology, each element within the Operator Performance Appraisal (OPA) and the Pollution Hazard Appraisal (PHA) was assigned an associated weighting. The practice of applying weights throughout GREENCODE was not adopted due to earlier experience gained during the development of the SAFECODE⁽³²⁾ system, where users were found to adjust the weightings of particular elements in pursuit of more favourable overall scores.

This approach of not using weightings was supported sometime later in Version 2 of OPRA⁽⁴¹⁾ that was published late in 1997 and in which the use of weights was removed from the methodology.

Significance Rating

It was decided that the Significance Rating would be calculated using the following formula, which incorporated all three of the elements, Environmental Importance, Management Factor and Pollution Factor:

Significance Rating = EI x MF x PF

Where: EI = Environmental Importance
 MF = Management Factor
 PF = Pollution Factor

This methodology offered a range of significance scores between 1 and 2500.

By developing this new approach to significance rating, the problem highlighted with the earlier GREENCODE system regarding the effective integration of management audit results within the initial review process had now been addressed and by following a route similar to that of OPRA⁽⁴¹⁾, the aspects were now evaluated in a way which followed that of a risk assessment approach.

The ‘Smart’ linking that had been designed into GREENCODE (i.e. Aspects to Legislation, Aspects to Departments, Audits to Aspects, Corrective Actions to Audits, and Costs to Corrective Actions) could now be used to facilitate effective reporting in a form not readily available from the raw data alone and to facilitate the identification of environmental priorities.

New Prioritisation Module

A new prioritisation methodology now had to be developed to assist the user to identify which aspects should be subject to corrective action.

ISO 14001⁽¹⁵⁾ allows for issues other than environment to be considered when determining the aspects on which an organisation is going to take action to improve its overall environmental performance. These include such issues as financial considerations, technological advances, risk to the organisation and views of interested parties.

All of these issues, environmental and business, constitute inward and outward risk, inward risk representing a risk to the organisation in terms of public perception,

organisational image, operational delay etc. and outward risk representing the risk to the environment.

The new methodology for determining the environmental significance rating of an aspect was regarded as sufficient to represent the level of risk to the environment (i.e. the outward risk).

The indicators developed in the initial methodology to represent the maximum foreseeable **Consequences** (i.e. purchaser relations, organisational image, operational delay etc.) together with the **Significance Rating** were brought together to represent the organisational risk using the following equation:

$$\begin{aligned}\text{Organisational Risk} &= \text{Consequences} \times \text{IE} \times \text{MF} \times \text{PF} \\ &= \text{Consequences} \times \text{Significance Rating}\end{aligned}$$

Therefore, organisational risk (i.e. Inward Risk), is determined by considering the maximum foreseeable consequences to the company together with the risk to the environment (Outward Risk). This method allows the organisation to consider, for example, instances where the environmental impact could be small but where negative public perception may be very high (e.g. installation and operation of incineration plant) and vice versa.

The system at this point had two indicators for each environmental aspect, **Outward Risk** represented by the **Significance Rating** and **Inward Risk** represented by **Organisational Risk** and the question now was what indicators should be used to prioritise actions. It was decided that the decision as to which one the user should use must be left to the collective professional judgment of those involved in this process since they are best placed to understand the restrictions and/or barriers that may exist to progressing in a particular manner.

To help those involved in this process, it was identified that some additional indicators could be generated such as:

Environmental Significance Reduction	(Considers only the reduction of impact on environment)
Organisational Risk Reduction	(Considers only the potential risk reduction to the organisation)

However, these indicators could only be generated once the user had entered the relevant information on what actions were to be taken to improve the situation by addressing either the weaknesses associated with the Management Factor or the measures to improve the Pollution Factor scores associated with a particular aspect.

Experience has shown that, in most cases, the limitations on corrective action are of a financial nature and, therefore, the user must be able to enter an estimate as to the cost of any corrective action and be able to view the cumulative cost of several corrective actions being implemented at any one time.

Furnished with all of the above information, it would then be possible to prioritise on any one of the several different indicators listed below, whilst keeping a watchful eye on the cost of each option.

1. Environmental Significance (Considers only the impact on environment)
2. Environmental Significance Reduction (Considers only the reduction of impact on environment)
3. Organisational Risk (Considers only the potential risk to the organisation)
4. Organisational Risk Reduction (Considers only the potential risk reduction to the organisation)

The one issue remaining in terms of ISO 14001⁽¹⁵⁾ was how to demonstrate continual improvement.

By implementing the GREENCODE modules for significance and prioritisation, the process of continual improvement could be measured by the overall reduction in environmental significance of the environmental aspects present on a site. With year on year reports being generated, it would be possible to track the performance of individual aspects, which would generate the necessary documentary evidence that continual environmental improvement was being achieved.

At this point in the GREENCODE development, it was recognised that, due to the changes between BS 7750⁽¹²⁾ and ISO 14001⁽¹⁵⁾ and the developments that had been made during the recent round of research and development, some changes would need to be made to the existing modules to bring users into line with the thinking of the time. In addition, although ISO 14001 was now the recognised standard for environmental management systems, the Forum noted that not all Trusts might wish to implement an environmental management system to the full extent of ISO 14001.

Therefore, an alternative route had to be an option for those Trusts not wishing to fully implement ISO 14001, which would be less onerous than ISO 14001 but would still represent a responsible approach to environmental management. It was decided that this route would be called the GREENCODE route and such a system would be available before the next phase of GREENCODE (i.e. Phase 2) would be released.

As a result, the two new modules of **Significant Aspects**, which would be used to determine the individual significance rating of each aspect, and **Prioritisation**, which would be used to determine on which aspects corrective/improvement action would be taken, were developed keeping in mind the option for the user to follow a GREENCODE route.

Subsequent to these developments, the existing GREENCODE database module was adjusted to also incorporate the GREENCODE route, which would be the point at which the user would initiate this option. For a detailed description of how the new and amended modules looked and operated from a user's point of view see Appendix

9 which contains the manuals issued as part of GREENCODE Phase 2. The manuals describe the basic functionality of the GREENCODE Database, Significant Aspects and Prioritisation modules incorporating the GREENCODE route as requested by the Forum members. GREENCODE Phase 2 was issued to Forum members in January 1997.

At this point it was understood that certification to ISO 14001⁽¹⁵⁾ would be available in the autumn of 1997. It was decided by the Forum members that the current software system should now be further developed and accompanied by the full raft of documentation (see Appendix 5) necessary to assist Trusts to achieve certification to ISO 14001.

It was also decided by Forum members that the complete GREENCODE environmental management system should be piloted again by assisting three Trusts, two in Scotland and one in Northern Ireland, to achieve ISO14001 certification, with a view to making any necessary adjustments to the package identified during this process prior to widespread release to the National Health Service.

Chapter 6

Development of Documentation and ISO 14001 Certification Pilot

Documentation Development

As was outlined in the previous chapter, the Forum members had instructed that GREENCODE should now be developed to assist Trusts to achieve ISO 14001⁽¹⁵⁾ certification which was shortly to become available. However, before releasing the final Phase of GREENCODE (i.e. Phase 3) to the National Health Service in Scotland, the Forum wished the fully developed system to be piloted. This provided the opportunity to research the certification requirements for ISO 14001.

The first task was to identify and generate the documentation that was to accompany the GREENCODE software and to further develop, where necessary, the existing software modules to achieve certification.

Research carried out in 1993/94⁽⁴²⁾ and subsequent production of the NHS in Scotland Energy & Environment Report for 1993/94⁽⁴³⁾ had shown evidence of poor record keeping and/or lack of access to accurate records. With this evidence in mind, it was decided that standard forms would be produced for each procedure to record the output and to include specific instructions on how and where to store the associated records within the procedure itself.

Further research was needed to establish the detailed content of any additional procedures and of any amendments needed to the existing procedures. Therefore, each individual clause of section 4 within the ISO 14001 standard (i.e. the section which outlines the requirements that have to be met in order to achieve certification) along with the associated guidance offered in Annex A of the standard were read, analysed in detail and conclusions drawn as to the full range of procedural issues the user would need to address in order to meet the requirement of that clause.

Since GREENCODE was being designed to be a generic system it was important that it was developed to aid consistency of approach and understanding. Therefore it was thought prudent to develop procedures for the full range of issues revealed by the research irrespective of whether the clauses of the standard formally required them or not.

Several procedures had already been developed during the development of Phases 1 & 2 of GREENCODE (see chapter 3). Due to this earlier work, a format for written procedures already existed upon which the remaining procedures could be based. Since the format of GREENCODE procedures had already been established and was found to be easily understood and implemented by the users during Phases 1 & 2, there was no justification for moving to an alternative format.

At the time of generating the documentation, publications such as Croner's Policy & Procedures⁽²⁶⁾ and The Green Managers Handbook⁽²³⁾ existed but none of these references contained any documentation or referenced any other documentation or styles that could be used directly to fulfil the requirements of the GREENCODE system. Therefore, these references were used simply to give a better understanding of the problem with some basic examples of how to approach a solution.

It was concluded from the research that the following additional GREENCODE management procedures (MP) and management system procedures (MSP) were required. A description of each procedure and the issues to be addressed within them are given below.

(MP) Setting Objectives & Targets (GREENCODE Document 3.1.6)

Objectives are the overall goals set by the Trust for environmental performance. They must be consistent with the Trust's environmental policy and are one of the essential elements used in developing and measuring compliance within any environmental management system. When deciding the objectives for the Trust, it is essential to

consider the results of any audits, reviews and identified significant environmental aspects.

Once the objectives have been agreed, suitable environmental targets can then be set in relation to each objective. It is important that all targets are measurable and achievable within a fixed time period.

It was concluded from the research that the content of the procedure should address the following issues:

- The frequency of meetings to decide Objectives and Targets by management team;
- The associated standard form for recording Objectives and Targets;
- Explain what should be entered in the standard form and by whom;
- Identification of actions necessary to achieve the stated objective and target;
- Obtaining authorisation for the agreed objectives and targets;
- The production and storing of records;
- The informing of relevant personnel within the organisation of agreed objectives and targets;
- Reviewing of objectives and targets by the management team;
- How future changes to the procedure should be recorded;
- Direct the management team to the procedure for producing the Environmental Management Programme.

(MP) Generating Management Programme (GREENCODE Document 3.1.7)

The environmental management programme is an essential element in the successful implementation of any environmental management system. It outlines the approach to be adopted by the site in achieving its objectives and targets. The programme should be easy to understand, show clearly the approach being adopted and how all the individual elements are linked to the environmental policy.

The programme should highlight the policy area being considered, the associated objective(s) and target(s), the performance measure(s) to be used, where the responsibility for implementation of the objective(s) and target(s) lies and the method and frequency of reporting on progress.

It was concluded from the research that the content of the procedure should address the following issues:

- The order in which this procedure should be carried out;
- What the management team need to agree:
 1. The associated objectives and targets as recorded in document 3.1.6 (SF/01);
 2. The target date for achieving each objective & target;
 3. The performance measures to be used (e.g. GJ/m³/Annum for energy);
 4. Where the responsibility for implementation of objectives and targets lies;
 5. The frequency of reporting on progress; and
 6. The method of monitoring to be used in assessing achievement of each objective & target (e.g. written reports, analysis of procedure records etc.).
- Reviewing of the Environmental Management Programme by the management team;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Training Identification & Co-ordination (GREENCODE Document 3.1.8)

Environmental training identification and co-ordination is one of the most important aspects of any environmental management system. If executed correctly, it ensures that personnel who have responsibility for achieving policy and objectives and targets have the appropriate knowledge to achieve their individual environmental goals.

Environmental training is essential to ensure that a sound knowledge of regulatory requirements, internal standards, environmental policy and objectives and targets is obtained by relevant staff.

Gaining certification to ISO 14001⁽¹⁵⁾ will be influenced by the site's ability to demonstrate a commitment to environmental training for all staff whose work may create a significant impact on the environment.

It was concluded from the research that the content of the procedure should address the following issues:

- The identification of training needs;
- The development of a training programmes to address the staff training needs;
- The identification/generation/maintenance of training records;
- The reviewing of the Environmental Management Programme by the management team;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Monitoring & Measurement (GREENCODE Document 3.1.9)

Environmental monitoring and measuring is a key activity within an environmental management system and helps to ensure that the site is performing in accordance with its stated environmental management programme, objectives & targets and environmental policy.

One of the main areas of concern within monitoring and measurement is the issue of legal compliance. Commitment to compliance with legislation is a fundamental requirement of the environmental policy statement under ISO 14001.

It was concluded from the research that the content of the procedure should address the following issues:

- The completion of standard forms for monitoring and measurement;

- The completion of standard forms for calibration and maintenance;
- The completion of standard forms for legal compliance;
- The raising of Non-Conformances and conditions under which these should be raised;
- The reviewing of the monitoring and measurement records by the management team;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Incident Reporting (GREENCODE Document 3.1.10)

Environmental Incidents such as chemical spillages, accidental releases into the atmosphere etc. should be logged as soon as possible after the incident occurs. Recording these incidents helps identify any potential legal breaches.

It was concluded from the research that the content of the procedure should address the following issues:

- The completion of standard forms;
- The identification of action;
- The signing of the incident report by the management representative;
- The reviewing of incident reports by the management team;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Communication (Internal & External) (GREENCODE Document 3.1.11)

A record should be maintained of the communications received from different parties, both internal and external to the site. Any follow-up action should also be recorded for completeness and to provide evidence that the communications received are given the appropriate response.

This procedure details how communication records relating to environmental management issues should be generated and processed within the GREENCODE

environmental management system. Its purpose is to ensure that all communications, both internal and external, are dealt with in a consistent and efficient manner.

It was concluded from the research that the content of the procedure should address the following issues:

- The information to be communicated;
- Who should receive this information;
- The standard forms to be used if any;
- The reports to be produced;
- The identification of publicly available information by the Management team;
- The distribution of the Environmental Management Review report;
- The Production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Emergency Preparedness & Response (GREENCODE Document 3.1.12)

An Emergency plan/manual and related procedures should be established and maintained to ensure that there will be an appropriate environmental response to unexpected incidents, accidental incidents or emergency situations should they arise.

The emergency plan/manual and related procedures should where appropriate, consider:

- Accidental emissions to atmosphere;
- Accidental discharges to water;
- Accidental discharges to land; and
- Potential emergency situations.

An emergency plan/manual can include:

- Emergency organisation and responsibilities;
- A list of key personnel;
- Details of emergency services (e.g. fire service, spill clean-up service, local authority);
- Internal/external communication plans;

- Action to be taken in the event of different types of emergencies/incidents;
- Information on hazardous materials, including potential impact on environment and measures to be taken in the event of accidental release; and
- Training plans and testing of procedures for effectiveness.

It was concluded from the research that the content of the procedure should address the following issues:

- The identification of potential incidents and emergency situations by the management team;
- The recording of the situations in the standard form;
- The identification of related procedures to be used in the event of any of the identified situations occurring;
- Ensure that the identified procedures contain information on the prevention and mitigation of environmental impacts;
- The recording of when related procedures were last reviewed;
- The recording of when related procedures were last tested;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MP) Operational Control (GREENCODE Document 3.1.13)

Operational Control is possibly the most important function within any environmental management system. The functions and/or activities that will normally require operational control are those which give rise to environmental aspects.

Control is normally achieved through written work instructions or procedures that detail the acceptable operating criteria for that function/activity. In accordance with ISO 14001⁽¹⁵⁾ a written procedure is only required where the lack of such a procedure could lead to deviations from the environmental policy and objectives and targets.

The simplest way to address this requirement is to generate an operational control matrix and record the location of related documentation. The purpose of this matrix

is to aid management in identifying and recording the location of operational control procedures and related documentation which are pertinent to the environmental aspects identified as being present on a site.

It was concluded from the research that the content of the procedure should address the following issues:

- The printing of the necessary standard form from the GREENCODE Database module;
- The identification of operational control procedures;
- The recording of control procedure information in standard form;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MSP) Format of Documents (GREENCODE Document 3.2.1)

Format of documents is very important within any documented management system. This procedure outlines how all controlled documentation contained within the GREENCODE environmental management system should be generated.

It was concluded from the research that the content of the procedure should address the following issues:

- The identification of controlled documents within GREENCODE;
- The method of referencing documents within GREENCODE;
- The layout of documents, Page size (A4), headers and footers etc.;
- The format of each document type;
- The standard forms to be used; and
- How future changes to the procedure should be recorded.

(MSP) Document Control (GREENCODE Document 3.2.2)

Document control is one of several important tasks in operating any documented management system. This procedure details how personnel generate and control

those documents that are essential to the efficient operation of the GREENCODE Environmental Management System.

It is important to ensure that all types of documentation contained within the environmental management manual are generated, issued and maintained in a consistent, effective and efficient manner, thus avoiding financial loss or loss of esteem due to inaccurate information resulting from obsolete, illegible, possible untraceable or unauthorised documents.

It was concluded from the research that the content of the procedure should address the following issues:

- The generation of new documents;
- The review process required for new documents;
- The introduction of new documents into the Environmental Management System;
- The use of 'Document Distribution Matrix';
- The issuing of documents;
- How to deal with obsolete documents;
- How to deal with uncontrolled copies of documents;
- How existing documents are altered using a 'Request for Change' mechanism;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MSP) Auditing & Audit Programme (GREENCODE Document 3.2.3)

Audits of the environmental management system should be conducted periodically to determine how well the system is being implemented and maintained and to determine how well it is achieving its objectives. There are four different types of audit which can be carried out within GREENCODE:

1. **Management System Audit:** These are independent evaluations of the documentation within the GREENCODE environmental management system;
2. **Management Audits:** These are the audits which were performed for the first time during the initial environmental review. These audits assist management review their management practices within nine key areas of environmental management;
3. **Follow-up Audit:** These are audits performed, subsequent to an audit, to verify that any identified corrective action has been implemented and has been effective; and
4. **Operations Audit:** These are audits to review all records contained within GREENCODE to ensure that the environmental management system remains effective.

This procedure outlines how audits should be programmed, performed and reported on.

It was concluded from the research that the content of the procedure should address the following issues:

- The content of GREENCODE Management Audits and Management System Audits;
- The areas to be audited;
- The auditors to be used;
- The frequency of all audits;
- The start, completion and follow-up dates for all audits;
- The raising of auditor report worksheets;
- The use of auditor reports worksheets by auditors;
- The raising of non-conformances;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MSP) Non-conformance Reports (GREENCODE Document 3.2.4)

If any non-conformances within a management system are highlighted, corrective action must be undertaken and must have a timescale for completion. This procedure details how the Environmental Management Representative should generate and control non-conformance reports within the GREENCODE environmental management system.

It was concluded from the research that the content of the procedure should address the following issues:

- The standard form to be used;
- The identification of the responsible person to implement corrective action;
- The recording of details of the non-conformance;
- The agreeing of immediate corrective action and action to prevent a re-occurrence;
- The following-up and verification of the corrective action;
- The production and storing of records; and
- How future changes to the procedure should be recorded.

(MSP) Control of Records (GREENCODE Document 3.2.5)

Effective management of environmental records is essential to the successful implementation of the environmental management system. Environmental records demonstrate conformance with requirements of the system, they must be protected from damage, loss and deterioration and must be retrievable.

It was concluded from the research that the content of the procedure should address the following issues:

- The identification of all records to be controlled;
- The responsibility for controlling all records;
- The retention times for all records;
- The identification of confidential records;
- The rules for access to records;

- The procedure for removal of records by individuals;
- The protection of records from damage, loss and deterioration; and
- How future changes to the procedure should be recorded.

(MSP) Environmental Management Review (GREENCODE Document 3.2.6)

An environmental management review is conducted to ensure the continuing suitability and effectiveness of the environmental management system adopted. The environmental management review should be considered as part of the ongoing process of continuous improvement and not as a one-off exercise.

The management review can be conducted at intervals determined by the site management. Once per year is adequate once the system is fully operational and under control. However, until this is achieved, management reviews should be conducted on a more regular basis. Regular reviews will highlight weaknesses within the system and help record progress on continual improvement.

It was concluded from the research that the content of the procedure should address the following issues:

- The frequency of management review process;
- The identification of who should be present and participate in an Environmental Management Review;
- The documentation/areas that should be considered and/or reported on during the review;
- The generation of the Environmental Management Review report;
- The contents of the Environmental Management Review report;
- The assessment of actions identified in previous Environmental Management Review; and
- How future changes to the procedure should be recorded.

Whilst identifying the additional procedures and associated documentation that would be necessary for the ISO 14001⁽¹⁵⁾ system, it became apparent that a complete

new section was needed within the GREENCODE documentation structure. This new section was a Management Systems Records section, which would contain the records produced by the user as they implemented each procedure.

It was envisaged at this time that the GREENCODE folder with this section included could become the location for all subsequent Environmental Management System records in addition to those held and generated during the initial environmental review. Therefore, a new section, Section 8 'Management System Records' was added to the contents of GREENCODE. The revised contents of GREENCODE are contained in Appendix 10.

Having generated the necessary procedures and standard forms to comply with ISO 14001⁽¹⁵⁾ (See Appendix 11), it was then possible to generate a document linking the individual clauses of ISO 14001 and the relevant procedures within GREENCODE. This document was entitled 'GREENCODE Links to ISO 14001' and is contained in Appendix 12.

The only clause of ISO 14001 that is not addressed within GREENCODE is that for 'Structure & Responsibility'. This was due to the diverse nature of management structures that are employed within all industry sectors. Furthermore, it was not viewed as part of the remit of GREENCODE to dictate the management structure necessary to implement ISO 14001 but to allow each individual organisation to decide how it could best meet the management needs of the system.

The ISO 14001 Pilot

The Trusts to participate in the ISO 14001 pilot were selected on the basis of performance in previous environmental management pilots and active participation in Forum activities in the past. Three sites were invited to take part in the pilot with the Estates Environment Forum assisting these sites with the costs associated with achieving ISO 14001 certification.

The three sites selected were:

1. Glasgow Dental Hospital and School NHS Trust,
2. South Ayrshire Hospitals NHS Trust, and
3. Down Lisburn HSS Trust in Northern Ireland.

Before the certification process could take place, two important issues had to be addressed:

1. An appropriate certification body had to be selected; and
2. The Trusts participating in the pilot had to be trained in the new procedures and software that had been developed as this was now substantially different both in operation and size in comparison to GREENCODE version 2.0 which they were currently operating.

To address the first of these issues an investigation was undertaken to find an appropriate certification body. UKAS (United Kingdom Accreditation Service) was contacted for information on which companies were currently accredited to audit to the ISO 14001⁽¹⁵⁾ standard. At this time only nine companies were accredited certification bodies for the ISO 14001 standard:

1. Aspects Certification Services Ltd.;
2. British Approvals Service for Cables;
3. British Standards Institution;
4. Bureau Veritas Quality International Ltd.;
5. CQA Ltd.;
6. Det Norske Veritas Quality Assurance Ltd.;
7. ITS Intertek Services;
8. Lloyds Register Quality Assurance Ltd.; and
9. SGS Yarsley ICS Ltd.

In order to certify a hospital, the certification body must be accredited by UKAS to certify within that industry sector. This meant that the certification body must demonstrate to UKAS that their audit team included members with the appropriate

level of experience and understanding of that sector before being allowed to certify anyone within that sector.

Upon further investigation, it became apparent that none of the above accredited certification bodies had been accredited with a remit to certify within the healthcare sector. However, a number of them were intending to apply in the future.

Therefore, the Forum was now in the position of not being able to implement a certification pilot at this time. Coincidentally, one of the companies on the list (Aspects Certification Services Ltd.) had been in contact with the Estates Environment Forum Executive only weeks before enquiring if any hospitals were intending to implement ISO 14001⁽¹⁵⁾.

It later became apparent that Aspects Certification were investigating the potential market for ISO 14001 certification within the healthcare sector with a view to applying immediately to UKAS to extend their current scope of accreditation to include the healthcare sector.

Since Aspects Certification were already some way towards applying to UKAS for an extension of their current scope to include the healthcare sector, it was decided to meet with them to see if there was any way the National Health Service in Scotland and Aspects Certification could work together to achieve their individual goals.

During this meeting, it was concluded that Aspects Certification would work closely with the Safety & Environmental Management Unit to review GREENCODE and that the Safety & Environmental Management Unit would supply the necessary personnel for the certification process. In return, Aspects Certification would use the personnel supplied by the Safety & Environmental Management Unit to demonstrate to UKAS that they had a team available and of the appropriate expertise to extend their certification scope to include the healthcare sector.

The second issue of training the pilot sites on the new software and documentation now had to be addressed. A three-day course was generated to introduce the new system to Forum members and to which the three Trusts were encouraged to attend.

The course had to be made available to all members of the Forum and not just the three Trusts selected for the pilot since the developers of GREENCODE would be members of the auditing team for the ISO 14001 certification pilot. Training of individual clients is strictly not allowed under UKAS rules which govern the certification process, as it could be interpreted as coaching.

The training course was run successfully and attended by representatives from 9 different Trusts from Scotland, England, Ireland and Wales. After the training, the pilot Trusts were instructed to begin the implementation process and to communicate their progress to the Estates Environment Forum Executive so that an appropriate schedule for the certification process could be formalised.

Over the following few months the Trusts began the implementation process and Aspects Certification Services generated the required documentation to satisfy UKAS of the expertise contained within the proposed audit team. This documentation was accepted with the following conditions:

1. UKAS must be present throughout the certification process on one of the sites to assess the performance of the audit team;
2. As it was a pilot for the NHS and Aspects Certification were the first to apply for an extension of scope in this area and in recognition of the lack of experts in this field, UKAS would allow the certification process to continue with the developers of GREENCODE being part of the team; and
3. The developers of GREENCODE could no longer be members of the audit team after the pilot programme was completed since this would constitute members of the audit team assessing their own system.

Following the agreement with UKAS, a certification programme was agreed with the Trusts. The programme contained two significant dates for the completion of the Pre-Assessments and the Main-Assessments. The Pre-Assessments were to be completed by the end of November 1997 with the Main-Assessments by mid February 1998 in order for the certification body to submit their recommendations for certification to UKAS. Both of these dates were met by all three Trust taking part.

The following observations and subsequent improvements were made during the Pre-Assessment and Main-Assessment to assist the Trusts achieve ISO 14001⁽¹⁵⁾ certification in a more efficient manner.

The UKAS observer highlighted a problem during the pilot process with how the users identified the ISO 14001⁽¹⁵⁾ conditions Normal, Abnormal, Planned and Emergency associated with a selected aspect. GREENCODE was originally designed with default values automatically selected for the users and these were imported when the user selected an aspect as being present on their site. This was not acceptable to UKAS in that the user was required to think about these selections and be allowed to alter them in the light of professional judgement.

In response to these observations, GREENCODE was amended to allow the ISO 14001 aspect conditions to be selected and amended if necessary by the user. This actually made GREENCODE slightly slower from a user's point of view but, nevertheless, was necessary to satisfy the requirements of ISO 14001 as interpreted by UKAS.

UKAS identified a problem during the first part of the certification process (Pre-Assessment) with the GREENCODE documentation in that it did not show any form of formal adoption by the individual sites.

In response to this observation, a new instruction was added at the front of the GREENCODE folder detailing how the site should formally adopt the

GREENCODE system. In line with this instruction, all document front covers were amended to read 'Reviewed & Accepted By' and 'Authorised for Use By' with the appointed personnel on each site completing the appropriate section.

Again, during the pre-assessment phase of the certification process UKAS identified that the aspects identified for the site could not be traced back to the location/department and the activity that caused the aspects to be present on the site.

It was decided that the improvements needed to correct this problem would be best addressed within the GREENCODE database module. This was achieved by altering the aspects selection screen within the GREENCODE database module to allow the user to link departments to an aspect and describe the activity that caused the aspect to be present. A standard list of hospital departments was added which was editable by the user. The Printing function for aspects was altered to show departments and activities and the associated procedure was adjusted in line with the above changes.

During the pilot programme, the participants observed that the 'Environmental Importance' score was almost always 100 (the maximum possible). This had the effect of simply being a multiplier on the other two factors used to calculate significance.

Further investigation with other Forum users confirmed this. It was also discovered that almost all of the 69 aspects within GREENCODE had a legal implication associated with them thereby giving a score of 100. It was decided that this figure was offering little to the process of identifying the significance level of an aspect and was therefore removed from the equation.

The associated procedure 'Identifying the Importance of Environmental Aspects' was also removed from the GREENCODE documentation.

In response to the removal of the ‘Environmental Importance’ worksheet and its associated score, the ‘Significant Aspects’ module was adjusted to reflect this change. This resulted in the ‘Environmental Significance’ score being calculated from multiplying the ‘Management Factor’ by the ‘Pollution Factor’ (i.e. Environmental Significance = MF x PF).

It was observed during the pre-assessment phase of the certification process that the software did not offer the facility to identify and record ‘Other Requirements’ such as codes of practice, policies and other documents.

It was realised at this point that the electronic worksheet previously used to identify the ‘Environmental Importance’ score could be adjusted to resolve this issue. It was decided to adjust this worksheet by removing the last four columns and replacing them with the columns for ‘Policy’, Code of Practice’, ‘Other’ and ‘None’ to allow the user the facility to indicate which, if any, of these documents they were adhering to. If the user selected any of these columns, they were offered the facility to enter the title of the individual documents.

On printing applicable legislation, the identified ‘policies’, ‘codes of practice’ and ‘other’ document titles were also printed.

The menu options were adjusted to read ‘Legal and Other Requirements’ and ‘Legal and Other Requirements (Composite list)’.

The ‘Identification of Applicable Legislation’ procedure was amended to reflect the above changes and its title changed to ‘Identification of Legal and Other Requirements’, which reflected more accurately the ISO 14001⁽¹⁵⁾ requirement.

Although not formally recorded during the pilot programme the users reported that they found the process of following the ISO 14001 route very user friendly and fast to implement. In recognition of this, they expressed concern at there being an

alternative route available that might cause the GREENCODE route to be viewed as an inferior environmental management system if this option were to be chosen. This was also the feeling of the development team and this view had been expressed in previous meetings with the Estates Environment Forum Executive and the Forum members.

It was decided that these views would be conveyed again to the Forum Executive and the Forum members for their consideration. After lengthy discussions, it was decided that there would be no GREENCODE route offered in the final Phase 3 version.

In recognition of the costs associated with certification to ISO 14001⁽¹⁵⁾, the Forum indicated that an alternative form of certification (GREENCODE Certification) be researched which would not be as onerous as that for ISO 14001 and would offer an indication to interested parties of the responsible approach being adopted by a Trust to Environmental Management.

The GREENCODE route was subsequently removed from the software along with all references made to it in the associated documentation.

During the pilot programme, the users asked if there was any way the power of the computer could be used to help them complete the 'Objectives & Targets' and 'Environmental Management Programme'.

An investigation was undertaken to see if this was possible. It emerged that the best way to address this issue was to add a new function to the 'Priority' module called 'Objectives & Targets/Environmental Management Programme'. This new function was originally designed as two separate functions but was later incorporated into one to make it easier for the users.

The new function was designed to produce a new electronic worksheet and to automatically import information on corrective actions already entered by the users when identifying their environmental priorities. A new report was added to the printing functions within the Priority module to produce the necessary management system records for the users. These new functions are described in the GREENCODE Priority module software manual contained in Appendix 13.

The previous procedures relating separately to 'Objectives & Targets' and 'Environmental Management Programme' were combined into one procedure and were written to reflect the changes made to the GREENCODE Priority module.

A significant amount of emphasis was placed on the 'Operational Control' issues within ISO 14001⁽¹⁵⁾ during the pilot programme. Therefore, it was decided to develop a new function to assist the users address this important area.

Further investigation revealed that the GREENCODE Database module could be adjusted to include an electronic 'Operational Control Matrix' in a similar format to the 'Other Requirements Matrix' developed previously.

The new function was designed to import the selected aspects for a site into a worksheet which allowed the user to identify:

1. The procedure(s) used to control the aspects;
2. The location of these procedure(s) and their associated records;
3. The retention times for the records; and
4. The person responsible for implementing the procedure(s) and retaining the associated records.

The 'Operational Control' procedure and the GREENCODE Database module were adjusted to reflect these changes. A new report was also added to the database module to allow the user to print and store the records necessary for the environmental management system.

During the final Assessment of the pilot sites, it was discovered that the ‘Auditing and Audit Programme’ procedure was deficient in the area of audit protocol.

To address this issue the ‘Auditing and Audit Programme’ procedure was amended to include a section on audit protocol which included the following sub-sections:

1. The Audit Team;
2. Audit Preparation;
3. The Opening Meeting;
4. The Audit and Final Team Meeting; and
5. The Closing Meeting.

In addition to the above alterations made to the GREENCODE software and documentation, the following is a list of the less significant items that were also added/changed to assist the users to carry out their tasks more efficiently:

GREENCODE database module:

- The users were given the ability to add their own aspects and manually select the legislation thought to be applicable; and
- A new report was made available which printed the composite list of legislation and listed each piece of legislation against the aspects to which it applied.

GREENCODE significant aspects module:

- The last column was amended to read ‘Environmental Significance’;
- A new report was made available which printed the pollution factor details for each aspect;
- The pollution factor worksheet was amended to include a ‘Next’ and ‘Previous’ button thus allowing the users to navigate their way through the aspects list without leaving the pollution factor worksheet; and
- A new function was added to allow the importing of pollution factors from previous worksheets.

GREENCODE was recognised as having achieved its certification requirement when on the 2nd of March 1998, South Ayrshire Hospitals NHS Trust and Glasgow Dental Hospital and School NHS Trust announced that they had achieved certification to ISO 14001⁽¹⁵⁾. These Trusts, along with Down Lisburn HSS Trust in Northern Ireland, were the first in the UK healthcare field to be accredited to the ISO standard.

After all the above alterations were made to GREENCODE by the development team, GREENCODE was released to the service as Phase 3 in the autumn of 1998. The final documentation issued as GREENCODE Phase 3 can be viewed in Appendix 13.

Chapter 7

Summary, Conclusions and Future Research

Summary

This thesis is concerned with research into the possibility of developing an environmental management system with generic capabilities. Early in the research programme, the opportunity arose to develop this concept with the involvement of the National Health Service in Scotland. The NHS in carrying out its range of activities and services encompasses a large variety of impacts on the environment and therefore offered an appropriate vehicle for study.

The NHS in Scotland Estates Environment Forum was launched in November 1993 with the mission to develop a common and consistent approach to environmental management throughout the NHS in Scotland.

To achieve the mission of the NHS in Scotland, it was recognised that the eventual system would need to be sufficiently generic to make it applicable to all healthcare buildings.

The initial system requirements identified by the Forum early in 1994 were:

- To create a comprehensive list of environmental aspects for the health service;
- To develop a comprehensive database of environmental legislation;
- To design a series of audits to measure strengths and weaknesses in environmental management; and
- That the system structure should be developed and documented to comply with a recognised environmental management system standard.

These requirements were initially addressed in the development of GREENCODE Phase 1 'Initial Environmental Review' as outlined in Chapter 3. This system was

subsequently piloted within the NHS and adjusted prior to release as described in Chapters 4 and 5.

In developing the methodology and the accompanying software for the GREENCODE initial environmental review, a number of original solutions and innovative methodologies were introduced:

- A generic list of 69 environmental aspects as shown in Appendix 8;
- The linking of aspects to legislation as detailed in Chapter 3 ‘Register of Legislation, Regulatory and Other Policy Requirements’;
- The development of nine management performance audits which were linked to all 69 generic aspects as outlined in Chapter 5 ‘New Significant Aspects Module’;
- The linking of Management Performance to that of Pollution Factor to determine a rating of Environmental Significance for each Aspect as outlined in Chapter 5 ‘New Significant Aspects Module’; and
- The development of full documentation and guidance on how to conduct an initial environmental review and store the relevant records for future use as outlined in Appendix 13 GREENCODE Documentation (Final) - Guidance & Assessments - ‘Exemplary Guidance on Completing an Initial Environmental Review’.

With a generic approach to the initial environmental review now completed and with the unique advantage of utilising the procedures within it to form part of the overall ISO 14001⁽¹⁵⁾ management system, the next step was to continue this generic approach and develop the full system for achieving ISO 14001 certification.

As the research and development continued, it emerged that the following additional areas would need to be addressed in order to achieve this objective.

1. Identifying environmental priorities;
2. Setting objectives and targets;
3. Generating an environmental management programme;

4. Developing the documented procedures to address the remaining clauses of ISO 14001⁽¹⁵⁾; and
5. Developing the procedures to control the system documentation.

It was whilst researching a suitable methodology to help the GREENCODE users to identify their environmental properties that another innovative approach using the concept of 'Inward' and 'Outward' risk was developed.

This concept is described in Chapter 5 'New Prioritisation Model'. Using this methodology the user is able to view their identified environmental aspects as both an 'Inward' risk to the organisation and as an 'Outward' risk to the environment. Furthermore, based on the corrective actions agreed by the user relating to management performance and pollution factor they could also determine the potential reduction of 'Inward' and 'Outward' risk.

The actions to be taken and the financial implications of these are dependent on the way the user wishes to prioritise the aspects. The full prioritisation methodology and its development is described in Chapter 5.

Having prioritised the environmental aspects on 'Inward' or 'Outward' risk, or alternatively, the potential reduction of these risks, the way was now clear to determine the objectives and targets of each aspect and the management programme for realising them.

The process for determining 'Objectives & Targets' and the 'Environmental Management Programme' were originally paper based. Following the ISO 14001 pilot of GREENCODE Phase 3, the software was altered to make this process electronic as described in Chapter 6 'The ISO 14001 Pilot'.

The remaining tasks of developing the documented procedures to address the remaining clauses of ISO 14001 and developing the procedures to control the system

documentation were then undertaken and developed as outlined in Chapter 6 'Documentation Development'.

During the development of GREENCODE, which spanned almost 5 years in total, emphasis was changing within the software development and environmental management system certification environment. In the early 1990s the focus for environmental management was placed firmly on BS 7750⁽¹²⁾ and national standards. As time passed, this focus moved to the international arena with the introduction of ISO 14001⁽¹⁵⁾ which eventually replaced BS 7750.

The topic of sustainability was also introduced more prominently than in the past, with the formal introduction of the European Union's Fifth Environmental Policy and Action Programme (Towards Sustainability)⁽⁴⁾. In terms of software development and information transfer the massive expansion in use of the Internet and the introduction of Internet based applications offered some insight into future possibilities.

The development of GREENCODE took into account the advancements in these areas and incorporated as many as were possible without losing focus of its original objectives. However, this still leaves some areas which would merit further investigation and/or research and development.

Conclusions

The overriding conclusion from this thesis is that the GREENCODE environmental management system, having been piloted at each critical phase of its development, achieved its objective of providing a common and consistent approach to environmental management for the NHS.

Three Trusts, two in Scotland and one in Northern Ireland, achieved ISO 14001 certification in March 1998 whilst using the GREENCODE environmental management system. These hospitals, offering a wide range of healthcare activities ranging from dental care through long stay to acute services, further evidenced the generic nature of the system within the healthcare sector.

Experience gained during this project provided evidence that the data required to facilitate the implementation of an environmental management system and GREENCODE can generally be found within the existing dataset of an NHS Trust. However, two principle reasons were identified as to why there may be problems in accessing this data.

1. Difficulties relating to internal communication and sharing of data between different departments; and
2. The loss of information due to organisational change and the passage of time.
e.g. technical drawing and historical monitoring data.

An essential ingredient, which contributed largely to the success of the overall project, was the project management technique employed throughout its development. It was realised at a very early stage, that in order for the project to be successful a significant amount of input would be required from experienced members of the NHS over a prolonged period. Therefore, an appropriate mechanism for bringing these people together, for coordinating their input and for encouraging a sense of ownership and influence throughout the development of the environmental management system had to be designed and implemented.

To this end, specialist subgroups were set up through which all issues could be discussed and subsequent research and development work could be presented and agreed. This approach proved to be successful in allowing the project to progress through all the phases of development and implementation.

In addition, it was found that the operational issues of processing the information and data supplied by the subgroups coupled with the presentation of subsequent research findings and feedback had to be delivered in a sufficiently professional manner to establish confidence and credibility in the output. Equally important was the ability to take on board the comments made by subgroup members so that individuals felt that their opinions were being heard and taken into account.

Experience also showed that the level of commitment from senior managers and a dedicated environmental management team is equally important in terms of successfully implementing an environmental management system at site level. The management team require to be the driving force behind the system and to have the necessary authority to set and implement objectives and targets. Without this commitment and authority the system will eventually falter during implementation.

The GREENCODE system has subsequently been used by companies in other industry sectors (PC Sheet Metal Fabrication and Silicon Wafer Manufacturing) to successfully achieve ISO 14001⁽¹⁵⁾ certification further evidencing the extent to which the system is generic and has achieved the overall objective.

The research undertaken in developing the GREENCODE system proved that ISO 14001 is a competent engine for managing change in relation to the environment. It offers a very logical process for any organisation to measure its current situation and identify realistic objectives for the future with regard to environmental management. Furthermore, it offers the platform upon which the organisation can implement this change plus monitor and confirm its progress in achieving their objectives.

In recognition of ISO 14001's ability to facilitate change, the recently published British Standard on Occupational Health & Safety BS 8800⁽⁴⁰⁾ offers an ISO 14001 implementation route. Since GREENCODE was developed to meet the requirements of ISO 14001, a feasibility study⁽⁴⁴⁾ was undertaken to investigate the possibility of using the GREENCODE methodology to address the requirements of BS 8800.

The study demonstrated that GREENCODE had the potential of being adapted to achieve the requirements of BS 8800 based on the ISO 14001 approach advocated by BS 8800 itself. The system also has the advantage of being widely distributed throughout the NHS in Scotland and HSS Northern Ireland with its use increasing.

During the development of the GREENCODE environmental management system, the topic of sustainability evolved and the European Union developed a comprehensive approach to the protection of the environment through its Fifth Environmental Policy and Action Programme (Towards Sustainability)⁽⁴⁾. In many ways, the Fifth Environmental Policy and Action Programme exemplifies an approach to sustainable development that is becoming widely accepted. It is a strategic programme, setting objectives and targets and identifying those responsible for implementation. These techniques are all contained within ISO 14001⁽¹⁵⁾ methodology and therefore make it a competent vehicle to facilitate change in the area of sustainability. This has also been recognised elsewhere⁽⁴⁵⁾.

ISO 14001⁽¹⁵⁾ puts in place the beginnings of a sustainable system. It does this by identifying the environmental impacts of the organisation, making individuals aware of the environmental impacts caused by the activities they carry out or have responsibility for and giving a commitment to continual improvement. It must be stressed however, that ISO 14001 offers only a foundation upon which more must be built to create a comprehensive sustainable development system.

The ISO 14001 engine is recognised as a competent engine for managing change in relation to the environment. This recognition as an engine for change has been further evidenced by its inclusion within the British Standard BS 8800⁽⁴⁰⁾ on Occupational Health and Safety Further and other literature⁽⁴⁵⁾ relating to Sustainable development. It can be concluded from this evidence that there may be a core set of generic management functions that could operate as the centre piece of an integrated system that could bring together such issues as environment, finance, occupational health and Safety etc. and manage change in an integrated way.

Also during the development of GREENCODE the progress in the area of information technology accelerated significantly with the introduction of the Internet which gave increased access to all types of information e.g. legislation, government policy documents, guidance, general information etc. ISO 14001 requires the users to

have access to legislation and GREENCODE currently offers limited information on legislation but could be enhanced by adding Internet browsing capabilities such that the users could access full text legislation on the Internet.

Another issue that is becoming important is that of a corporate environmental overview. GREENCODE was designed to be compatible with ISO 14001⁽¹⁵⁾ and was therefore designed to operate at site level. However, limitations of this site level approach by ISO 14001 are encountered when an organisation wishes to obtain a corporate overview of its environmental position. Part of the solution will revolve around having the information from all the individual sites available in one central location thus facilitating the analysis necessary to determine the corporate overview.

The Internet may again facilitate the necessary communication channels to make this a reality. By taking an ISO 14001 based system such as GREENCODE and making it an Internet based application would offer all the advantages of networking and accessibility from any location with an Internet browser. Further research is necessary to determine if this is the most suitable way forward and if such a system could be designed to facilitate the corporate overview and still comply with the current requirements of ISO 14001 certification or whether ISO 14001 certification requirements would need to change to facilitate this.

Experience gained in the development of GREENCODE has shown that the 'Smart' linking of data (i.e. Aspects to Legislation, Aspects to Departments, Audits to Aspects, Corrective Actions to Audits, and Costs to Corrective Actions) facilitates the generation of effective reporting in a form not readily available from the raw data alone. In recognition of the explosion of information caused by the Internet, 'Smart' linking will need to form part of any methodology developed to present information in relation to ISO 14001 in order to prevent an information overload to the user. More work is needed in this area of 'Smart' linking and processing of data to generate effective reporting in areas such as corporate environmental management and sustainability.

Notwithstanding the success of GREENCODE in the NHS and beyond, it has not been tried in Small and Medium Sized Enterprises (SMEs). Experience has shown that SMEs have traditionally had problems implementing systems to meet the requirements of BS 7750⁽²⁷⁾ and ISO 14001⁽¹⁵⁾ due to the systems being viewed as too onerous in terms of both financial and physical resources. With the proliferation of the Internet and new technologies that accompany it, it may be possible to create an online environmental management system which SMEs could link into and operate without the problem of keeping up to date with the latest information and software.

However, on its own, the online system, will not reduce the burden on manpower and time needed to implement the requirements of ISO 14001. Therefore, a less onerous set of requirements needs to be developed for SMEs which follow the basic principles of the standard and which would be acceptable in terms of financial and physical resource input from SMEs whilst striving to better protect the environment from the impacts associated with these types of companies.

Currently the GREENCODE system only deals with the operational life of a building's life cycle. The life cycle of a building can be described broadly as having four phases:

- Design;
- Construction;
- Operation; and
- Demolition.

A true environmental management system for a site should be able to operate in and inform all of these phases. In recognition that, prior to the operation phase of the site's life cycle, the design and construction phases must have taken place, there is scope for research into these areas to investigate amongst other things how environmental aspects can be minimised during these phases and how potential environmental aspects could be 'designed-out' therefore preventing their occurrence

during the operation phase. Furthermore, information from the first three phases should be passed on to new users of the site and indeed inform the demolition phase of the buildings life cycle.

Future Research

As identified in the above conclusions there are a number of areas which would justify further research.

The area of Occupational Health & Safety is one in which a feasibility study⁽⁴⁴⁾ has been carried out which has concluded that the GREENCODE methodologies would be adaptable to this topic. Further work is needed to research and develop the modules and procedures necessary for this to become a reality.

The area of sustainability is one area where further research is needed to evaluate the impact or influence that ISO 14001⁽¹⁵⁾ methodologies could have on facilitating the necessary change in human consumption and behaviour necessary for sustainability as outlined in the EU's Fifth Environmental Policy and Action Programme. ISO 14001 has at its disposal the mechanisms for identifying impacts, allocating responsibilities, setting objectives & targets and monitoring the achievement of these. Further investigation is needed to ascertain if these mechanisms can be used to influence the other issues of sustainability such as the social and economic elements.

The concept of there being a set of generic management functions that could operate as the centre piece of an integrated system; that could bring together such issues as environment, finance, occupational health and Safety etc. and manage change in an integrated way; is an area that may benefit from further research.

Currently GREENCODE is a system which is implemented and operated at site level. A large number of organisations have several sites under their control and wish to identify and consider their corporate overview relating to environmental management. Further research is needed to determine how multiple site information

can be collected and analysed in order to present the corporate position relating to the environment.

Making better use of the facilities offered by the Internet is another area that requires some further research to ascertain how this can be best utilised to increase access to corporate methodologies, systems and information as and when required.

The Internet also offers opportunities to mount methodologies such as those used in GREENCODE, thus making them more accessible and able to facilitate the generation of such information as corporate overviews for environmental management, occupational health and safety information, sustainability etc. However, to facilitate effective reporting in these areas further work is required into 'Smart' linking of data and analysis of this data to prevent an information overload to the users.

Further research is needed to investigate possible ways of encouraging Small and Medium Sized Enterprises (SME's) to implement environmental management systems such as ISO 14001⁽¹⁵⁾. This may include providing access to an Internet based system and producing different implementation requirements for such companies which are not as onerous for them in terms of financial and manpower resources whilst striving to better protect the environment from the impacts associated with these companies.

Further research is needed to investigate the use of ISO 14001 methodologies in the design, construction and demolition phases of a building or site's life cycle. This could enable the seamless flow of information from one phase to the next. Furthermore, it could also help design out possible environmental aspects and inform the people responsible, during each phase of the life cycle, of potential environmental impacts which may occur so that they can be managed in an appropriate manner.

References

1. Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
2. The United Nations Conference on Environment and Development, Rio de Janeiro, June 1992.
3. UK Government's White Paper, This Common Inheritance, Cm1200, HMSO, September 1990.
4. Towards Sustainability, A European Community programme of policy and action in relation to the environment and sustainable development, Official Journal of the European Communities, May 1993.
5. The Treaty on European Union, Maastricht February 1992.
6. Environment in the European Union, European Environment Agency, 1995.
7. Freedom of Access to Information on the Environmental Information, The Council of the European Communities, Official Journal of the European Communities, (EC/90/31/1990).
8. Environmental Impact Assessment, Official Journal of the European Communities No. L175, Council Directive 85/337/EEC, July 1985.
9. Climate Change, The Intergovernmental Panel on Climate Change (IPCC) Scientific Assessment, 1990.
10. The Intergovernmental Panel on Climate Change (IPCC), Second Assessment Report by Working Group II, 1995.
11. Brundtland Report 'Our Common Future', World Commission on Environment and Development, 1987.
12. BS 7750 Specification for – Environmental management systems, British Standards Institution, January 1992.
13. BS/ISO 9000 Quality Systems, British Standards Institution, 1987.
14. Eco-Management and Audit Scheme, European Council Regulation (EEC) No 1836/96 29 June 1993.
15. ISO 14001 Environmental management systems – Specification with guidance for use, International Organisation for Standardisation, 1996.
16. A Blueprint for Survival, The Ecologist, Penguin Books, 1972.

17. The ECO-SPASM Report, Alvin Toffler, Bantam, 1975.
18. Only One Earth, Barbara Ward and Rene Dubos, Penguin Books, 1972.
19. Our Common Future, The World Commission on Environment and Development, 1987.
20. Responsible Care Management System®, Guidelines for certification to ISO 9000 – health, safety and environmental management systems (BS7750 – environmental management systems) in the chemical industry, Chemical Industry Association, 1992.
21. EQS – Software for Environment, Quality and Safety management, Grannhern International, 1994.
22. The CBI Environment Business Forum, Confederation of British Industry, 1992.
23. The Green Manager's Handbook, Kit Sadgrove, Gower, 1992.
24. Croner's Environmental Management, Croner Publications Ltd, 1992.
25. Croner's Waste Management, Croner Publications Ltd, 1993.
26. Croner's Policy & Procedures, Croner Publications Ltd, 1995.
27. BS 7750: An Implementation Pack for the Healthcare Sector, Devised by Northern Regional Health Authority with help from David Bellamy Associates. Issue 1, November 1993.
28. A Strategic Guide to Environmental Policy - for General Managers and Chief Executives, NHS Estates, November 1992.
29. A Review of Environmental Award Schemes in the Context of Health Care Buildings, Dr P. P Yaneske, University of Strathclyde, June 1993.
30. Environmental management system for the Estates Department of the University of Strathclyde, Safety & Environmental Management Unit, 1992.
31. Environmental Management Systems in Further & Higher Education Institutions. McDonach, K and Yaneske, P.P. The Environmentalist, Volume 16 No 1, Spring 1996.
32. SAFECODE, A Health and Safety Management Tool for the NHS, Crown Copyright, 1994.
33. Environmental Management Microfile, Barbour Index PLC.

34. Microsoft Visual Basic Version 5 Enterprise Edition, Microsoft Corporation 1991-1996.
35. Microsoft Access 97, Microsoft Corporation 1991-1996.
36. Successful Health and Safety Management, HS(G) 65, HSE 1991.
37. Operator and Pollution Risk Appraisal (OPRA) Version 1. Environment Agency, Bristol, UK. April 1995.
38. Risk Estimation, Steel. C, 'Safety Practitioner', June 1990 Vol. 8 No 6 pp 20/21.
39. Principles of Health and Safety at Work, St. John Holt. Allan & Andrews. Huw, IOSH Publishing 1993, pp84.
40. BS8800: Guide to: Occupational health and safety management systems. British Standards Institute, 1996.
41. Operator and Pollution Risk Appraisal (OPRA) Version 2. Environment Agency, Bristol, UK. August 1997.
42. Methodology for Reporting Energy use within the NHS in Scotland. McDonach, K and Yaneske, P.P. February 1996.
43. NHS in Scotland Energy Report 1994/95. University of Strathclyde, Safety & Environmental Management Unit, K McDonach & P.P Yaneske, January 1996.
44. A Feasibility Study and Outline Strategy for the Application of GREENCODE to the Integration of Occupational Health and Safety and Environmental Management, University of Strathclyde, Safety & Environmental Management Unit, K McDonach & P.P Yaneske, December 1998.
45. Sustainable Development - The Role of EMS. Institute of Environmental Management & Assessment, Proceeding, Annual Conference, Polgreen, K. December 1999.

Appendices

Due to their size the following appendices are contained in the accompanying CD which is attached to the inside back cover of this thesis.

- Appendix 1:** GREENCODE Database & Audit Software Manual.
- Appendix 2:** GREENCODE Audit Question Sets.
- Appendix 3:** Significant Aspects Worksheet.
- Appendix 4:** GREENCODE procedure 'Identification of Significant Environmental Aspects'.
- Appendix 5:** GREENCODE Documentation Structure.
- Appendix 6:** GREENCODE Preparatory Environmental Review Guidance Document.
- Appendix 7:** GREENCODE Initial Review Procedures.
- Appendix 8:** GREENCODE Document 3.1.1 SF/01.
- Appendix 9:** GREENCODE User Manuals for Database, Significant Aspects and Priority.
- Appendix 10:** Revised GREENCODE Contents for ISO Pilot.
- Appendix 11:** GREENCODE (ISO 14001) Procedures & Standard Forms.
- Appendix 12:** GREENCODE Links to ISO 14001.
- Appendix 13:** GREENCODE Documentation (Final).