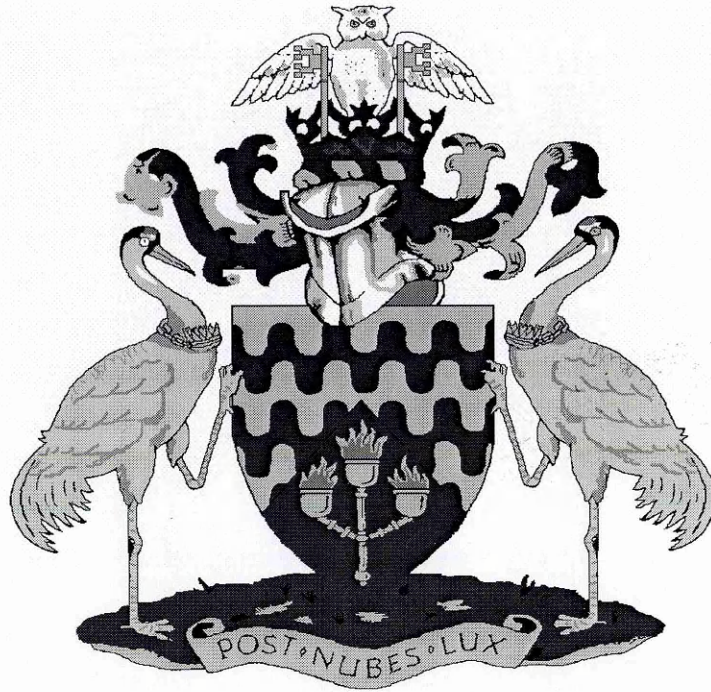


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FM VAN DER ZWAN

**INTEGRATED SOLUTIONS AS A NEW PERSPECTIVE
FOR ECO-EFFICIENT SERVICES
- A CROSS-INDUSTRY EXPLORATION**

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

PhD THESIS

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CRANFIELD UNIVERSITY

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

ENTERPRISE INTEGRATION

PhD THESIS

Academic Year 2002 – 2003

FM VAN DER ZWAN

**Integrated solutions as a new perspective for eco-efficient services
- a cross-industry exploration**

Supervisor: T Bhamra

February 2003

**This thesis is submitted in partial fulfilment of the requirements
for the degree of Doctor of Philosophy**

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ABSTRACT

Over the past forty years many methods have been developed to reduce the environmental impacts of lifestyles of the Western world. A concept that has emerged in academic and policy making circles is that of 'eco-efficient services'. This concept is still in the process of being developed and as yet has not successfully been taken up by industry. The research project upon which this thesis reports was initiated to address these concerns.

In order to contribute to the research on eco-efficient services, gaining knowledge of a different but successful business concept was considered constructive. The main focus of this research was a novel concept that has parallels with eco-efficient services – namely 'integrated solutions'. The central research question was how knowledge of this concept could support the development of eco-efficient services or solutions. The overall aim of this research was to provide those that wish to promote the development of eco-efficient services and solutions, with an understanding of a useful business design framework and an understanding of factors that might lead to increased eco-efficiency of these offerings.

To this end, two stages of research were initiated and completed. The first stage was the Pilot Study in which a more detailed understanding of the concept of integrated solutions was sought. During this stage, data was elicited from a variety of sources so as to provide a robust foundation of knowledge upon which subsequent inquiry could be initiated. On the basis of the findings from a review of substantive literatures on integrated solutions and the findings of the Pilot Study, a framework and a model were developed. The integrated solutions framework describes the features of an integrated solution and the eco-efficient solutions model shows the elements that can influence the eco-efficiency of a solution. In the second stage, both the framework and the model were validated. These findings were then analysed and incorporated in the initial framework and model, which resulted in a refined eco-efficient solutions model.

This research explored how knowledge of the concept of integrated solutions can support the development of eco-efficient services and solutions in a business-to-business context. Nine distinctive features of an integrated solution were identified and described in the refined integrated solutions framework. Furthermore, nine elements that might influence the eco-efficiency of a service or solution have been identified and described in the refined eco-efficient solutions model. Environmental legislation will play an important part in operationalising the model. A number of companies that took part in the research project were interested in taking these ideas forward. The intention of this work was not to refute current trajectories of research in the eco-efficient services domain, but rather to provide an additional body of knowledge that can allow those authors in the eco-efficient services domain, to realise the opportunity that the eco-efficient services concept provides to significantly improve resource efficiencies.

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My love is warmer than the warmest sunshine, softer than a sigh
My love is deeper than the deepest ocean, wider than the sky
My love is brighter than the brightest star that shines every night above
And there is nothing in this world that can ever change my love

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- Van der Zwan, F.M. and T.A. Bhamra (2000), “The service approach: generate added value with less environmental impact”, *Electronics Goes Green 2000+ conference*, 11th – 13th September, Berlin, Germany, pp. 867 - 872.

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LIST OF ABBREVIATIONS

3S	:	sustainable services and systems
ASP	:	application service provider
B2B	:	business-to-business
B2C	:	business-to-consumer
BOO	:	build own operate
BOT	:	build operate transfer
BS	:	British Standard
BSIA	:	British Security Industry Association
CCD	:	coupled charge devices
CCTV	:	closed circuit television
CEM	:	contract energy management
CHP	:	combined heat and power
CMS	:	chemical management services
CoPS	:	complex products and systems
CRM	:	customer relationship management
CT	:	computerized tomography
EMAS	:	Eco Management & Audit Scheme
EPC	:	engineering procurement contracting
EPR	:	electronic patient record
FMCG	:	fast moving consumer goods
FvdZ	:	Frank van der Zwan (researcher)
HIS	:	hospital information system
ICT	:	information and communication technology
ID	:	identity (as in ID-card)
ISO	:	International Standards of Organisation
IT	:	information technology
LCA	:	life cycle assessment
MD	:	managing director
MRI	:	magnetic resonance imaging
MSc	:	Master of Science
NACOSS	:	National Approval Council for Security Systems
PACS	:	picture archiving and communication system
PC	:	personal computer
PCB	:	printed circuit board
PhD	:	Doctor of Philosophy
PIR	:	passively infrared sensor
PSS	:	product service systems
R&D	:	Research & Development
RIS	:	radiology information system
RQ	:	research question
SLA	:	service level agreement
SME	:	small and medium sized enterprise
TALC	:	technology adoption lifecycle
TCO	:	total cost of ownership
TCM	:	total chemical management
WBCSD	:	World Business Council on Sustainable Development
WCED	:	World Commission on Environment and Development
WEEE	:	Waste of Electrical and Electronic Equipment
UK	:	United Kingdom

1 INTRODUCTION

This chapter introduces the research upon which this thesis is based. The background to this research and the research problem are described. An appropriate structure, aims, and objectives are also detailed.

1.1 BACKGROUND TO THE RESEARCH

“Wanted: Two (Phantom) Planets. If everybody lived like today’s North Americans, it would take at least two additional planet Earths to produce the resources, absorb the wastes, and otherwise maintain life-support. Unfortunately, good planets are hard to find...” (Wackernagel & Rees, 1996, p. 15)

There is wide agreement that the Earth’s ecosystems cannot sustain current levels of economic activity and material consumption, let alone increased levels. The environmental impacts of lifestyles of the Western world will need to be reduced by a factor four or more, if we are to live ‘in line with the Earth’s carrying capacity’. Over the past forty years, this challenge has resulted in many approaches to reduce material and energy consumption; from end-of-pipe approaches via pollution prevention to industrial ecology. A concept that has also been developed to this end in academic and policy making circles is that of ‘eco-efficient services’. An eco-efficient service is a product-service mix that has a higher added value and a smaller environmental impact compared to a similar product-service mix or a situation in which the activity was not performed at all (Zaring *et al*, 2001, p. 37). The concept is still ‘under construction’ and as yet has not successfully been taken up by industry. The research project upon which this thesis reports was initiated to address these concerns.

In order to contribute to the research on eco-efficient services, it was thought useful to study and gain knowledge of a different concept. The main focus of this thesis is a novel and successful business concept that has similarities with eco-efficient services – namely ‘integrated solutions’. This concept can be understood, for the moment, as follows:

“Creating solutions means combining products and services in novel ways to solve a customer’s specific problems.” (Davies, 2001, p. 7)

This thesis reports the findings of a PhD which formed part of a three year UK government funded research project, which commenced in 1999. It builds upon research carried out at Cranfield University into ecodesign (e.g. Lofthouse, 2001; McAloone, 1998; Sherwin, 2000) and the subsequent move from products to eco-efficient services (Bhamra & Evans, 1999; Cook, 2002; Sherwin, 1999). Next, the research problem is described as well as the research aims and objectives. After that, the scope of this study and the background of the author are given, and finally, the appropriate thesis structure is presented.

1.2 THE RESEARCH PROBLEM

Approaches to reducing energy and material consumption have become more extensive over time; from product modification to system innovation. This has made these approaches more elaborate than their predecessors. This is also the case with the concept of eco-efficient services. Researchers in the field of eco-efficient services have only just started to acknowledge that more skills and capabilities are needed and that the development of these services covers a wider range of disciplines than incremental strategies like ecodesign. They would like eco-efficient services to be taken up by industry, but to date they struggle to find the much needed demonstration projects and pilots to generate knowledge of and experience with eco-efficient services.

Simultaneously, there is the concept of integrated solutions that has been successfully taken up by industry in recent years. On first impression, it seems that eco-efficient services and integrated solutions overlap significantly; e.g. both concepts focus on satisfying a customer's need, rather than selling products. It was suggested that integrated solutions, or at least knowledge of integrated solutions, might provide a link between ecological thinking and business success.

Hence, the central concern of the research project upon which this thesis reports, was to find out the extent to which knowledge of the concept of integrated solutions can support the development of eco-efficient services – and support the development of more eco-efficient solutions in general.

1.3 RESEARCH AIMS, OBJECTIVES, AND QUESTIONS

In this section, the research aims, objectives and research questions are detailed. The research deliverable is also stated.

1.3.1 RESEARCH AIM

The overall aim of the research was to provide those who wish to promote the development of eco-efficient services and solutions with an understanding of a useful business design framework and an understanding of factors that might lead to increased eco-efficiency of these types of services or solutions.

1.3.2 RESEARCH OBJECTIVES

Having defined the aim of the research, a number of objectives were developed for the purpose of meeting this. The concern of these objectives was to ensure that an appropriate body of knowledge was developed to enable the aim of the research to be met.

- To review critically substantive literatures, useful theoretic literatures and other necessary secondary sources in relation to:
 - the rationale, origins, and attributes of the concept of integrated solutions
 - the rationale, origins, and attributes of the eco-efficient services concept
 - eco-efficiency and sustainability issues
 - theoretical perspectives on business strategy
- To develop a conceptual framework that describes the characteristics that are specific to the concept of integrated solutions.
- To identify the specific elements of integrated solutions that might affect the eco-efficiency of an offering.
- To ascertain how the characteristics of integrated solutions and the elements affecting the eco-efficiency of an offering can be used to support the development of eco-efficient services and solutions.

1.3.3 RESEARCH QUESTIONS

In addition to the aims and objectives a number of research questions were generated. These guided research activities and ensured that research objectives were met. Thus, it might be understood that there was a clear relationship between the research questions and the objectives.

- | | |
|------|--|
| RQ1a | What is an integrated solution? |
| RQ1b | What is an eco-efficient service? |
| RQ1c | What is eco-efficiency? |
| RQ2a | To what degree are integrated solutions and eco-efficient services alike? |
| RQ2b | What are the similarities between integrated solutions and eco-efficient services? |
| RQ2c | What are the differences between integrated solutions and eco-efficient services? |
| RQ3 | What are the characteristics of integrated solutions that might affect the eco-efficiency of the solution? |
| RQ4a | How might the characteristics that have been identified in RQ3 be used to support the development of eco-efficient services? |
| RQ4b | How might the characteristics that have been identified in RQ3 be used to support the development of more eco-efficient solutions? |

1.3.4 RESEARCH DELIVERABLE

The research deliverable is an eco-efficient solutions model, based on an integrated solution framework. This identifies and describes the features of the concept of integrated solutions. It also describes the elements affecting the eco-efficiency of a solution. It provides a business design framework for eco-efficient services and might be used to identify opportunities for the development of new types of eco-efficient solutions.

1.4 THE SCOPE OF THIS STUDY

The scope of the research project reported in this thesis was relatively wide but well defined. As has been made clear, the intention of this study was to explore the concept of integrated solutions. This provided clear boundary conditions for this study. Firstly, integrated solutions are chiefly offered by multinational companies in a business-to-business (B2B) market and secondly, a broad overview of the concept was desired. Therefore, several multinational companies operating in B2B markets across different industries were involved during the course of this study.

The purpose of the Pilot Study was to identify and gain a broad understanding of the characteristics of the concept of integrated solutions. The scope of this phase was necessary broad. Data was collected from a wide variety of sources so as to provide a robust body of data. This was subsequently combined with theoretical knowledge from integrated solutions literatures and used to develop an integrated solutions framework. After this, the features and the data they represented were studied on their effects on the eco-efficiency of the integrated solution. This resulted in the eco-efficient solutions model. During the Validation, this model was validated and refined. The scope of the second phase was necessarily reduced.

The scope of this study ensured that data was collected on integrated solutions from a variety of sources. Finally, it is emphasised that the main focus of the research project is the concept of integrated solutions, rather than the eco-efficient services concept.

1.5 THE AUTHOR

In this study the author forms a fundamental and important part of the research process. It is therefore useful to describe the author's background and personal motivations:

“Remember that who you are has a central place in the research process because you bring your own thoughts, aspirations and feelings, and your own ethnicity, race, class, gender, sexual orientation, occupation, family background, schooling, etc. to your research.” (Kirby & McKenna, 1989, p. 46 in Robson, 1993, p. 22)

The author was born and raised in The Netherlands and lived there prior to coming to the UK to undertake this research project. The author's academic background is rooted in design; he completed an MSc in Industrial Design Engineering at Delft University of Technology in the Netherlands. This course took a multidisciplinary approach and thus modules from a wide variety of fields were studied; e.g. design methodology, ergonomics, mechanical engineering, consumer behaviour, and business administration. After three years of core courses he specialised in the management of innovation, focusing on the initial stages of the product innovation process.

During this MSc the author got acquainted with environmentally conscious design approaches. Several modules were studied, such as environmentally conscious innovation management and a study on the environmental issues of the design curriculum. During his

MSc he first came across the concept of eco-efficient services. He was particularly intrigued by the so-called 'result services' from an innovation management perspective, but knowledge about this type of services was limited. He decided to undertake this research in order to explore the concept of eco-efficient services further. The broad multidisciplinary foundation provided a useful basis for undertaking research in the eco-efficient services, and later integrated solutions, domain.

1.6 THESIS STRUCTURE

In order to present this thesis in logical order, it was necessary to divide it into seven further chapters.

Chapter 2: Literature Review

This chapter aims to review substantive literatures to provide a state of the art view of the eco-efficient services and integrated solutions domains. In order to establish these two concepts, contextual literatures are also reviewed. In the final section of this chapter, a research proposition is offered on the basis of the findings of this literature review.

Chapter 3: Research Methodology

The aim of this chapter is to present the research design considerations, in order to give insight into the research process that was followed and to demonstrate that appropriate methods were selected and used to tackle the research problem central to this investigation. Altogether, this chapter helps to create an understanding of this research.

Chapter 4: Pilot Study

This chapter analyses the findings of the Pilot Study, which can be considered a more in-depth exploration of the concept of integrated solutions. The aim of the Pilot Study is to get a more intimate understanding of integrated solutions and to elicit elements related to these solutions. In this chapter the findings of the Pilot Study are analysed and elements that are useful for the development of more eco-efficient services and solutions are laid out.

Chapter 5: Model Development

In this chapter, the results of the literature study on integrated solutions, the Pilot Study, and the concept of 'eco-efficiency' are brought together, making an eco-efficient solution model. This is the first model that shows the different elements that are involved in the development of more eco-efficient solutions.

Chapter 6: Validation

The framework and model developed in the previous chapter were discussed with companies and environmental consultancies. These findings are reported in this chapter. The increased understanding of the elements from the model and their possible contribution towards a more eco-efficient solution are described. Based on this, a refined eco-efficient solutions model is developed and presented.

Chapter 7: Discussion

In this chapter the findings of the Pilot Study, Model Development and the Validation are discussed and expanded upon. Useful insights on substantive literatures and current thinking within the integrated solutions and eco-efficient services domains are gained.

Chapter 8: Conclusions

This chapter presents the conclusions of this study. It shows that the research aim and objectives have been met and reflects upon the research process. The contribution to knowledge made by this study is shown and, in view of this, areas for future research are identified.

Figure 1.1 below shows gives a schematic overview of this thesis.

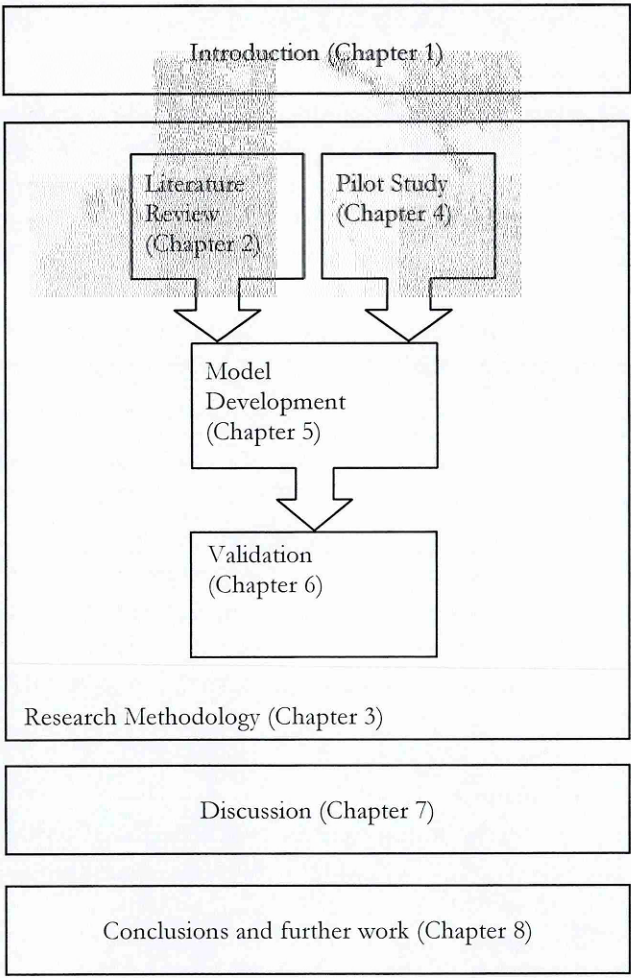


Figure 1.1 Schematic structure of this thesis

This chapter has introduced the thesis and gives readers a clear understanding of what to expect in subsequent chapters. As noted above, the research process began with a review of literatures. This is outlined in the next chapter.

2 LITERATURE REVIEW

This chapter aims to review substantive literatures to provide a state of the art view of the eco-efficient services and integrated solutions domains. In order to establish these two concepts, contextual literatures are also reviewed. In the final section of this chapter a research proposition is offered on the basis of the findings of this literature review.

2.1 INTRODUCTION

After the introduction to this thesis in the previous chapter, this chapter will report on the findings from the review of literatures. The aim of this chapter is threefold. Firstly, it intends to give an overview of the concepts of eco-efficient services and integrated solutions; the so-called substantive literatures. Secondly, this chapter aims to provide a context for these substantive literatures and by reviewing the contextual literatures, seeks to establish a vocabulary or nomenclature for this thesis. Thirdly, based on the findings of the review of both contextual and substantive literatures, this chapter aims to present a research proposition, which guides subsequent research activities.

Figure 2.1 shows the substantive and contextual literatures that are reviewed in this chapter.

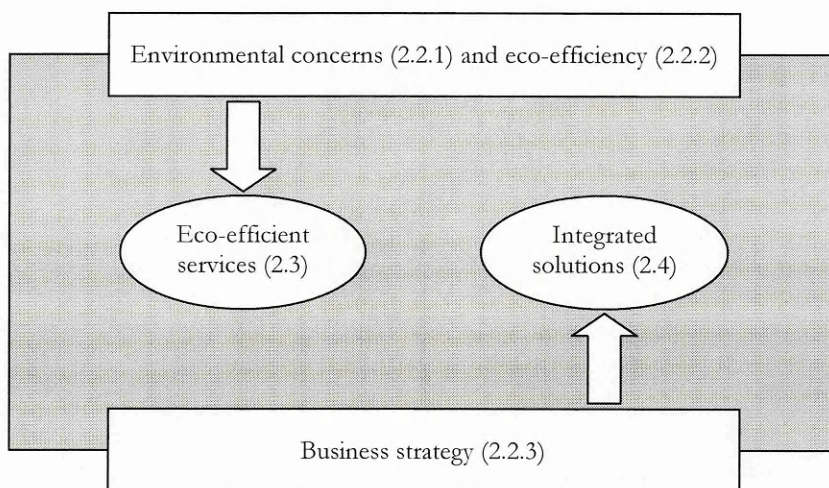


Figure 2.1 Literatures reviewed (and the sections in which the corresponding parts can be found)

In the next section, the different contextual literatures are reviewed. These include environmental concerns and modern responses, the concept of eco-efficiency, and business strategy issues. After this, the notion of eco-efficient services is reviewed. Then, the concept of integrated solutions is discussed. In the final section of this chapter, the findings of the review of literatures are used to offer a research proposition.

2.2 CONTEXTUAL LITERATURES

In this section the key themes from literatures which provide the intellectual contexts within which the concepts of eco-efficient services and integrated solutions were developed are reported. First, an overview of environmental concerns in modern Western society is outlined. Next, the related concept of eco-efficiency is expanded upon and finally, relevant business issues are highlighted. The scope of this section did not allow an exhaustive review of these literatures. Instead an overview of the key issues was sought.

2.2.1 ENVIRONMENTAL CONCERNS

“It was a spring without voices. On the mornings that had once throbbed with the dawn chorus of robins, catbirds, doves, jays, wrens, and scores of other bird voices there was now no sound; only silence lay over the fields and woods and marsh.”
(Carson, 1962, p. 22)

With her book *Silent Spring* (1962), Rachel Carson exposed the effects of technology and consumption on the environment and she succeeded in creating a new public awareness of the environment, which inspired the modern environmental movement (Burnie, 1999). Since then, many literatures have stated the devastating impacts of human activities on the global environment (e.g. Gore, 1992; Hawken, 1993; Schumacher, 1973; Wackernagel & Rees, 1996). Thirty years ago, the first report for the Club of Rome, *Limits to Growth*, was published (Meadows *et al*, 1972). For the first time it expressed the existence of a ‘global problematique’; there were no longer separate economic, political or social problems, which could be judged on their own terms and be dealt with individually, one by one (Giarini, 1980). The report acknowledged that there were biophysical, institutional, political, and managerial limits and constraints to both population and economic growth.

“If present growth trends in world population, industrialisation, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years” (Meadows *et al*, 1972, p. 23)

In 1983 the World Commission on Environment and Development was asked by the General Assembly of the United Nations to formulate a global agenda for change (WCED, 1987). The commission focused its attention on population, food security, the loss of species and genetic resources, energy, industry, and human settlements. In *Our Common Future* the commission called for ‘sustainable development’ – which can be defined as ‘development that meets the needs of the present without compromising the ability of future generations to meet their own needs’ (WCED, 1987, p. 43). The commission identified three securities as being relevant to sustainable development (Fussler, 1996): ecological security (being able to rely on the continued functioning of natural systems); resource security (food, energy, raw materials and other physical requirements of humanity will be available in required quantities at reasonable cost); and socio-economic security (no unemployment, high crime, excessive inequalities in income and wealth, illiteracy, and serious threats to health before old age is reached). The idea of sustainable development has become popular amongst governments, industry and academia, in the face of growing

social expectations encompassing both standards of living and environmental concerns (Chaharbaghi & Willis, 1999, p. 41). However, the definition of the concept is frequently considered to be too vague to provide any operational value (Daly, 1996; Day & Arnold, 1998; Spangenberg, 2001, p. 26) and the contradictions embedded in the variable imagery prevalent in the sustainable development debate have transformed this into both ‘a chaotic game and an impenetrable jungle’, leading to a greater number of sceptics questioning the whole concept (Chaharbaghi & Willis, 1999, p. 41).

2.2.1.1 Industry and sustainable development

Moving towards a more sustainable world will involve reducing energy and resource flows, as well as waste and pollution generated, per head of population in the industrialized countries by anything from four to twenty times (Reijnders, 1998; Von Weizsäcker *et al*, 1997). In the quest for sustainable development, industry has been dealt a key role (e.g. Schmidheiny, 1992; WCED, 1987).

“Many essential human needs can be met only through goods and services provided by industry. ... Industry has the power to enhance or degrade the environment; it invariably does both.” (WCED, 1987, p. 206)

As has been previously made clear, the start of the modern environmental movement can be dated back to the 1960s, which began by exposing environmental pollution caused by industrial emissions. Therefore, in the early days industry tended to focus on ‘end-of-pipe solutions’. These solutions involved measures to manage environmental pollution and waste after it had been produced, such as wastewater treatment facilities (Roy, 2000). From the 1980s onwards, companies began to shift their attention to developing ‘cleaner’ manufacturing processes that generated less pollution and waste and made more efficient use of energy and materials, which simultaneously brought about cost reductions. This last aspect of cleaner production is epitomised in the popular motto ‘Pollution Prevention Pays’ (DeSimone & Popoff, 1997). It was then realized that major environmental impacts arise from the choice of materials used in the products, and from the use and disposal of these products. Engineers and designers started to think in terms of greener products; avoiding toxic materials, using less material or becoming more energy efficient. A more systematic approach emerged in the 1990s known as ‘ecodesign’ or ‘lifecycle design’ (Roy, 2000). This approach aims to reduce and balance the adverse impact of a manufactured product on the environment by considering the product’s whole lifecycle – shown in Figure 2.2 below – from raw materials acquisition, through manufacturing, distribution and use, to recycling and final disposal.

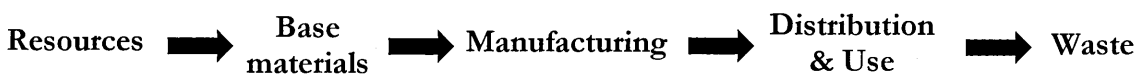


Figure 2.2 The product lifecycle

These adverse impacts can be reduced through, for example, elimination or reduction of harmful ingredients, optimising the product life span, by a combination of the functions of more than one product, and through re-use, remanufacturing, recycling, or disposal at the end of the product lifecycle (Brezet & Van Hemel, 1997; Roy, 2000; Schmidheiny, 1992).

Ecodesign has its limitations though, primarily because it takes existing methods of production and consumption as a given (Roy, 2000; Ryan, 2000b). It is also limited by market growth due to economic development and population expansion (Ryan, 2000b). Therefore, the focus of environmentally conscious product development approaches needed to move towards defining and creating alternative systems of production and consumption that have significantly lower environmental impacts. This challenge has led to concepts such as sustainable product design (Tischner & Charter, 2001) and sustainable technology development (Partidário & Vergragt, 2000; Weaver *et al*, 2000), in which the functions of products are considered and alternative, more sustainable, means of fulfilling these functions are examined. These strategies may also involve organizational and social innovations (Roy, 2000; Stevels, 1997). Eco-efficient services, which are discussed in Section 2.3, is also one of the concepts formed to tackle this challenge.

Many authors have promoted adapting market systems to reduce the environmental degradation (e.g. Daly, 1996; Hawken, 1993; Hawken *et al*, 2000; Von Weizsäcker *et al*, 1997) and have argued that environmental problems can only be addressed properly through substantial changes in product development and consumption (e.g. Fussler, 1996; Hart, 1997; Schmidheiny, 1992; Von Weizsäcker *et al*, 1997). To this end, Vermeulen and Weterings (1996) connect four classes of innovation strategies to potential or expected environmental improvement levels or 'factors': Phase one focuses on product improvements (factor 2 improvements); phase two on improvements of existing product concepts (factor 5 improvements); phase three focuses on innovations in function fulfilment (factor 10 improvements); and phase four on systems innovations (factor 20 improvements) (Vermeulen & Weterings (1996) in Meijkamp, 2000, p. 12). An important underlying assumption is that by stretching the boundaries of the system, opportunities to diminish the environmental effects are enhanced (Meijkamp, 2000; Stevels, 1997). These so-called 'eco-innovations' are,

“... in contrast to such technologies as microelectronics and telecommunications, normally not self-enforcing. Because factors of technology push and market pull do not seem to be strong enough, eco-innovations need specific regulatory support.”
(Rennings, 2000, p 326)

The main drivers for companies to engage in environmental activities are pressure from consumers or customers (whether they are private, industrial, governmental, or institutions) and competition, protecting present and future quality and costs, and tightening regulations and legislation (McAloone, 1998; Schmidheiny, 1992; Stevels, 1999). These laws and regulatory pressures can be direct regulatory instruments for the prohibition of hazardous substances or product take back obligation. They can also consist of providing compulsory information, like labelling for batteries and energy consumption or they can take the shape of financial instruments, like charges and subsidies. Finally, there is the provision of voluntary information, such as environmental labelling and voluntary agreements (Remmerswaal, 2000, p. 76). Since 1992, 'the environment' is also incorporated in environmental- and quality management systems, like ISO 14000, BS7750, and EMAS, covering management systems, auditing, performance evaluation, labelling, lifecycle assessment, and environmental aspects in product standards (Remmerswaal, 2000, pp. 69 – 73). Apart from these pressures, companies have also recognised the opportunities which engaging in environmental activities can bring, through practicing 'green marketing' (Ottman, 1998; Polonsky, 2001).

2.2.2 ECO-EFFICIENCY

“Called ‘eco-efficiency’, it has been developed by business for business. The first word of the concept encompasses both ecological and economic resources - the second says we have to make optimal use of both.” (DeSimone & Popoff, 1997, p. 2)

The term ‘eco-efficiency’ was first coined as the business end of sustainable development (Schmidheiny, 1992) during the 1992 Earth Summit in Rio de Janeiro, Brazil by the World Business Council on Sustainable Development (WBCSD) and has later been defined as follows:

“Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfies human needs and brings quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the Earth's carrying capacity.” (DeSimone & Popoff, 1997, p. 47)

This definition has five core themes (DeSimone & Popoff, 1997):

1. An emphasis on service – business needs to rethink the service that is being provided to customers and devise a new one that creates additional value both by meeting customers’ needs better and reducing environmental impacts.
2. A focus on needs and quality of life – an emphasis on performance that meets genuine needs rather than on products alone.
3. Consideration of the entire product lifecycle – companies have a responsibility to consider the upstream and downstream implications of their activities and take actions to mitigate them.
4. A recognition of limits to eco-capacity – defining the precise relationship between a company’s activities and the earth’s carrying capacity is difficult if not impossible, but an understanding that some kind of limits do exist, creates a sense of urgency.
5. A process view – a recognition that eco-efficiency is more a process than a once-and-for-all objective.

Eco-efficiency thus harnesses the business concept of creating value and links it with environmental concerns. According to DeSimone and Popoff (1997) there are seven practical, technical dimensions of eco-efficiency, which every business should be taking into account when developing products, introducing process changes, or taking other actions with environmental implications. These are described in Table 2.1 on the next page.

One important aspect of eco-efficiency in practice is resource productivity, which is linked to ‘dematerialisation’. Dematerialisation can be defined as ‘the absolute or relative reduction in the quantity of materials used and/ or the quantity of waste generated in the production of a unit of economic output’ (Cleveland & Ruth, 1999). It thus means creating products and services with the same level of performance, but with inherently lower environmental burden (Mont, 1999). Von Weizsäcker *et al* (1997) for example have identified fifty examples of quadrupling resource productivity, focusing on energy, material, and transport productivity.

Guideline	Details
I. Reduce the material intensity of goods and services	<p><i>Environmental aspect:</i> Mining, refining, growing, manufacturing, and transport of materials requires energy and creates pollution and wastes.</p> <p><i>Business aspect:</i> Mining and processing materials can be expensive. Using materials more efficiently and sustainably makes sense both for the environment and for business.</p> <p><i>Related issues:</i> dematerialisation, use of new technologies, environmental legislation, and reducing packaging.</p>
II. Reduce the energy intensity of goods and services	<p><i>Environmental aspect:</i> Energy is consumed during all stages of the lifecycle of any product or service. Producing and consuming this energy creates pollution and waste materials and often depletes non-renewable fossil fuels. Therefore, making lifecycles more energy efficient creates great environmental benefit.</p> <p><i>Business aspect:</i> As energy is costly even today, reducing the energy intensity will also create economic benefit.</p> <p><i>Related issues:</i> energy use of buildings, equipment, appliances and transport, energy subsidies, process monitoring and control, and utilizing waste heat.</p>
III. Reduce toxic dispersion	<p><i>Environmental aspect:</i> Some harmful substances that are emitted to the environment remain unchanged or are converted to even more toxic forms and spread through the atmosphere. They can then cause negative environmental and health impacts. The opportunity is to significantly reduce and control such dispersal.</p> <p><i>Business aspect:</i> Reducing health and safety risks of business operations to humans and the environment is part of a business' corporate responsibility.</p> <p><i>Related issues:</i> health and safety, use of chemicals, and separation of waste streams.</p>
IV. Enhance material recyclability	<p><i>Environmental aspect:</i> Materials and energy utilisation can be improved by re-use in the same or another system.</p> <p><i>Business aspect:</i> Recycling avoids the energy and waste costs of mining or creating virgin materials. Eco-efficient recycling is that which maximizes the financial value of materials and minimizes the environmental effects of their processing.</p> <p><i>Related issues:</i> re-use components or materials, remanufacture, recycling the material to an alternative use, incineration to utilize its energy content, take back legislation, closing the loops, and lifecycle analysis.</p>
V. Maximize sustainable use of renewable resources	<p><i>Environmental aspect:</i> The fossil fuels and some of the key materials on which our modern world is built are finite. It is difficult to predict how long they last, but sometime in the future we have to replace them with alternatives. Using renewable resources often tends to create less environmental impact over the entire lifecycle.</p> <p><i>Business aspect:</i> Using renewable resources might over time create economic benefit, but there is not an abundance of incentives as yet.</p> <p><i>Related issues:</i> solar power, new technologies, and ecological design.</p>
VI. Extend product durability	<p><i>Environmental aspect:</i> One way of extending the resource productivity is by extending the useful life of products. This results in less frequent replacements, which in turn can mean less waste and the use of fewer material and energy resources.</p> <p><i>Business aspect:</i> Product-life optimisation can be used to gain competitive advantage. Barriers to product durability are reliance on purchase of products for revenue, image of durable products, and the rate of technological innovation.</p> <p><i>Related issues:</i> anticipation of future use, and careful utilisation and maintenance of equipment.</p>
VII. Increase the service intensity of products	<p><i>Environmental aspect:</i> Increased service intensity means creating additional value for customers while reducing or holding constant service impacts.</p> <p><i>Business aspect:</i> Creating additional value for customers can generate economic benefits.</p> <p><i>Related issues:</i> shared use, multifunctionality, and upgrading.</p>

Table 2.1 Seven dimensions of eco-efficiency (after DeSimone & Popoff, 1997, pp. 56 – 78)

Eco-efficiency is not achieved by technological change alone. There are several organisational elements that need to be taken into account (DeSimone & Popoff, 1997):

- Leadership – the single most important requirement for eco-efficiency. If top management does not support it by word and action, change simply will not happen.
- Foresight – looking into the future and translating this into vision of sustainable business development and the competencies and technologies needed to achieve it.
- Culture – individual employees make the difference between eco-efficiency happening or not, so there must be a culture that creates commitment and action by everyone in the organisation.
- Management tools – such as environmental management systems, environmental performance measures, and environmental accounting techniques provide the data and incentives to drive eco-efficiency within the organisation.
- Lifecycle management – understanding and improving the lifecycle impact of products, particularly through ecodesign.
- Research and development (R&D) – to ensure that tomorrow's environmental challenges are dealt with as well as today's sustainability, means thinking in timescales of twenty to thirty years.
- Production and operations – most companies begin their environmental actions in this area and much can be achieved through waste minimisation and other initiatives.
- Marketing and procurement – there is a need for environmentally improved products, based on getting closer to customers to form a view of their real needs; procurement can encourage suppliers to improve their own environmental performance and minimize buying-in waste or pollution problems.
- After-sales service and disposal – companies have a responsibility and a business opportunity to consider environmental impacts created by use and disposal.

The WBCSD suggests that business can implement eco-efficiency on four levels: eco-efficient processes, exchange of by-products, developing better products, and eco-efficient markets (Mont, 1999, p. 16).

2.2.2.1 Criticisms on eco-efficiency

The concept of eco-efficiency is a controversial one and determining its contribution to sustainable development is complex (Ryan, 2000a). The main point of criticism is that eco-efficiency takes an incremental approach, rather than the 'much needed' revolutionary approach which would lead to fundamental changes in the dynamics of industrial activities (Ehrenfeld, 2000; Ehrenfeld & Brezet, 2001). According to Ryan (2002), eco-efficiency appears to have become an excuse for complacency, a new and simplistic technological optimism that things as they are can become more sustainable by improving the efficiency of processes and resource use. This, while consumption is showing up as the real limiting factor in product improvement strategies; it is currently rising faster than improvements in eco-efficiency (Ryan, 2000a, p. 11). McDonough and Braungart (2001, 2002) argue that reduction is a central tenet of eco-efficiency, but that does not halt depletion or destruction – it only slows them down.

“We have just too little knowledge about industrial pollutants and their effects on natural systems for ‘slowing down’ to be a healthy strategy in the long term.”
(McDonough & Braungart, 2002, p. 55)

They stress it is better to use 'eco-effectiveness' rather than 'eco-efficiency' to guide improvements:

"Our concept of eco-effectiveness means working on the right things – on the right products and services and systems – instead of making the wrong things less bad. Once you are doing the right things, then doing them 'right', with the help of efficiency among other tools, makes perfect sense." (McDonough & Braungart, 2002, p. 76)

They do not, however, condemn all efficiency. According to them, when implemented as a tool within a larger, effective system that intends overall positive effects on a wide range of issues – not simply economic ones – efficiency can actually be valuable.

"It is valuable too when conceived as a transitional strategy to help current systems slow down and turn around. But as long as modern industry is so destructive, attempting only to make it less bad is a fatally limited goal." (McDonough & Braungart, 2002, p. 65)

Eco-efficiency can thus be used as a tool in service to a larger vision, not as a goal in itself (McDonough & Braungart, 2002, p. 131). Ehrenfeld (2000) has voiced similar concerns about the concept of eco-efficiency. He argues that, while pursuing increased eco-efficiency in practice is necessary for the creation of sustainability, it is insufficient. Its failing springs from two sources: one is simply the insufficiency of efficiency improvements to counter the absolute impacts created by growth occurring at rates greater than those of the improvements. A second short-coming is that the idea of sustainable development fails to capture the inherent radicalness of the very idea of sustainability and its ties to biological and social origins.

"That is not to say that the search for efficiency cannot lead to innovations that depart radically from the status-quo ... Nor should my 'no' be taken as a criticism of eco-efficiency; only of its adequacy to produce transformation, that is, fundamental change." (Ehrenfeld, 2000)

It is clear to Mont (1999) that eco-efficiency answers just a part of the sustainability challenge. It must be accompanied by concepts and approaches dealing with fundamental changes in consumption patterns before sustainability can be achieved.

2.2.3 BUSINESS STRATEGY

If it is desirable for a company to be sustainable from a social and environmental perspective, as discussed above, it is imperative for a company in today's business world to be sustainable from an economic perspective. A company must thus offer its products or services to a more or less competitive marketplace and sell these at a profit, in this way creating competitive advantage (Porter, 1985). In his influential book *Competitive strategy* (1980), Michael Porter presents three generic strategies for coping with the different forces driving industry competition: overall cost leadership, differentiation, and focus. In an overall cost leadership strategy a company sets out to become the low-cost producer in its industry. In a differentiation strategy, a firm seeks to be unique in its industry along some dimensions that are widely valued by buyers. In a focus strategy, a company selects a segment and tailors its strategy to serving it to the exclusion of others. By optimising its

strategy for the target segments, the company seeks to achieve a competitive advantage in its target segments even though it does not possess a competitive advantage overall. Porter (1985) also presents the concept of the 'generic value chain' consisting of primary activities and support activities. The value chain disaggregates a firm into its strategically relevant activities in order to understand the behaviour of costs and the existing and potential sources of differentiation (p. 33). Porter's generic value chain is shown in Figure 2.3 below.

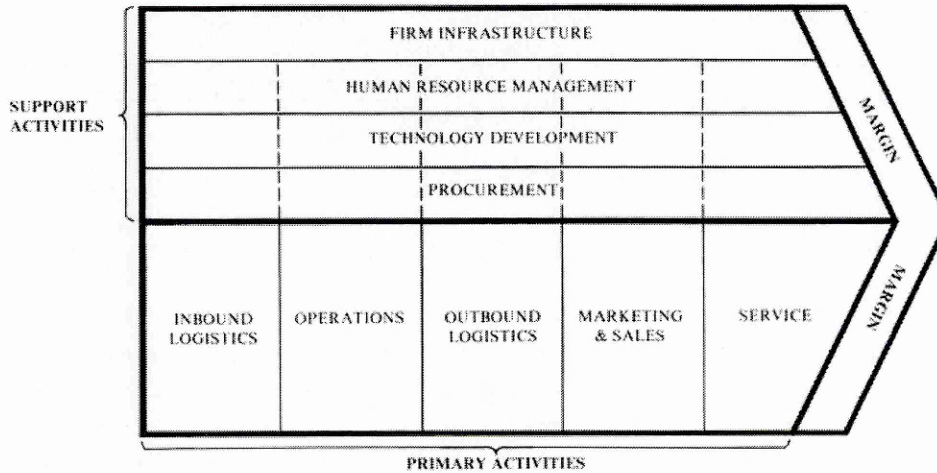


Figure 2.3 The generic value chain (Porter, 1985, p. 37)

Although Porter's three generic strategies are useful, recent research suggests that it does not describe all the ways companies compete in the current business environment. Hax and Wilde (1999) have developed a new model which 'fills a significant void in the development of strategic thinking' (p. 12) by offering three potential strategic options: best-product, customer solutions, and system lock-in. The best-product strategic option is built on the forms of competition as defined by Porter; through low cost or differentiation. The customer solutions option is based upon a wider offering of products and services that satisfies most if not all the customer's needs. With this option, the focus is on customer economics, rather than product economics. Finally, with the system lock-in strategic option, the company considers all the meaningful players in the system that contribute to the creation of economic value. The company nurtures, attracts, and retains players that can enhance the company's offering – the so-called complementors – and locks out competitors. This can ultimately lead to achieving the *de facto* proprietary standard in an industry.

2.2.3.1 Changing business environment

Over the last few decades 'the marketplace' has been dramatically transformed. We have gradually moved from an industrial economy to an economy that is dominated by services (Giarini & Stahel, 1993; Quinn, 1992). (This shift is further discussed in Section 2.3.1.) There has also been a shift from mass-production to customisation, as a reaction to saturated markets and stiff competition (Rifkin, 2000). Business has moved from being transaction-based to being relationship-based (Sheth & Parvatiyar, 2000), and information and communication technology has transformed all aspects of production and consumption (Sharma & Molloy, 1999). In Table 2.2, the differences between the industrial economy and the contemporary one are stated, as summarised by Vandermerwe (1993).

Industrial	Contemporary
Get volumes for firm	Offer value to customers
Start with producer and work forwards	Start with end-users and work backwards
Compete in closed protective environments	Collaborate in open interdependent systems
Emphasise internal productivity	Focus on utility for customers
Pursue economies of scale	Obtain optimisation of scale/ scope for total system
Choose mass or specialised markets	Markets consist of generic, targeted, individual components
Dominate mass markets	Cement key and selected markets
Machines add value	Man adds value

Table 2.2 Industrial versus contemporary mindsets (Vandermerwe, 1993, p. 23)

These transitions had (and still have) implications for a company's 'business design'. A business design is the totality of how a company selects its customers, defines and differentiates its offerings, defines the tasks it will perform itself and those it will outsource, configures its resources, goes to market, creates utility for customers and captures profit (Slywotzky, 1996, p. 4). Slywotzky recognises a pattern in companies he labelled 'value migration'; a pattern of accelerating value migration away from increasingly outmoded business designs towards others that are better designed to maximise utility for customers and profits for the companies (1996, pp. 3 – 4). One of these patterns of value migration is from conventional selling to high-end solutions. In the age of manufacturing, most companies would use a direct sales force to market their products. Since product margins went down over time, companies could not afford this sales force anymore. This resulted on the one end of the spectrum in low cost distribution and on the other end through increased customer sophistication, in high-end solutions (Slywotzky, 1996, p. 210). These high-end solutions are discussed in Section 2.4, but in the next section the concept of eco-efficient services is discussed.

2.3 ECO-EFFICIENT SERVICES

In this section the concept of eco-efficient services is presented. Firstly, the move from products to services is described. Secondly, the drivers and barriers for eco-efficient services are stated, after which eco-efficient services are classified. Then the environmental effects of these services are examined, and finally, an overview of the progress of the research field of eco-efficient services is given.

Since this section talks about eco-efficient services, the term 'service' needs to be specified to avoid confusion, as this is not an unambiguous term (Manzini, 1996); the term 'service' is sometimes used to mention the 'utility embodied in a product' (Giarini, 1987). When talking about this, the word 'benefit' will be used (Lovelock & Wright, 1999). The term 'service' is defined as 'any act or performance that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product' (Kotler, 1994, p. 464).

2.3.1 THE SERVICE ECONOMY

People in the Western world are now living in a service economy. According to Euromonitor (2000) 68 per cent of the EU gross domestic product is generated by services. This did not happen overnight. The 'Industrial Economy' was gradually replaced by the 'Service Economy'. Many authors have written about the rise of this service economy (e.g. Deutsch, 1997; Lovelock, 1994; Quinn, 1992; Rifkin, 2000; Vandermerwe, 1993), but Giarini and Stahel started to write on the service economy from a global wealth and welfare point of view (e.g. Giarini, 1980, 1984, 1987; Giarini & Stahel, 1993; Stahel, 1999, 2001). One of their key publications on the shift from products to services is *The Limits to Certainty* (Giarini & Stahel, 1993). It describes the shift from the traditional Industrial Economy, where value is essentially attributed to products which exist materially and which are exchanged, to the new Service Economy, where value is more closely related to the performance and the real utilization of the products integrated in a system. The growth of services is mainly the result of the specific and successive evolution of the production process itself. As Giarini explains:

“A simple hammer can be easily used and its mere existence can be said to embody the possibility of its utilization. Modern technologies, however, require the input of an increasing number of services in order to be of any use ...” (Giarini, 1987, p. vi).

The advance of technology, which changed production processes by enhancing efficiency, produced a great development of service functions at all phases of the transformation process. The largest share of product cost nowadays is in product development, storage and distribution, marketing, financial and insurance services, waste management and disposal systems – all services that are essential for the provision of the product's functionality. Therefore, services have become indispensable in making available products that fulfil basic needs (Giarini & Stahel, 1993). The increased complexity of the production process has led to subsequent trends, like companies having to focus on their core competencies, since controlling the whole production process has become practically impossible.

In the Service Economy the notion of utilisation value is central; it is about the utility gained from a stock of products or services for the period or duration of their life time whatever their destination, and regardless of the fact that they are paid for or not (Giarini, 1980). This means that a car with which one can drive 200,000 miles in its lifetime has twice the utilisation value of a car lasting 100,000 miles. In the Service Economy the function fulfilment or the production of end-results is optimised, rather than goods and their distribution (Giarini & Stahel, 1993). As a result, companies are delivering services instead of selling products. Table 2.3 on the next page shows the differences between the traditional Industrial Economy and the new Service Economy.

2.3.2 DRIVERS AND BARRIERS FOR ECO-EFFICIENT SERVICES

Many authors argue that the emergence of services gives rise to opportunities for the introduction of concepts that significantly improve the environmental performance of production and consumption systems (e.g. Bhamra & Evans, 1999; Brezet *et al.*, 2000; Brügemann, 2000; Goedkoop *et al.*, 1999; Meijkamp, 2000; White *et al.*, 1999), such as eco-efficient services.

Sale of a performance (Service Economy)	Sale of a product (Industrial Economy)
The object of the sale is performance, customer satisfaction, the result	The object of the sale is a product
The seller is liable for the quality of the performance (usefulness)	The seller is liable for manufacturing quality (defects)
Payment is due <i>pro rata</i> if and when the performance is delivered (a no-fun, no-money principle)	Payment is due for and at the transfer of property rights (an as-is, where-is principle)
The work has to be produced <i>in situ</i> (service), around the clock, no storage or exchange is possible	The work can be produced centrally or globally (production); products can be stored, re-sold, exchanged
Property rights and liability remain with the fleet manager	Property rights and liability are transferred to the buyer
Advantages for the user: <ul style="list-style-type: none">▪ high flexibility in utilisation▪ little own knowledge necessary▪ cost guarantee per unit of performance▪ zero risk▪ status symbol as when buying a product	Advantages for the buyer: <ul style="list-style-type: none">▪ Right to a possible increase in value▪ Status value as when buying performance
Disadvantages for the user: <ul style="list-style-type: none">▪ No right to a possible increase in value	Disadvantages for the buyer: <ul style="list-style-type: none">▪ Zero flexibility in utilisation▪ Own knowledge necessary (driver's licence)▪ No cost guarantee▪ Full risk for operation and disposal
Marketing strategy = customer service	Marketing strategy = publicity, sponsoring
Central notion of value: constant utilisation value over long-term utilisation period	Central notion of value: high short-term exchange value at the point of sale

Table 2.3 Selling performance versus selling products (Stabel, 2001, p. 154)

The concept is recognised by the United Nations Environment Programme (which uses the term ‘product service systems’) as a means “to reduce the environmental footprint of production and consumption patterns” (UNEP-DTIE, 2000, 2001):

“If employed at a global level, product service systems can lead to reduced resource use and waste generation since fewer products are manufactured. ... As a business concept, product service systems have the potential to improve standards of living worldwide... With product service systems, consumers worldwide have less need to buy, maintain, dispose of, and eventually replace a product.” (UNEP-DTIE, 2000)

2.3.2.1 Drivers

To date, the move from selling products to providing services has hardly been driven by environmental issues but largely by business concerns instead (Goedkoop *et al*, 1999; IZT *et al*, 2002; Mont, 1999; Rocchi, 1997; White *et al*, 1999; Zaring *et al*, 2001), such as increasing competitiveness, reducing costs, serving a market’s need for speed, convenience, flexibility or specialist skills, improving corporate identity, or responding to a discrete business opportunity (Rocchi, 1997; White *et al*, 1999). Goedkoop *et al* (1999) have identified several specific drivers for eco-efficient services, which include the threat of legislation, responding

to client's wishes, the company considering themselves environmentally and socially responsible, covenants with and green purchasing by authorities, and servicing client's environmental problems. The threat of legislation is a driver acknowledged by other authors as well (Charter & Tischner, 2001; Rocchi, 1997; White *et al*, 1999). Environmental legislation, when it is properly designed, should stimulate firms to discover 'win-win solutions' (Charter & Tischner, 2001).

It is envisaged that the move from products towards eco-efficient services for government will result in fewer waste management concerns from the domestic and manufacturing sector, a more sustainable economy based on higher levels of service, and increased employment (UNEP DTIE, 2001). More jobs per unit of material product are created because of labour-intensive services, such as take back systems, repair, refurbishment, or disassembly. They also provide jobs to local markets, and thus contribute to strengthening the local economy, since services are generally closely tied to location (Cooper & Evans, 2000; IZT *et al*, 2002). These services also have the potential to offer a new way of understanding and influencing stakeholder relationships and viewing product chains, which again may facilitate development of more environmentally oriented policies (Mont, 1999).

For consumers the shift towards eco-efficient services would result in lower costs and fewer problems associated with the buying, use, maintenance, and eventual replacement of products (UNEP DTIE, 2001). The quality of the service and consumer satisfaction, may improve with eco-efficient services because the service provider has the incentive to use and maintain equipment properly, increasing both efficiency and effectiveness (UNEP DTIE, 2001). It might also result in greater diversity of choices in the market, in terms of maintenance and repair services, payment schemes, and different schemes of product use that suit the customer best in terms of ownership responsibilities (Mont, 1999, p. 34).

2.3.2.2 Barriers

There are, however, considerable barriers to overcome when companies aspire to offer eco-efficient services. Most companies lack a systematic approach, which may improve system parameters and conditions, provide competitive advantage and allocate resources more efficiently (Mont, 1999, p. 3) and companies often lack the experience to design service methods and management systems (UNEP DTIE, 2001). Offering services requires obtaining a deeper understanding of client's business and production processes and a greater degree of trust when the service provider takes over in-house activities (White *et al*, 1999). There is by and large a poor understanding of costs associated with eco-efficient services (and services in general) both on the supply and demand side, making it difficult to determine how to charge knowledge and information (White *et al*, 1999). The occurrence of transaction costs (for additional communication and co-operation) can complicate the proliferation of interactive service solutions (IZT *et al*, 2002; Zaring *et al*, 2001). In general, there is a lack of information available to consumers to influence their purchase decision, e.g. lifetime costs of ownership (Cooper & Evans, 2000; UNEP DTIE, 2001; Zaring *et al*, 2001). For some types of services, customer psychology can be a considerable barrier, for offering services can mean moving towards a situation of non-ownership, especially since current economic and social infrastructure has developed to reinforce individualistic lifestyles and routine activities based on private consumption (Cooper & Evans, 2000; UNEP-DTIE, 2001; White *et al*, 1999). Finally, lack of top management support can be a challenge (Zaring *et al*, 2001).

2.3.3 CLASSIFICATION OF ECO-EFFICIENT SERVICES

Eco-efficient services are known by many different names, like product-service systems (PSS), product-service combinations, sustainable services and systems (3S), eco-efficient services, and eco-services; each term stressing a particular element of the offering. As can be deduced from these different terms, they must have slightly different meanings, as a sustainable service is different to an eco-efficient one. However, in the literatures these differences are ill-defined and the different terms are used haphazardly. For the sake of clarity and consistency, throughout this report the term 'eco-efficient services' will be used. They can be defined as follows:

"Eco-efficient services are all kinds of commercial market offers aiming at fulfilling customer needs by selling the utilisation of a product (system) instead of providing just the product. Eco-efficient services are services relating to any kind of product, in which some of the property rights are kept by the producer." (Meijkamp, 2000, p. 35)

Additionally, Zaring *et al* (2001) stress the environmental aspect of eco-efficient services:

"An eco-efficient service is a certain product-service mix, which has a higher added value, and a smaller environmental impact compared to a similar product-service mix or a situation in which the activity was not performed at all." (Zaring *et al*, 2001, p. 37)

Different typologies of eco-efficient services exist (e.g. Cooper & Evans, 2000; Giarini & Stahel, 1993; Meijkamp, 2000; UNEP-WG-SPD, 1997; White *et al*, 1999; Zaring *et al*, 2001). A typology of strategies related to the concept of eco-efficient services that is often used is the following (Econcept, 2000; Hockerts, 1999; Meijkamp, 2000; Schrader, 1999):

- Product services – these offer additional service for the product sold, like maintenance, upgrading, repair, guarantee, and product take back in order to extend its useful life (e.g. a maintenance service for a washing machine).
- Use services – the provider no longer sells its product, but only its use, like leasing, renting, sharing and pooling (e.g. car sharing).
- Result services – their purpose is the satisfaction of customer needs regardless of the material product, meaning that the service provider guarantees a certain result (e.g. integrated pest management).

These categories are discussed more in-depth below.

2.3.3.1 Product services

Product services aim at product-life extension, through for example maintenance or product take back. Giarini and Stahel (1993) mention a number of strategies to extend the life of products, i.e. to close the material loops. These strategies are re-use, repair, reconditioning, upgrading, and recycling. These are shown in Figure 2.4 on the next page.

Product services are characterised by customer ownership of the physical good (Schrader, 1999) and thus represent only a minimal departure from a traditional sell-buy arrangement. These services enhance the utility that ownership of the product delivers to the customer, through warranties and maintenance agreements for example (White *et al*, 1999).

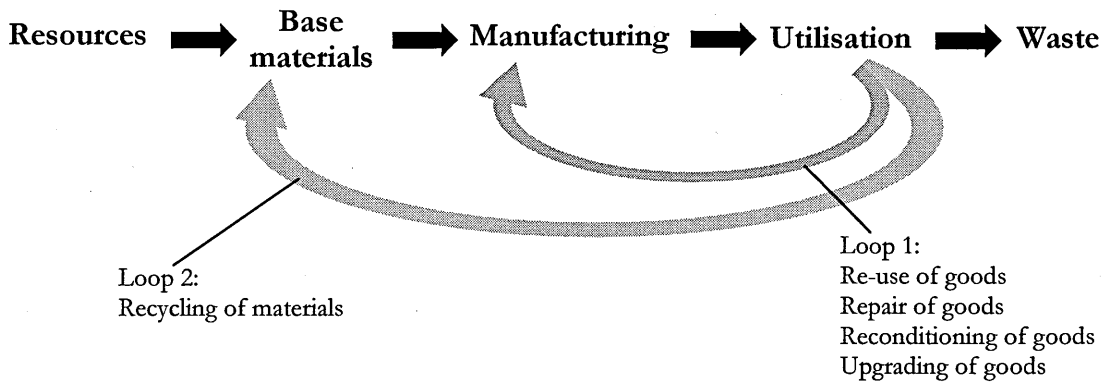


Figure 2.4 The product lifecycle with two closed material loops (adapted from Stabel, 1999, p. 68)

The environmental motivation for manufacturers to adopt product services is that they increase the lifetime of the product to which they are attached, e.g. maintenance service for a washing machine. As a result, fewer machines are needed over time, saving materials and energy. Besides the environmental motivation, there is also a business motivation; the experience of some manufacturing companies is that with a steady service income, it is much easier to bind a client to their companies in the long term (Hockerts, 1999, p. 99). Generally, using less material and energy means less cost, and therefore not surprisingly, these strategies are not strictly environmentally driven. By reducing the amount of resource and energy consumption per unit of performance, these services contribute to the traditional bottom line of a company, namely generating profit. For example, taking back products does not only mean less waste going to landfill. Some products do still have a considerable value at the end of their useful life, in terms of re-usable components, valuable materials, or embodied energy (White *et al*, 1999), like cars and office machines. A product take back service can reclaim this value. Xerox Europe, for example, take back their copiers and reprocess all the re-usable parts. Through equipment remanufacture alone, possible through these take back services, Xerox Europe has saved millions of dollars in costs, while diverting thousands tons of materials from landfill (Hendriks, 2001).

2.3.3.2 Use services

In the case of use services, ownership of the products resides with the service provider. Customers have the use of the products, but maintenance as well as end-of-life disposition is the responsibility of the service provider (White *et al*, 1999). Thus, the consumer gains the function of the product without ownership; there is merely a temporary transfer of material goods from the provider to the customer. Traditional rental or leasing arrangements fall into this category, such as Laundromats, tool-rental, taxis, and but also sharing and pooling schemes, e.g. car sharing. With rental systems, consumers can use products for some time without the need to purchase and to own them. The expected increased eco-efficiency rating for use services is closely related to the high use intensity of products, which brings about a reduction in the number of products needed (Manzini, 1999a; Schrader, 1999). For example, when people share a car, fewer cars are needed to make the total amount of desired travel kilometres. Producers or providers are being paid for the units of service as delivered to the customers. They therefore have an economic interest in reducing the use of resources (materials and energy) in the production of each unit of service. In addition, costs will be shared between all the units of service over the entire lifecycle (Meijkamp, 2000).

2.3.3.3 Result services

Finally, with result services the objective of a business becomes to sell results rather than physical products (Manzini, 1999a, b). With this approach the product is owned and run by the supplier, who therefore has an incentive to intensify and optimize the product's operation, and to increase its service life. A pesticide manufacturer for example, offers farmers an 'integrated pest management' service. They train and assist farmers in the use of pesticides. They can save up to fifty per cent of pesticide costs and at the same time increase yields because many crops react adversely to an excess of pesticide. In a more developed version the pesticide provider could even offer a 'crop insurance' service, guaranteeing the customer that certain pests will not affect its yield. The whole pesticide application would be carried out by the service provider (Hockerts, 1999; Rocchi, 1997). As this example illustrates, how the customer's need is satisfied is irrelevant, as long as it is satisfied. An additional aspect of result services is that by developing and offering a result instead of a pre-specified product or service, the environment can be incorporated from scratch. Consequently, significant reductions in the material and energy consumption per unit of service are envisaged (Van der Zwan & Bhamra, 2001). Chemical management services (CMS), for example, are services where the chemical supplier manages the chemical procurement, delivery, inspection, inventory, storage, labelling and disposal of chemicals for industrial customers. By managing everything linked to chemicals, CMS companies promise use reductions to their customers, inverting the traditional supplier-customer relationship from one where profits are tied to sales to one where profits are tied to efficiency (White *et al*, 1999). In this kind of service strategy, products are perhaps the least important to consumers as they are merely buying 'results' (Hockerts, 1999). Another example that illustrates this strategy is a carpet company offering a floor-covering service, where they,

“... sell the services of the carpet: color, design, texture, warmth, acoustics, comfort under foot, cleanliness, and improved indoor air quality, but not the carpet itself.”
(Anderson, 1998, p. 14)

In the utilities, a category of services is present that is closely related to this result oriented approach, namely 'demand side management'. These services consider the end-use service that buyers want, and working out the least-cost method of supplying it (Roy, 2000). The basic assumption is that, since customers are not interested in the provision of gas and electricity themselves but in heating their home or workplace, what the service is providing is not kilowatt-hours or cubic metres of gas, but a thermal comfort service. As a consequence, it is in the economic interest of the producer to guarantee the best possible service, by reducing his own costs (Rocchi, 1997).

2.3.3.4 Eco-efficient producer services

Zaring *et al* (2001) have looked at eco-efficient producer services specifically in a business-to-business market. They came up with the following classification:

- Activity management – the provider delivers a complete solution to an on-going need for a customer, e.g. waste managing services and facility management.
- Advise and consultancy – the provider delivers advice to customers as main input, e.g. water management advice and advice on energy-efficient architecture.

- Information – the provider offers information about the customer's operations, processes, etc. or about contextual factors which influence the eco-efficiency of a customer's activities, e.g. precision farming.
- Intermediation – the provision of information to reduce mis-allocation of resources and to explore unutilised capacity, e.g. truck load optimisation services and broker service for used car parts.
- Product extension – a service to enhance product utility while leaving customer ownership unchanged, e.g. maintenance of office equipment.
- Product result services – services which guarantee specified performance results, e.g. energy performance contracting.
- Product utility/ ownership services – the provision of products to customers while retaining ownership, e.g. hiring of cleaning fabrics and leasing of transport vehicles.
- Service substitution possibility – services replacing material-intensive means of creating value by information-intensive ones, e.g. videoconference and distance learning.

These services can have several outputs. As stated with the previous classification, these services can enable life extension, improved resource utilisation, and the re-use and recycling of marketable materials and components. They can also bring about behavioural change, achieved through awareness building, the availability of alternatives, and provision of information. Services such as fleet management can result in improved utilisation of capacity. Eco-efficient producer services can also bring about dematerialisation through substitution processes, through services like video conferencing and distance learning. Some services are targeted for impact management, i.e. to influence the pattern and scales of customers' environmental performance. Finally, the system can be optimised through co-ordination of an entire system so that overall inputs are more precisely tailored to customer needs (Zaring *et al*, 2001).

2.3.4 THE ENVIRONMENTAL EFFECTS OF ECO-EFFICIENT SERVICES

Although eco-efficient services have been heralded as a panacea to unlink economic growth from consumption of natural resources (Goedkoop *et al*, 1999), the environmental implications of introducing eco-efficient services are poorly studied. There is so far no conclusive evidence that the use of these services contributes positively to sustainable development (Mont, 1999). However, the general assumption regarding the beneficial environmental effects of the eco-efficient services approach is based upon the expectation that because producers are being paid for the units of service as delivered to the customers, producers get an economic interest from the functional optimisation of a consumption practise. This economic interest would in turn stimulate technological, organisational and marketing innovations directed towards integrated solutions that are optimised over the entire lifecycle, since the costs over the complete lifecycle will be amortised over all the units of service over their entire lifecycle (Meijkamp, 2000). Thus, the environmental benefits derive from reallocation of property rights or responsibility across product lifecycle and the consequent internalisation of costs and benefits (White *et al*, 1999, p. 28). According to White *et al* (1999) the environmental impact of eco-efficient services can be reduced in various ways. This is shown in Table 2.4 on the next page.

	Source of impact reduction	Conditions to achieve reductions
Use impacts	Via product design	Use-related environmental costs are internalised, and these costs may be reduced by better design of products
	Via increased turnover	Servicizing drives more rapid turnover of product stock in use and progressive efficiency improvements in consecutive years
	Via more optimal operation of existing product (maintenance, training, process efficiency)	Where the product is a cost rather than a profit centre, and more optimal operation extends product life/ reduces products consumed, use-related environmental costs are internalised, and these costs may be reduced by more optimal operation.
Non-use impacts	Via reductions in number or volume of product manufactured	The product is a cost rather than a profit centre, providing incentives for any of the following: more durable products, products with larger service capacity via the realisation of economies of scale, more efficient utilisation of products in use
	Via reductions in the volume of materials mobilised per unit (reclamation activities)	The product has economic value at the end-of-life, or where end-of-life costs are internalised – in either case stimulating reclamation activities
	Via improved environmental improvement of non-use processes	The product has economic value at end-of-life, or where end-of-life costs are internalised – in either case stimulating reclamation activities

Table 2.4 Ways to reduce the environmental impact of eco-efficient services (White et al, 1999)

2.3.4.1 E2-vector

Goedkoop *et al* (1999) devised a tool to assess the unlinking of economic value and environmental load, called the E2 (Economy-Environment) vector. For this, the value created during each stage of the lifecycle and its corresponding environmental impacts can be plotted in a graph – this is shown in Figure 2.5 below.

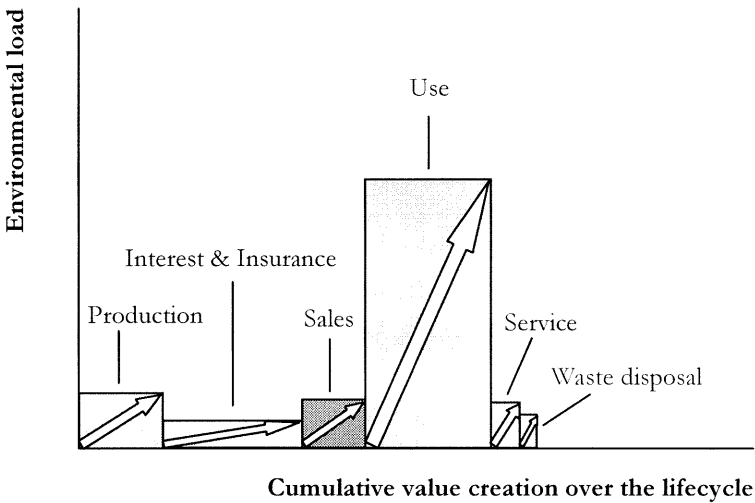


Figure 2.5 Value created and environmental load per lifecycle stage (after Goedkoop et al, 1999)

In each block a vector is shown; the slope of these vectors stands for the environmental load per amount of value created. For the E2-vector, the cumulative value is plotted against the cumulative environmental load. Thus the vectors for each stage in the lifecycle can be combined to make an overall vector for that product offering. This is shown in Figure 2.6.

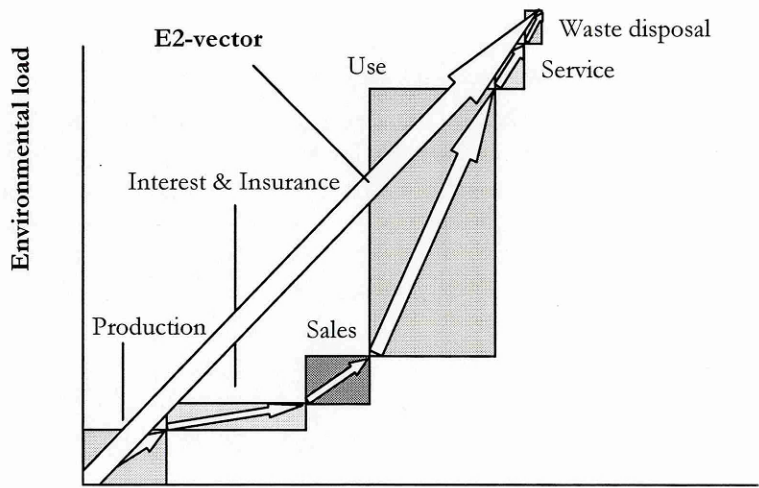


Figure 2.6 The E2-vector (after Goedkoop et al, 1999)

A system with an E2-vector that is less steep than a reference vector, can contribute to the unlinking of the creation of value and the corresponding environmental impacts, as the ratio between environmental load and value is better (Goedkoop et al, 1999). This unlinking is shown in Figure 2.7. It is envisaged that the eco-efficient services concept can bring about this unlinking (Goedkoop et al, 1999; Mont, 1999).

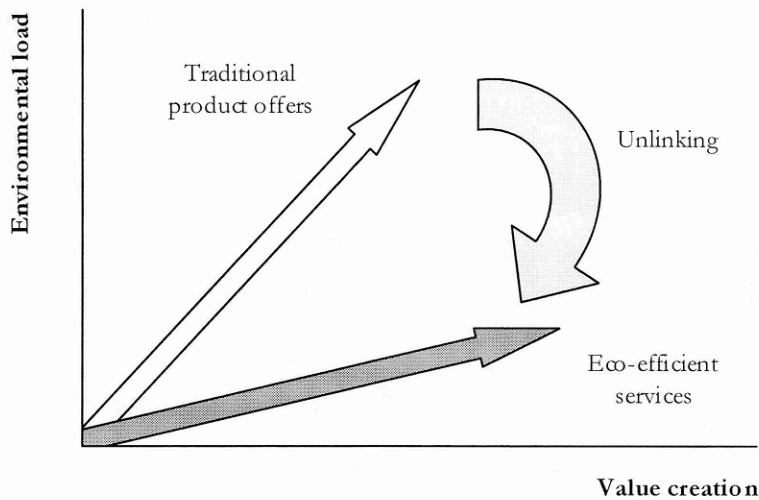


Figure 2.7 Unlinking when shifting from products to eco-efficient services (after Goedkoop et al, 1999)

2.3.4.2 Reservations regarding eco-efficient services

“PSS arguments involve three propositions: services have low material (resource) intensity; the utility of a product can be replaced by the utility of a service (without ownership of a product); and there will be good consumer markets for PSS. Yet there is good reason to be sceptical about all three of these statements.” (Ryan, 2000a, p. 13)

The concept of eco-efficient services primarily originates from macroeconomic ideas and theories concerning the environmental effects of production, not from empirical observations or practices (Meijkamp, 2000, p. 42). Eco-efficient services have not yet been developed beyond the concept to practical, realistic proposals (Mont, 1999, p. 3). According to Mont (1999) there is insufficient external demand for companies to create new eco-efficient services. It may be necessary to devise market incentives, regulations, and other measures to make them viable (Roy, 2000). Nevertheless, three main uncertainties regarding the applicability and feasibility of eco-efficient services remain: the readiness of companies to adopt them, the readiness of consumers to accept them, and their environmental implications (Mont, 1999, p. 3). It is, however, clearly not necessarily true that services are environmentally benign (Brügemann, 2000; Cooper & Evans, 2000; White *et al*, 1999). According to White *et al* (1999) a service economy is better thought of as a value-added layer resting upon a material-based, industrial economy.

IZT *et al* (2002) have identified several possible advantages and drawbacks of applying a eco-efficient services strategy, which are shown in Table 2.5 below. Apart from the environmental drawbacks, a service strategy is not always preferable, because it might be rejected by product-oriented companies, it might not be accepted by customers, and there is the rebound effect (Brügemann, 2000, p.13).

Environmental implications of renting	
Possible environmental advantages	Possible environmental disadvantages
<ul style="list-style-type: none">▪ Reduction of purchased goods▪ Ability to use more expensive goods of a higher environmental performance (depending on the product the environmental implications might be + or -)▪ Improved maintenance▪ Intensive use of products	<ul style="list-style-type: none">▪ Ability to use more expensive goods of a higher quality (in the case of cars this might lead to a higher use of fuel)▪ For specific products more transport is needed▪ Decrease of product responsibility▪ Purchase of products after trial period
Environmental implications of leasing	
Possible environmental advantages	Possible environmental disadvantages
<ul style="list-style-type: none">▪ More possibilities for environmental chain management (recycling, product reuse)▪ Leasing facilitates monitoring of products during phase of use and upon return and disposal▪ Lessor's interest in prolonging the durability of the product leased▪ Possibility of realising an optimal technical life span▪ Appliances more efficient in use▪ Ability to use more innovative technologies, e.g. solar systems and heat pumps	<ul style="list-style-type: none">▪ Stimulation of additional demand resulting in higher material flow▪ Leasing products age faster than products owned by the user▪ Less product responsibility in case of operational lease might lead to irresponsible use▪ Easier replacement of products▪ More intense use in case of financing independent of use (e.g. leased cars)

Table 2.5 Possible advantages and drawbacks of renting and leasing (IZT et al, 2002, p. 19)

2.3.4.3 The rebound effect

The 'rebound effect' is the environmentally negative second order effects which can sometimes arise from eco-efficient service inputs to customers (Mont, 1999; Zaring *et al*, 2001). The more the price of something goes down, the more likely it is that demand will increase in response to the falling price. Hence, if eco-efficient services result in falling prices for particular activities or goods (e.g., because energy or material requirements are reduced), the demand for them is likely to be increased. The question then is whether the environmental impacts from the increased demand outweigh those from the reduction in environmental impacts per unit of output (Zaring *et al*, 2001, p. 136). Three levels of rebound effect can be distinguished (Zaring *et al*, 2001):

- Direct effects – where introduction of a new service creates additional demand for a closely related product or activity. Energy management services, for example, reduce the cost of energy to customers who respond by having higher standards of warmth and therefore increased energy consumption.
- Indirect effects – where introduction of a new service creates additional demand for linked products or activities. For example, on-line capacity markets and location positioning and scheduling services reduce the cost of logistics and thereby stimulate demand for more transport of goods.
- Platform effects – where new services influence the general factors determining the level and patterns of production and consumption. For example, e-learning services create better educated and richer individuals who consume and travel more than previously.

The cases that were studied by Zaring *et al* (2001) demonstrate at least four ways in which services can create direct or indirect rebound effects: the effects on demand when the cost of supply of physical inputs falls, the geographic extension of economic and social activity, the effects on demand from time savings, and changed behaviour arising from changes in contractual or property relationships (pp. 136 – 137). One important task therefore is to gain a clearer understanding of the circumstances in which eco-efficient services are more or less likely to create rebound effects. The case studies by Zaring *et al* (2001) suggest that some important variables in influencing these outcomes are the characteristics of the service, elasticity of demand, resource costs, and systems conditions.

2.3.5 DEVELOPING ECO-EFFICIENT SERVICES

Across universities and research institutes, mainly in Europe, methodologies for the development of eco-efficient services are being developed (Brezet *et al*, 2001; Brügemann, 2000; Goedkoop *et al*, 1999; Hockerts, 1999; Hoogerwerf, 1996; Manzini, 1996; Mont, 2000; Zaring *et al*, 2001). The research field of eco-efficient services is by and large made up of academics and practitioners with a product design or ecodesign background (e.g. Brezet, Brügemann, Charter, Manzini, Roy, Ryan, and Tischner). Developing eco-efficient services is thus often regarded as a more sophisticated product development process (e.g. Brezet *et al*, 2001; Ryan, 2000b). According to Brezet *et al* (2001) much of the existing product design basics and environmental tools are applicable, but need to be adapted; especially the initiation phase of the process is considerably more complex. Ryan (2000b) views developing eco-efficient services as a design challenge, like 'future concept products' which

are developed in R&D departments of design-led companies, where aspects of market change (e.g. new regulations, technology, or demographic shifts) are assumed and incorporated in the development process. Although he admits,

“... we know how to manipulate (design) material to generate desire but we have comparatively little knowledge of how to do the same for immaterial ‘pseudo-things’.”
(Ryan, 2000a, p. 14)

One of the difficulties when developing eco-efficient services is the different nature of services as opposed to products. Services have distinctive characteristics that make them fundamentally different from products, e.g. their intangible nature, the inseparability of their production and consumption, their heterogeneity, perishability, and a different concept of ownership (Gabbott & Hogg, 1997). An entire academic field is based around this notion, namely the field of services marketing (e.g. Berry & Parasuraman, 1993; Grönroos, 1978; Lovelock, 1983; Rathmell, 1966; Shostack, 1977; Zeithaml, 1981). Since this recognition twenty-five years ago, a great deal of work has been undertaken to manage the implications of these distinctive characteristics of services (e.g. Lovelock & Wright, 1999; Parasuraman *et al*, 1988; Payne, 1993; Zeithaml & Bitner, 1996). The field of services marketing has now also moved into the area of relationship marketing (e.g. Sheth & Parvatiyar, 2000), acknowledging the shift from transaction-based marketing towards a relationship and interaction approach in the service industry.

Mont (2000) showed that it is difficult to create general, wider applicable eco-efficient services. She has encountered numerous barriers, such as the lack of information about environmental features of eco-efficient services and the risk that these services generate rebound effects. According to Mont, there is a need for methodologies for the eco-efficient services concept introduction to companies of different industry branches and an urgent need for an extended analysis of existing cases, and for the development of new detailed case studies of eco-efficient services – based on the criteria of business opportunity, economic profitability and continuous environmental improvement (Mont, 2000). Consumers, customers, and users will need to be informed of, and made excited by, the unconventional properties of product-services from the functional economy that is placed in their hands (Mont, 1999, p. 39).

2.3.5.1 Progress in the research community

In 2000 the PREPARE Thematic group on Sustainable Services and Systems was set up in and held its first meeting in Cologne (Econcept, 2000). The aim was to share information and experiences and determine a common research agenda. From this and subsequent expert meetings, it became apparent that a considerably wider range of skills, techniques and disciplines is needed when developing eco-efficient services, as opposed to an approach like ecodesign. This was echoed in the numerous open questions that were formulated at these meetings and are to be answered by the research community (Econcept, 2000; Tischner *et al*, 2001; UNEP-DTIE, 2000):

- How do services and systems work?
- Systems and service design does not exist or is carried out like product design – is this the right approach? Who are the right people to design services?

- How to create demand for intangible non owned products? How to design immaterial things?
- How to understand ultimate impacts of complex systems changes?
- How to change the culture of ownership? How to change consumption patterns?
- How can a company develop better strategies? What kind of tools and methodologies are needed?
- Which are the areas of eco-efficient services that are especially successful and profitable?
- Where do we factor in society and societal needs as stakeholders?
- How to communicate the concept to the different stakeholders (government, industry, research community, societal organisations, consumers, and media)? What is the potential of advertising and marketing?

It was acknowledged that the research community has a lack of understanding societal aspects, such as consumer behaviour, and psychological and sociological aspects (Econcept, 2000). It is also important to make a distinction between public, private, and business consumers (Mont, 2001). Pilots and demonstration projects are needed (Econcept, 2000; Mont, 1999; Ryan, 2000a; UNEP-DTIE, 2001) and there is a need to take a more systematic approach when investigating eco-efficient services (Mont, 2001).

2.4 INTEGRATED SOLUTIONS

Although the concept of integrated solutions is new and unfamiliar in most industries, this has not stopped the phrase from becoming one of business's most overused terms. According to a recent survey sixty-three percent of the Fortune 100 companies already claim to offer solutions (Sharma *et al*, 2002, p. 1).

This section examines the concept of integrated solutions on the basis of literature. It is important to note that all the literature available on integrated solutions discusses integrated solutions against a 'traditional' product-focused background. It talks about how product-based companies can make the shift towards becoming an integrated solution provider. This approach inevitably has its effects on the way integrated solutions are presented, but is echoed in this section.

First, the brief history of integrated solutions is presented. Next, its definition, trends and drivers, and main characteristics are discussed. Finally, the characteristics of a solution provider are considered. All this is summarised at the end of this section.

2.4.1 HISTORY OF THE CONCEPT

Integrated solutions are a relatively new phenomenon and have thus far mainly been examined by technology and management consultants. Vandermerwe is in 1993 one of the first people to talk about solutions and Slywotzky talks in 1996 about high-end solutions in

a business design context. Wise and Baumgartner (1999) view solutions as a way to capture value down the value chain, closer to the customer. A substantial amount work has been done by consultants from Booz·Allen & Hamilton (Sharma & Molloy, 1999; Cornet *et al*, 2000; Dyer & Lucier, 2000; Bennett *et al*, 2001; Sharma *et al*, 2002) and McKinsey (Foote *et al*, 2001; Roegner *et al*, 2001).

The world's first academic research on integrated solutions undertaken by Davies (2001) has evolved from work done in the area of so-called complex products and systems (CoPS) (e.g. Davies & Brady, 1998, 2000; Gann & Salter, 2000; Hobday, 1998, 2000; Hobday *et al*, 2000; Tidd *et al*, 2001). They define CoPS as 'high cost, engineering and information technology intensive, customised products having large numbers of tailored subsystems and components' (Hansen & Rush, 1998, p. 555). Examples of CoPS include aircraft, flight simulators, constructed facilities, telecommunication networks, and many other heavily engineered products and systems. Davies' research provides the key elements of a business model for the emerging integrated solutions sector (Davies, 2001).

Finally, Shepherd and Ahmed (2000) examine the movement towards a solutions innovation paradigm from a new product development point of view. Altogether, it seems integrated solutions is as yet a concept that resides predominantly in industry, as opposed to academia.

2.4.2 DEFINITION OF INTEGRATED SOLUTIONS

Given the novelty of the concept, no clear-cut definition of an integrated solution exists yet, but,

“... the term solutions is tossed around carelessly, often unattached to a real solutions strategy. Very frequently, the word solution is merely a costume thrown over a repackaged, existing set of products and services.” (Sharma *et al*, 2002, p. 1)

Solutions are more than bundles of products and services, since conceptually a portfolio of products and services bundled together might give some increased margins in the form of savings, efficiency, and lack of redundancy, but they do not create new value (Sharma & Molloy, 1999; Cornet *et al*, 2000). Solutions also consist of the knowledge, experience and thinking it takes to make the components work together (Sharma & Molloy, 1999, p 2). Consultants from Booz·Allen & Hamilton define a solution as a response to the query “Where do our customers have to go to succeed in the marketplace, and how can we be a partner in helping them get there?” (e.g. Sharma *et al*, 2002, p. 1)

Table 2.6 on the next page shows the various definitions of (integrated) solutions that have been found in literature. The various descriptions stress different elements of the multi-faceted concept of integrated solutions; e.g. its complex nature (Shepherd & Ahmed, 2000), its holistic nature (Foote *et al*, 2000), and its novelty (Womack & Fitzpatrick, 2000). Cornet *et al* (2000, p. 2) provide a clear definition. According to them a solution can be distinguished from a product, system, or service by the following defining characteristics:

- Solutions are co-created by a customer and supplier and cover all aspects of the relationship (commercial, operational, and financial);

Name used	Reference	Description of the concept of (integrated) solutions
Solutions	Shepherd & Ahmed (2000)	Solutions comprise a defined group of components (hardware, software and services) which, when integrated together, will resolve a customer's complex business problem. (p. 104)
	Foote <i>et al</i> (2001)	Creating high-value solutions by integrating various products and services to solve a complete customer problem
	Roegner <i>et al</i> (2001)	"A true solution is defined by and designed around a customer's need, not around an attempt to find a new use for a supplier's current products. And only as the relationship between supplier and customer becomes more collaborative in defining the customer's need - designing the product and service components and integrating the whole into a distinctive offering that is better than any alternative - can a supplier be said to offer a true solution." (p. 94)
Customer solutions	Sharma & Molloy (1999)	Solutions have common characteristics: (p. 11) <ul style="list-style-type: none"> ▪ value proposition; help customers improve the value they deliver to their customers, focused more on results ▪ products and services; cover a broad set of customer functional and aspirational/ emotional needs through access to broad product and service offerings ▪ customer offering; tailored to suit individual requirements, often bundled into an integrated package ready to use or apply ▪ pricing; value based, typically with an element of risk sharing ▪ customer relationship; focused more on partnering relationship, less on transactions
	Dyer & Lucier (2000)	When selling a solution, a supplier takes responsibility for value-added integration using its superior knowledge to integrate and sell an interdependent system of products and services. (p. 2)
	Cornet <i>et al</i> (2000)	A solution is a fundamentally new approach to creating incremental value in the system for the customer and, by extension, the solution provider. Typically developed as a combination of products, services, and knowledge, a solution is a supplier's customised response to a customer's pressing business need. It is an innovative construct built on a foundation of cooperation and mutual trust that revolutionises the customer value proposition. p. 1
	Sharma <i>et al</i> (2002)	A real solution is a fundamentally different approach that creates additional value for customers and suppliers by meeting five criteria: (p. 1) <ol style="list-style-type: none"> 1. It is co-created by a customer and supplier 2. It integrates products with services to meet essential customer needs 3. Suppliers accept some of the risk, often through performance-based and/ or risk-based contracts 4. Relationships between suppliers and customers are unusually intimate, far beyond a traditional buy-sell relationship 5. Solutions, therefore, are tailored to each customer
Integrated solutions	Wise & Baumgartner (1999)	Integrated solutions combine products and services into a seamless offering that address a pressing customer need (p. 138)
	Womack & Fitzpatrick (2000)	Integrated solutions combine right-sized physical goods in novel ways to solve problems (p. 52)
	Davies (2001)	Creating solutions means combining products and services in novel ways to solve a customer's specific problems (p.7)

Table 2.6 Different descriptions of solutions used in literature

- solutions are customised in one or more of the following respects: design, assembly, delivery, operation, or pricing;
- solutions involve the supplier taking risks and therefore often include performance- and/or risk-based contracts; and
- solutions create new value in one or more key ways: improving operating performance, increasing asset effectiveness, enabling market expansion, or mitigating risk.”

The characteristics mentioned here are discussed more in-depth later in this section.

2.4.3 DRIVERS AND BARRIERS FOR INTEGRATED SOLUTIONS

In this section the trends, or competitive pressures, that affect business are stated, as well as the drivers and barriers for offering integrated solutions.

2.4.3.1 Trends leading to providing integrated solutions

According to literature, an important trend for offering integrated solutions is the *reduced profitability of manufacturing products* (e.g. Wise & Baumgartner, 1999; Bennett *et al*, 2001, p. 1; Davies, 2001). The combination of *stagnant product demand* and an *expanded installed base* has pushed economic value downstream, away from manufacturing and towards providing services required to operate and maintain products (Wise & Baumgartner, 1999, p. 134). An aspect of this reduced profitability is *commoditisation of the products* that are manufactured. In many industries, including chemicals, vehicles, and computer workstations, the technical and performance differences among products of major manufacturers are often small and easily bridged (Wise & Baumgartner, 1999, p. 136). This makes it harder for companies to maintain their profit margins when selling traditional products and services (Cornet *et al*, 2000, p. 3; Bennett *et al*, 2001, p. 1).

Another trend is the *use of information technology* (IT) and the *new distribution channels* as a result of this, like telemarketing and the Internet, which is putting more pressure on commodity product prices by broadening access to the supply base (Sharma & Molloy, 1999, p. 1; Wise & Baumgartner, 1999). *Outsourcing* is also mentioned as a trend for offering integrated solutions (e.g. Davies, 2001; Cornet *et al*, 2000, p. 2). Finally, a trend discussed in literature is *rapidly changing market requirements* (Shepherd & Ahmed, 2000; Davies, 2001). This is due to increased levels of competition, higher rates of technical obsolescence, and shorter product lifecycles.

2.4.3.2 Drivers for providing solutions

The main driver for offering solutions is *customer demand* (e.g. Brown, 2000; Davies, 2001). Customers require suppliers to provide them with conceptual solutions that address their business needs. So these customers not only expect a supplier to design, integrate and build their system, but also finance, maintain and operate it through its entire lifecycle (Davies, 2001). Countering the competitive pressures mentioned in the previous section, such as reduced profitability and the use of IT, is a major driver for offering integrated solutions (e.g. Brown, 2000; Foote *et al*, 2001). Offering integrated solutions *introduces significant barriers against competitive attack* (Shepherd & Ahmed, 2000). Solutions also have the prospect of *increased revenue*, since it is clear that solution providers can earn a premium with solutions (e.g. Cornet *et al*, 2000, p. 9).

“... solutions providers are due the largest premium because they create a new way for components to work together to enhance the solution's overall functionality beyond that of the next best alternative and also spare the customer from the need to deal with multitudes of suppliers and to integrate the components and services itself. Add to that the value of a collaborative relationship, in which the solutions provider assumes some portion of its customer's risk and guarantees responsibility for part of the business.” (Roegner *et al*, 2001, p. 94 - 95)

A driver related to this is the potential for *continuous revenue* on the basis of the installed-base annuity stream (Wise & Baumgartner, 1999). By offering a solution, companies can capture more of the lifecycle profits associated with products. The promise of counter-cyclical growth is attractive to companies. According to one estimate, revenues from operational services – i.e. services to maintain, upgrade, and operate products and systems – now represent ten to thirty times the annual volume of underlying product sales (Davies, 2001, p. 13). Offering integrated solutions also has the advantage of opening the door for *securing tomorrow's orders* for new systems and upgrades (Davies, 2001).

Other drivers include government-led market reforms, like privatisation and deregulation (Davies, 2001), the apparent fact that clients perceive solutions as durable shareholder value (Foote *et al*, 2001), and the sheer ability to offer solutions due to a company's scale and expertise (Sharma & Molloy, 1999, p. 7).

2.4.3.3 Barriers for providing solutions

A major problem is that *no accepted business model offering integrated solutions exists as yet* (e.g. Bennett *et al*, 2001; Davies 2001). Consequently, companies do not know how to plan initial moves into offering solutions, how to organise and build appropriate capabilities, and how to improve performance in their provision (Davies, 2001). The absence of an accepted business model is complicated by the fact that solutions are by their very nature individually tailored, which makes it hard following a uniform approach or template (Cornet *et al*, 2000, p. 4). Another potential barrier is the *unlikelihood that one company possesses all the skills required to provide integrated solutions* (Shepherd & Ahmed, 2000). Companies might also *struggle to integrate the full range of their products and technical capabilities* into solutions (Sharma & Molloy, 1999; Foote *et al*, 2001). Another barrier from providing solutions might be that *the strengths of a product-focused business can hinder effort to become a solutions provider* (e.g. Foote *et al*, 2001). Most suppliers are structured with strict boundaries separating product lines and with R&D (Research and Development) focused on creating the next iteration of a product, rather than tailoring it for customers' incremental gains (Sharma *et al*, 2002, p. 4). In some industries, *lack of trust* is consistently cited as the greatest hurdle to growing a solutions-business (Cornet *et al*, 2000, p. 4).

2.4.4 INTEGRATED SOLUTIONS

2.4.4.1 Characteristics

Solutions not only increase margins, they also *create new value*. To build a real solutions business, a supplier must have a realistic idea of how it can best create value for the customer (Cornet *et al*, 2000, p. 2). Value accumulates at each stage of the process of production to make up the overall value chain (Davies, 2001). Integrated solutions *focus on*

the business need of a customer, rather than a technical need (Shepherd & Ahmed, 2000). WS Atkins, for example, provided services like engineering consultancy, project management and technical services for infrastructure projects. Now they provide integrated solutions for the built environment, which include design, build, finance and operate infrastructure across industrial sectors. They are one-stop-shop for design, construction, maintenance and finance (Davies, 2001, p. 9). Integrated solutions take over activities previously part of the customer's value chain (ISS project team, 2000). A *desired outcome for a customer* is the start when developing value propositions for solutions:

“In developing value propositions for solutions ... managers start not with a product but with a desired outcome for a customer - an outcome that could encompass a whole range of needs.” (Foote *et al*, 2001, p. 87)

An important aspect for providing economic viable solutions is *leveraging competences* (e.g. Cornet *et al*, 2000; Foote *et al*, 2001). Profitable solutions are made up of a combination of standardised products and customised products that can be replicated for multiple customer relationships; only through replication that the solution provider can leverage the knowledge and capabilities gained from its custom efforts on its biggest and most complex customers (Sharma & Molloy, 1999, p. 1).

“The ideal is to create an advanced custom solution for a large customer with deep pockets and sophisticated needs and apply it to other customers.” (Sharma & Molloy, 1999, p. 8)

Integrated solutions are about *extending the core system integration activity* from individual offers, such as design and project management, to embrace complete turnkey solutions (ISS project team, 2000). Solutions often *utilise the power of information technology* to provide greater functionality and performance (Shepherd & Ahmed, 2000) and they are *built upon hard-to-copy capabilities* (Foote *et al*, 2001).

2.4.4.2 Value proposition

Sharma and Molloy (1999) have identified four sources of value creation that can help building a solutions proposition. Firstly, solutions might bring about *improvements in operating performance*; enabling the customer to lower product costs or raise margins or both through improvement in manufacturing, supply chain or administrative functions. Shell Brazil has taken this approach. Traditionally, Shell shipped lubricants formulated to customer specifications. Managing the performance of the machine and the lubricants was the customer's responsibility. However, with its extensive knowledge of lubricants and its R&D capabilities, Shell had a resource that could be exploited. It now uses its expertise to offer a new value proposition based on improving machine performance. This has resulted in improved machine up-time, fewer unscheduled repairs, and lower spending on lubricants. Taking this proposition a step further might also include guaranteeing up-time and taking the maintenance responsibility (Sharma & Molloy, 1999, p. 4).

Secondly, integrated solutions might *increase in asset effectiveness*, where incremental value is added by increasing system-wide return on assets, either through increased utilisation or better prioritisation or reduced asset requirements. For example, Ryder Logistics offer transportation, inventory and facilities management services. Beyond providing basic fleet management, Ryder offers customers an ‘events management programme’, which makes

Ryder the intermediary between a customer and all its suppliers. Ryder monitors manufacturing and delivery transactions agreed to by its customers and makes sure that the schedule never slips. Ryder leverages its expertise and size to achieve scale advantages unavailable to any single customer (Sharma & Molloy, 1999, p. 4; Sharma *et al*, 2002, p. 10).

Thirdly, integrated solutions can also act as *enablers of market expansion*, which involves the creation of incremental market opportunities, either through increased penetration of existing markets or development of new ones. Procter & Gamble used its knowledge of customer needs and behaviours to increase its share of the fast-moving consumer goods market (Sharma & Molloy, 1999, p. 5), and telecom companies are extending their markets by hosting e-commerce services for traditional retailers (Cornet *et al*, 2000, p. 2).

Fourthly and finally, solutions might *mitigate risk*, like the solution provider taking on price and volume risks. For example, utilities offer ‘uninterruptable’ power supply options in order to guarantee against weather driven volume shifts; network management companies such as AT&T offer guarantees of continuous uptime (Sharma & Molloy, 1999, p. 7). Application service providers (ASPs), such as Exodus, allow customers to outsource data storage and application services, this way reducing customers’ risk of technical obsolescence by not having to invest in infrastructure (Cornet *et al*, 2000, p. 2). It has to be noted that assuming risks normally borne by the customer is a big leap for a product organisation which generally seeks to minimise risk (Foote *et al*, 2001).

2.4.4.3 Types of solutions

Since there are different sources of value creation and the fact that solutions are by their very nature tailored to satisfy a specific customer’s business need, a lot of different types of solutions do exist. The solution spectrum by Sharma and Molloy (1999, p. 5), shown in Figure 2.8 below, illustrates this range.

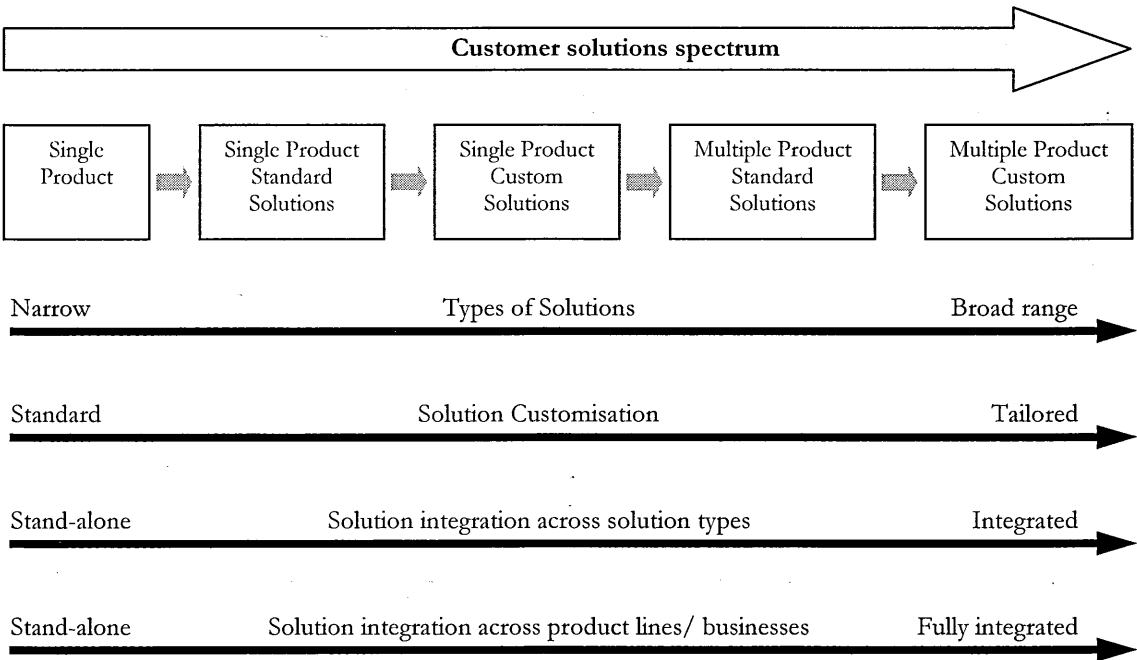


Figure 2.8 The solutions spectrum (Sharma & Molloy, 1999, p. 5).

Davies and Brady (2000) discuss *turnkey solutions*, where suppliers take on responsibility for activities previously undertaken in-house by their customers. Ericsson, for example, moved from a mobile communications manufacturer and systems integrator to a provider of turnkey solutions, offering a single point of contact for network planning, cell planning, site construction, system integration, project management, technology upgrades and after-sales support (Davies & Brady, 2000). They also discuss *outsourcing solutions*, involving the transfer of responsibilities for various of the customer's in-house functions and – in some cases – the transfer of the customer's physical assets and staff back towards their suppliers. For example, Cable and Wireless Global Markets moved into the provision of full outsourcing solutions, providing multinational customers with global telecommunications managed from a single source (Davies & Brady, 2000)

2.4.5 SOLUTION PROVIDER

In this sub-section the capabilities a solution provider needs to have are examined, as well as the desired organisational structure for offering integrated solutions. As has been mentioned at the start of Section 2.4, the integrated solutions literature focuses by and large on the shift from being a product-based company towards becoming a solution provider. It is impossible to disentangle information on capabilities and organisational structure from information on the different change processes that evidently need to occur.

2.4.5.1 Capabilities of solution providers

It is clear that providing solutions is distinct from the traditional categories of manufacturing and services, and requires a different set of capabilities (Davies, 2001). It entails refocusing capabilities from the product to the customer (Sharma & Molloy, 1999, p. 11). The competence profile of the solutions-focused company sees a progressive move away from a strong technical competence to one which is more balanced with integration-, and market- and business knowledge, competencies (Shepherd & Ahmed, 2000).

It is essential for solution providers to *understand clients' needs*, or 'cultivate an ability to listen' (ISS project team, 2000) and become far more intimate with their customers (Brown, 2000). This enables solution providers to quickly and accurately identify changing customer needs, so the solution provider can work together with the customer to define problems for which solutions are required (Shepherd & Ahmed, 2000). A solution provider needs to have the ability to see the problem from the customer's perspective (Davies, 2001); look at the value chain through the customer's eyes, examining all the activities the customer performs in using and maintaining a product throughout its lifecycle, from sale to disposal (Wise & Baumgartner, 1999). It becomes imperative to understand the customer's operating economics (Foote *et al*, 2000). All this requires unfamiliar levels of trust between supplier and customer (Sharma & Molloy, 1999, p. 1).

A solution provider also needs *business consultancy competence* (e.g. Sharma & Molloy, 1999). This allows the better identification of customer business problems and for an effective solution to be defined (Shepherd & Ahmed, 2000). They are particularly important at the front-end and pre-bid and bidding phases of the lifecycle, where a solution provider can advise customers on how to plan, design, build, finance, maintain and operate solutions (Davies, 2001).

A company's *system integration competency* need to be further developed. Delivering an effective solution demands expertise not only in technical integration of components, but also in an ability to identify valuable, process and organisational integration opportunities (Shepherd & Ahmed, 2000). The primary focus of systems integration is to ensure that components and subsystems are conceived and developed as integrated packages to meet an overall system design and to work together to the desired outcome. To achieve this, systems integrators perform a range of activities: technology development, design, project management, construction, assembly or integration of components, maintaining relationships with customers, and managing internal or external suppliers of specialised components (Davies, 2001).

Solution providers also need *operational service capabilities*, to maintain, finance, renovate and operate systems through their lifecycle (Davies, 2001). They have to develop service development and service delivery skills with which they identify and define service requirements, design services, establish credibility in the delivery of services, and keep up with competitor's service offers (ISS project team, 2000). A provider also needs *financing capabilities*, in order to provide a customer with help in purchasing new capital-intensive systems and in managing a customer's installed base of capital assets (Davies, 2001).

Davies and Brady (2000) have identified *functional capabilities*, required to improve a firm's R&D, product design, production, distribution, purchasing, finance and general management; *strategic capabilities*, enabling the company to move into growing markets more quickly than competitors; and *project capabilities*, like bidding, project design, implementation and de-commissioning. They also need *lifecycle management skills*:

"They will manage the life cycle of their output, rather than 'throwing it over the wall' to someone else." (Womack & Fitzpatrick, 2000, p. 53)

Other capabilities that are required include *application development competency*, which allows for an effective solution to be developed; the more traditional *technical competency* which encompasses the knowledge, experience and portfolios around hardware, software and networking products; and *market/ business knowledge*, which enables a company to bring relevant and complete information to bear around an industry, technology and customer (Shepherd & Ahmed, 2000). A solution provider also needs to acknowledge the importance of *soft skills*, like agility, flexibility, adaptability, decisiveness and risk taking (ISS project team, 2000).

According to Cornet *et al* (2000, p.4 – 9) there is an emerging set of core capabilities that every company needs to develop to successfully avoid the pitfalls and reap the considerable rewards of solutions. The first core capability is *value identification*. How does a company pick the right customers and opportunities? Value identification is concerned with the ability to identify and target the most appropriate customers for initial development and next-stage rolling is critical. The second capability is *value creation*. How does a company develop the best solution and deliver value? The key to value creation is working with the customer to integrate and bundle a mix of tailored products, services, systems, and commercial terms in such a way that the whole exceeds the sum of its parts. Finally, the third capability is *value capture*. How does a company make money? Solutions are a long-term endeavour. In assessing their value, companies cannot focus on individual transactions, but must instead evaluate their 'life-time value'.

In moving forward, firms need to decide how best to develop these capabilities. There are basically four options open to them, as they could develop the capabilities: in-house; through joint ventures with partners with established capabilities; through acquisitions of firms with specialised expertise; or by outsourcing, an option only possible for some of the less 'core' capabilities (Davies, 2001). It is important to mention two aspects of the capability building process. Firstly, there are important interactions among the different levels of an organisation – strategic, project, and functional – as the firm develops the new capabilities and secondly, the organisational learning process is dynamic and path dependent (Davies & Brady, 2000).

2.4.5.2 Organisational structure of solution providers

Solution providers need to have a different structure to product-based companies, since,

“... product organizations are grooved for products, an alignment usually formalized in a product-based business unit structure. These units have their own business plans, resources, channels, and customer relationships; status and power bases are built on the units and their products.” (Foote *et al*, 2001, p. 89)

A company that offers integrated solutions needs to be able to *manage the fluid organisational boundaries* that can arise when solution providers are taking on many functions previously undertaken by their customers (Davies, 2001, p. 24). A more organic, flexible and informal style of organisation is needed to accommodate the novelty, diversity, and scale of the projects they undertake (Davies & Brady, 2000, p.949). There is likely to be a *high degree of interdependence and accountability across units* (Foote *et al*, 2001); expanding and intensifying the way sales interacts with marketing, product development, engineering, manufacturing, and other critical functions within the organisation (Bennett *et al*, 2001, p. 4).

The organisation set up for offering integrated solutions needs to provide *space for experimentation* (Davies & Brady, 2000). The new solutions business can either be set up as a separate business or embedded in the existing organisation (Cornet *et al*, 2000). It is also important to provide useful *communication across functions* within the organisation, keeping everyone up to date with the changes and the need for change (Shepherd & Ahmed, 2000).

Foote *et al* (2001) discuss how a company should (re-)organise for offering solutions. The company should *form strong front-end solutions units*, which have neither product responsibilities nor product loyalties. They are staffed with a broader range of talent than is normal in product sales and marketing organizations and these units are amorphous; they configure and reconfigure their teams according to the project and its various stages. The solution provider should also *refocus product business units as "back-end" supporters of solutions*. They serve as internal supplier to solutions units and have to standardize product lines to be solutions-ready. The product business units respond with flexibility and openness to demands of front end. Finally, the company should *develop "top management strong centres"*; leading the drive for solutions and support lateral interaction between front- and back-end units. They manage common account planning process and common performance-assessment systems, and these centres include leaders from each unit and promote the cultivation of rich interpersonal networks.

2.4.5.3 Relationships

Solutions are built on relationships, not transactions (Sharma & Molloy, 1999). Solution providers thus need to *link up and share information with new parties* – downstream with clients and upstream with suppliers (ISS project team, 2000; Foote *et al*, 2001). It is important to *cultivate close customer relations* resulting in customer allegiance:

“The goal is not necessarily to gain the largest share of customers but to gain the strongest relationships with the most profitable customers. By earning their loyalty, a manufacturer can become their preferred supplier of services through the product life span.” (Wise & Baumgartner, 1999, p. 136)

It is necessary that effective and enduring relationships with customers are established in order to build a strong knowledge of their business and to quickly and accurately identify changing customer needs (Shepherd & Ahmed, 2000).

Besides building relationships with clients, it is deemed important to *form alliances with other firms* for sourcing products and services for a solution (e.g. Foote *et al*, 2001). A solution provider might need to establish key partnership with technology and service providers to construct an effective solutions-based portfolio (Shepherd & Ahmed, 2000). Many relationships rely on service level agreements (SLAs). They are drawn up at the contractual stage: SLAs ensure that the risks and responsibilities and managing a system during its operating life are transferred from customer to supplier and that clear reward structures are attached to system performance. They provide guidelines on how to monitor the ongoing relationship (Davies, 2001).

The best *customers for solutions might be new ones*, instead of existing customers for products. They may be upstart companies that look to others to manage non-core pieces of their business, have no established loyalties and are open to productive partnerships (Foote *et al*, 2001, p. 88). When looking at a company’s existing customer base, candidates for working with solutions should be customers with whom there is already a strong relationship, customers under pressure to improve market performance and generate more value, customers most likely to yield higher margin solutions in the short term, and customers likely to generate reusable modules or reusable commercial constructs that can be leveraged for future solutions offerings (Cornet *et al*, 2000, p. 5).

2.4.6 SHIFTING FROM PRODUCTS TO SOLUTIONS

As has become clear from the above, when a company wants to make the shift from being a product-oriented company towards becoming a solution provider, there are numerous aspects of the company and its offerings that need to change. This is summarised in Table 2.7 on the next page, which shows the differences between the product focus and the solution focus.

First of all, it has been made clear that *broader skills and capabilities are required*. Companies need to build and extend their capabilities to provide integrated solutions (ISS project team, 2000), and they must do this at less cost than it would take for their customers to maintain or acquire them (Sharma & Molloy, 1999, p. 1). Secondly, companies need to *redefine their role in the value chain*. They need to expand their definition of the value chain (Wise & Baumgartner, 1999) and find new positions in the value chain (Davies, 2001).

'Product' focused		'Solution' focused	
Product focused Filling white space Doing it alone Product economics	Strategic orientation	Customer focused Dominating markets that matter Relying on alliances and parthnerships Customer economics	
Known as outsider selling in Product push Relationship is built on personal trust Individual to individual	Customer orientation	Working as an insider Driving for customer pull Relationship built on team competency and trust Team to team	
Centrally driven Market/ top down	Innovation orientation	Innovation and application at the front line with the customer Replicated and applied market wide	
"One size fits all" process Functional process Intuitive decision making Functional and fragmented IT	Capability orientation	Tailored to customer End to end in sync with customer – cross functional, cross product and cross business processes Analytical capability at front line Integrated view and accessibility	
Rigid organisational boundaries Functional owners Bosses Position authority Individual, transactional measurement	Management orientation	Value-added networks Strategists, architects, consultative service providers Coaches and team builders, Recognition based on value-added Team performance measurement	

Table 2.7 Product versus solution orientation (Sharma & Molloy, 1999, p. 3)

Redefining the value chain also means redefining the way profit is measured; product margins can no longer be the primary yardstick (Wise & Baumgartner, 1999; Shepherd & Ahmed, 2000). The same goes for other performance measures; old metrics like market share, cycle time and quality levels, tend to focus solely on the product. A company thus needs to *redefine ways of measuring performance* (Wise & Baumgartner, 1999). They should, for example, measure the effectiveness of a solution (Shepherd & Ahmed, 2000) or a customer's improved business performance rather than a specific product's performance to specifications (Foote *et al*, 2001). Companies may find it necessary to concentrate on the lifetime value of customers, not just transaction profitability (Sharma *et al*, 2002, p. 4).

When a company wants to offer solutions it has to *make changes in organisational structure and business processes* (e.g. ISS project team, 2000). New business structures and cultures need to be defined around the provision of solutions (Davies, 2001). New processes and tools are often required to enable open communication with customers and to develop the more complex and insightful modelling necessary to develop economic solutions (Cornet *et al*, 2000, p. 11). When a company wants to shift towards providing solutions it must also be willing to *take risks* and be prepared to make mistakes and not be afraid to acknowledge them (ISS project team, 2000).

2.4.7 SUMMARY

The findings of this section are summarised in Table 2.8 on the next page.

Forces	Integrated Solution	Solution provider
<u>Trends</u> <ul style="list-style-type: none">- reduced profitability of manufacturing products- stagnant product demand and expanded installed base- commoditisation of products- rapidly changing market requirements- outsourcing- new distribution channels- use of information technology <u>Drivers</u> <ul style="list-style-type: none">- customer demand- introduce significant barriers against competitive attack- increased and continuous revenue- opening the door for securing future orders <u>Barriers</u> <ul style="list-style-type: none">- no accepted business model exists yet- unlikely to possess all the skills required to provide integrated solutions- struggle to integrate the full range of products and technical capabilities into customer solutions- strengths of a product-focused company can hinder effort to become a solution provider- lack of trust	<u>Characteristics</u> <ul style="list-style-type: none">- create new value- focus on business need of customer- focus on the desired outcome for a customer- leveraging new competencies- extending the core systems integration activity- utilise the power of information technology- built upon hard-to-copy capabilities <u>Value proposition</u> <ul style="list-style-type: none">- improvements in operating performance- increase in asset effectiveness- enabling market expansion- mitigating risk <u>Types</u> <ul style="list-style-type: none">- outsourcing solutions- turnkey solutions	<u>Capabilities</u> <ul style="list-style-type: none">- understand clients' needs- business consultancy capabilities- systems integration capabilities- operating services capabilities- financing capabilities- functional -, strategic -, and project capabilities- lifecycle management skills- application development competency- soft skills- value identification, - creation and - capture <u>Organisational structure</u> <ul style="list-style-type: none">- manage the fluid organisational boundaries- high degree of interdependence and accountability across units- provide space for experimentation- communication across units- form front-end solutions units- product-business units as back-end supporters- top management strong centre to mediate <u>Relationships</u> <ul style="list-style-type: none">- link up and share information with new parties- cultivate close customer relations- best customers for solutions might be new ones- form alliances with other firms <u>Change</u> <ul style="list-style-type: none">- broader skills and capabilities required- redefine role in the value chain- redefine ways of measuring performance- make changes in organisational structure and business processes

Table 2.8 Summary of literature findings on integrated solutions

2.5 GENERATING A RESEARCH PROPOSITION

In the preceding literature review, it has been made clear that industry, and indeed humanity, need to drastically change their production and consumption systems if we are to live in line 'with the Earth's carrying capacity'. In this light, eco-efficient services have been discussed. This concept has been ascribed with the potential to unlink value creation from environmental impacts, although no conclusive evidence to this end exists as yet. It has also been shown that researchers in the field of eco-efficient services have only just started to acknowledge that more skills and capabilities are needed and that the development of these services covers a wider range of disciplines than incremental strategies, such as ecodesign. It has become clear from literature that researchers would like eco-efficient services to be taken up by industry, but to date they struggle to find the much-needed demonstration projects and pilots to generate knowledge of and experience with eco-efficient services.

Simultaneously, there is the concept of integrated solutions that has been successfully taken up by industry in recent years. With integrated solutions, like with eco-efficient services (and especially result services), satisfying a customer's need is key, rather than selling products. On first impression, it seems that eco-efficient services and integrated solutions overlap significantly. The difference is that the eco-efficient services concept has been developed in the field of environmental management and the concept of integrated solutions stems from the field of business strategy. On the basis of the progress that has been made with changing production and consumption systems as yet, it is assumed that any product, service, or solution that is offered in the foreseeable future, whether they are eco-efficient or not, needs to be profitable from an economic point of view. Hence, it was suggested that integrated solutions, or at least knowledge of integrated solutions, might be a link between ecological thinking and business success. This has led to the following research proposition:

How can knowledge of the concept of integrated solutions support the development of eco-efficient services?

It was found from substantive literatures that integrated solutions mainly crop up in the business-to-business (B2B) markets within large multinational companies (e.g. Davies, 2001; Sharma & Molloy, 1999). Therefore, this study focuses on large multinational companies operating in B2B markets. Furthermore, the limitations of eco-efficiency in relation to sustainable development have been considered. Nonetheless, for the purpose of this study the concept of eco-efficiency is chosen, because of ease of communication and its usefulness as a 'transitional strategy'.

In summary, this study focuses on the concept of integrated solutions in relation to eco-efficient services, and multinational companies operating in B2B markets. This way the context and process under investigation are well defined.

The following chapter details the research methodology used in this study to address the research question generated above and subsequent research activities.

3 RESEARCH METHODOLOGY

The aim of this chapter is to present the research design considerations, in order to give insight into the research process that was followed and to demonstrate that appropriate methods were selected and used to tackle the research problem central to this investigation. Altogether, this chapter helps to create an understanding of this research.

3.1 INTRODUCTION

This chapter examines the methodological aspects of the research process. This treatise is crucial in order to create an understanding for this investigation and its specifics, as research can have different purposes, like explaining, exploring or describing a phenomenon (Robson, 2002). These purposes have a range of implications for the design of the research, the ways in which it is presented, and the ways it is intended to be understood (Hart, 1998, pp. 44 – 45). Figure 3.1 below, based upon a structure presented by Robson (1993), shows the more or less hierarchical interaction between the various research design activities. This means decisions made in the research design process, progress down so as to result in an appropriate design for a certain research problem.

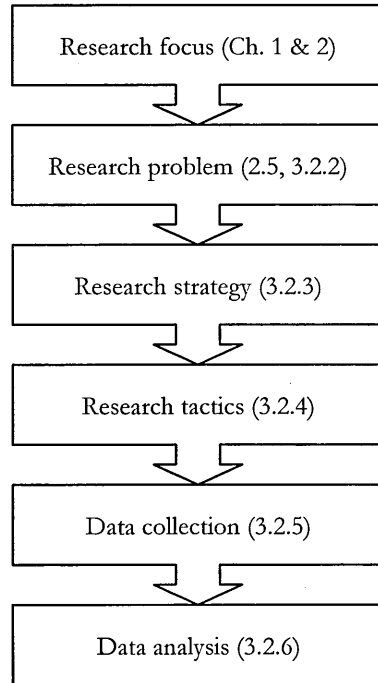


Figure 3.1 The research design process (adopted from Robson (1993)) (and the sections in which the corresponding parts can be found)

In the two preceding chapters the scene for this investigation has been set, i.e. the research focus has been established. As has been made clear, the research is focused on integrated solutions in relation to eco-efficient services. The literature review presented in the previous chapter has not only tried to put forward a state-of-the-art picture of these research fields. Furthermore, from the findings of this literature review, the research problem that is central to this study has been formulated. Based on this problem, the purpose of the investigation can be established. This means that it can be ascertained whether this investigation aims to explore, describe, or explain a phenomenon. Consecutively, this purpose determines the most appropriate research strategy, i.e. whether it is most appropriate to use a survey, case study or experiment approach. After this, the specific research methods, or so-called research tactics, can be chosen. This allows the collection of data, after which the collected data can be analysed.

This chapter aims to present the different research design challenges which have been met along the research process. The first part of this chapter follows the process discussed above and motivates the choice of strategy and methods. Section 3.3 describes the methods used for each stage in this research process. This chapter ends with conclusions on the research methodology that has been used in this study.

3.2 THE RESEARCH DESIGN PROCESS

As mentioned above, the first two steps of the research design process – establishing the research focus and the research problem – have been dealt with in the previous chapters. This section follows the research design process ‘downwards’. First, it starts with establishing the research paradigm in which the study is conducted. Then the purpose of the study is established. From that the most appropriate research strategy is derived, after which research tactics are discussed. Then data collection is considered, and finally issues related to data analysis are stated.

3.2.1 THE RESEARCH PARADIGM

Before further examining the research design process, it is important to determine what intellectual tradition is adhered to; since this determines what reality is (ontology) and the ways of establishing what can be accepted as real (epistemology) (Hart, 1998). There is a long-standing debate in the social sciences about the most appropriate philosophical position from which methods should be derived. It has been believed for a long time that there is a continuum with on-the-one-end, the natural-science based ‘positivism’ or post-positivism, and on the other the interpretative ‘phenomenology’, hermeneutics or relativism (Easterby-Smith *et al*, 1991; Gummesson, 1991; Miles & Huberman, 1994; Robson, 2002). The oldest paradigm is positivism. Its key idea is that the social world exists externally, and that its properties should be examined through objective methods rather than being inferred through sensation, reflection, and intuition (Easterby-Smith *et al*, 1991). The second paradigm arose during the last half century, largely in reaction to the application of positivism. It stems from the view that the world and reality are not objective and exterior, but that they are socially constructed and given meaning by people (Easterby-Smith *et al*, 1991). Both approaches are extremes and it is rare to find a

researcher that ascribes to all aspects of one particular view. Although there has been a trend away from positivism towards phenomenology over the last few years, there are many researchers, especially in the management field, who adopt a pragmatic view by deliberately combining methods drawn from both traditions (Easterby-Smith *et al*, 1991).

In recent times, ‘realism’ has been proposed as a third way, acknowledging that positivism has been discredited but avoiding the divorce from science implied by a thoroughgoing relativist approach (Robson, 2002, p. 42). Realism has a long tradition in the philosophy of science, including social science (Manicas, 1987 in Robson, 2002, p. 29). Realism holds that social phenomena exist not only in the mind but also in the objective world and that some lawful and reasonably stable relationships are to be found among them. The lawfulness comes from the regularities and sequences that link together phenomena (Miles & Huberman, 1994, p. 4). The characteristics of realism are highlighted in Table 3.1 below.

A realistic view of science
<ul style="list-style-type: none">▪ There is no unquestionable foundation for science, no ‘facts’ that are beyond dispute. Knowledge is a social and historical product. Facts are theory-laden.▪ The task of science is to invent theories to explain the real world, and to test these theories by rational criteria.▪ Explanation is concerned with how mechanisms produce events. The guiding metaphors are of structures and mechanisms in reality rather than phenomena and events.▪ A law is the characteristic pattern of activity or tendency of a mechanism. Laws are statements about the things that are really happening, the ongoing ways of acting of independently existing things, which may not be expressed at the level of events.▪ The real world is not only very complex but also stratified into different layers. Social reality incorporates individual, group and institutional, and societal levels.▪ The conception of causation is one in which entities act as a function of their basic structure.▪ Explanation is showing how some event has occurred in a particular case. Events are to be explained even when they cannot be predicted.

Table 3.1 *A realistic view of science* (Robson, 2002, p. 32)

Based on the above, realism is deemed to be an appropriate paradigm for this study, especially since it recognises that in social science it is essentially impossible to work in a closed system. As the business or whatever forms the focus of the research cannot be hermetically sealed from external influences, social scientists have to accept that they are dealing with tendencies and probabilities (Robson, 2002, p. 40). People, information, and all other aspects of the situation are likely to change in ways that may or may not have anything to do with the focus of the study.

☞ The study uses realism as the model of scientific explanation

3.2.2 RESEARCH PROBLEM

The following research proposition was formulated in Section 2.5 to guide this study:

How can knowledge of the concept of integrated solutions support the development of eco-efficient services?

This research proposition is made up of two elements. The first is the quandary, which forms the starting point for this research, namely the vast amount of new skills and

capabilities required by the eco-efficient services research field to develop and market eco-efficient services. The second part is possible aid to this quandary, namely the concept of integrated solutions, which bears some resemblance with eco-efficient services, which is successful in industry. From this, it can be reckoned that knowledge of the concept of integrated solutions might be used to support the development of eco-efficient services. The aim of this research is to find out to what extent the concept of integrated solutions might actually be a help.

It can be stated, implicitly, that the starting point of this research is the limited take up of the concept of eco-efficient services by industry. One could deduce, that the concept of eco-efficient services might not be an appropriate concept to be transferred into industry. Thus, solely focusing on the concept of eco-efficient services, might be considered myopic, depreciating this study. Instead, it is deemed more useful to focus on the distinctive objective of the concept of eco-efficient services, which is to bring about (service) offerings with increased eco-efficiency. The concept of integrated solutions, as a successful business concept, might provide opportunities to satisfy needs with improved eco-efficiency. Therefore, a more general research problem can be added:

How can knowledge of the concept of integrated solutions support the development of offers with increased eco-efficiency?

3.2.2.1 Research questions

The research problem has guided the development of a number of research questions, which are answered through conducting the related research project. The list of research questions is shown in Table 3.2 below.

No.	Research question	Discussed in chapter/ section:
RQ1a.	What is an integrated solution?	2.4; 4; 5; 7.2.1
RQ1b.	What is an eco-efficient service?	2.3
RQ1c.	What is eco-efficiency?	2.2.2
RQ2a.	To what degree are integrated solutions and eco-efficient services alike?	7.2.3
RQ2b.	What are the similarities between integrated solutions and eco-efficient services?	7.2.3.1
RQ2c.	What are the differences between integrated solutions and eco-efficient services?	7.2.3.2
RQ3.	What are the characteristics of integrated solutions that might affect the eco-efficiency of the solution?	5.3; 6.4
RQ4a.	How might the characteristics that have been identified in RQ3 be used to support the development of eco-efficient services?	7.3.1
RQ4b.	How might the characteristics that have been identified in RQ3 be used to support the development of more eco-efficient solutions?	7.3.2

Table 3.2 The research questions central to this study

The relationship between the research questions and the three concepts subject in this study is shown in Figure 3.2 on the next page.

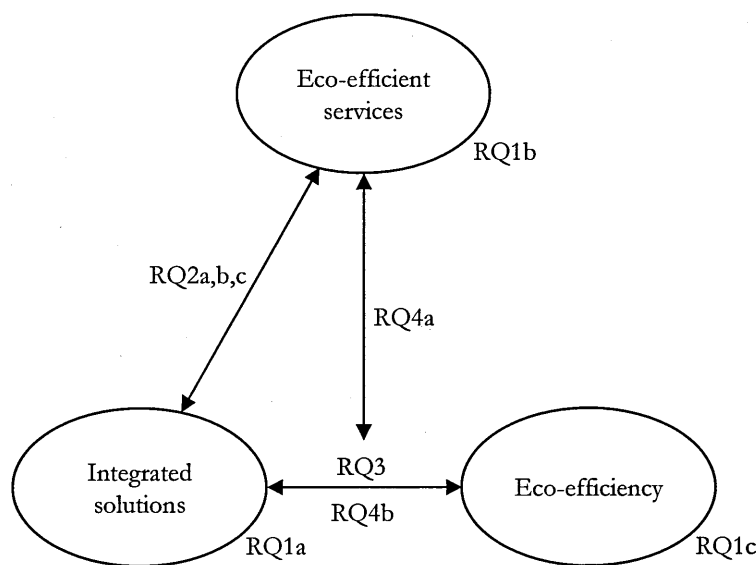


Figure 3.2 Relationship between the four research questions

3.2.2.2 Research purpose

A research project can be classified in terms of its purpose. It can either be exploratory, descriptive or explanatory, or a combination of these. The characteristics of these purposes are described in Table 3.3 below.

Research purpose	Description
Exploratory	<ul style="list-style-type: none">▪ Exploratory research seeks to find out what is happening, seeks new insights, asks questions, assesses phenomena in a new light, provides a better understanding, or provides illumination on a process or a problem.▪ Research questions focus on ‘how’, ‘what’, ‘when’ and ‘where’. Studies tend to be small scale and often informal in structure and are usually, but not necessarily, qualitative.
Descriptive	<ul style="list-style-type: none">▪ Descriptive research seeks to portray an accurate profile of persons, situations or events; requires extensive previous knowledge of the situation to be researched so that the appropriate aspects on which to gather information are known.▪ Research questions focus on the ‘how’ and ‘what’. Studies tend to be small and may be quantitative, and/or qualitative.
Explanatory	<ul style="list-style-type: none">▪ Explanatory research seeks to explain the cause or non-occurrence of a phenomenon, usually in the form of causal relationships, or to suggest reasons for events and make recommendations for change.▪ Research questions focus on the ‘why’ and aim to uncover laws and regularities of a universal nature. Studies can be large or small scale and are often associated with quantitative data.

Table 3.3 Different research purposes (after Robson, 2002, pp. 59 – 60; Hart, 1998, p. 47)

As has been made clear before, the main focus of this research study is the concept of integrated solutions. This is a novel concept and has been mainly studied from a business strategy perspective (see Section 2.4.1). It has hardly been the subject of academic research to date (Davies, 2001) and relatively little is known about the concept. Thus, virtually any study in this domain is exploratory in nature.

In addition, the specific purpose of this study is to seek new insights in the contribution of integrated solutions towards the development of more eco-efficient offerings. It assesses the concept of integrated solutions in a new light, as it is being viewed from an eco-efficiency point of view. Therefore, given the novelty, the maturity of research and the new avenue of enquiry, the purpose of this study is exploratory.

☞ The purpose of this study is exploratory

3.2.3 RESEARCH STRATEGY

From the research purpose and the research problem, the most appropriate strategy can be selected. The research strategy is the general approach taken in an enquiry, i.e. the broad orientation taken in addressing research questions. Robson (1993) distinguishes three traditional research strategies: experiments, surveys, and case studies. The characteristics of these research strategies are given in Table 3.4 below.

Research strategy	Description
Experiments	<ul style="list-style-type: none">▪ Measuring the effects of manipulating one variable on another variable.▪ Typical features: selection of samples of individuals from know populations; allocation of samples to different experimental conditions; introduction of planned change on one or more variables; measurement on small number of variables; control of other variables; usually involves hypothesis testing.▪ Focuses on 'how' and 'why' questions; requires control over events; and focuses on current events.
Survey	<ul style="list-style-type: none">▪ Collection of information in standardised form from groups of people.▪ Typical features: selection of samples of individuals from known populations; collection of relatively small amount of data in standardised form from each individual; usually employs questionnaire or structured interview.▪ Focuses on 'who', 'what', 'where', 'how many' and 'how much' questions; does not require control over events; and focuses on current events.
Case study	<ul style="list-style-type: none">▪ Development of detailed, intensive knowledge about a single case or a small number of related cases.▪ Typical features: selection of a single case (or a small number of related cases) of a situation; individual or group of interest or concern; study of the case in its context; collection of information via a range of data collection techniques including observation, interview and documentary analysis.▪ Focuses on 'how' and 'why' questions; does not require control over events; and usually but not necessarily focuses on current events.

Table 3.4 Characteristics of research strategies (after Robson, 1993, p. 40; Yin, 1994)

Although it has been acknowledged that any research strategy can be used for any or all of the research purposes, Robson (1993) states that, in general, case studies are appropriate for exploratory research, since one of the great strengths of the case study as a research strategy is its flexibility. Further guidance is provided by Yin (1994) who puts forward three criteria that might aid the strategy selection process: the types of research question; the extent to which the investigator requires control over events; and the degree of focus on contemporary as opposed to historical events. Next, these three criteria are considered.

It is commonly understood that the type of research question determines to a large extent the most appropriate strategy (Robson, 1993; Yin, 1994). Several types of research questions can be identified, like 'what', 'why' and 'how' questions (Yin, 1994). As stated in Table 3.4, experiments are suitable for 'how' and 'why' questions; surveys for 'who', 'what', 'where' and 'how much' questions; and the case study approach can be used for 'how' and 'why' questions. For this study the research problem, or overarching research question, is of the 'how'-type, which leaves the experiment and case study as appropriate strategies. The second criterion used by Yin is the required control over events. With an experiment as research strategy, control over events is required, as it measures the effects of manipulating one variable over another. This is not necessary for the case study approach, where the aim is to develop intensive knowledge about a case. For this study, control over events is not necessary. When looking at the contribution of integrated solutions towards the development of more eco-efficient offerings, it is important to first identify the different characteristics of integrated solutions that might bring about increased efficiency. To this end, using an experiment is not the most appropriate approach. This leaves the case study as the most appropriate approach for this study. Finally, from the third criterion mentioned by Yin – the focus on contemporary events – it can be stated, that this study focuses on the current contribution of integrated solutions towards more eco-efficient offerings. The study therefore has a contemporary focus. This does not preclude any of the strategies identified in Table 3.4.

Using the three criteria suggested by Yin, the case study is deemed to be the most appropriate research strategy. The next step is to determine whether a single- or a multiple-case design is the most appropriate strategy. A single case design is justifiable where the case represents a critical test of existing theory, where the case is a rare or unique event, or where the case serves a revelatory purpose (Yin, 1994, p. 44). Since this study is concerned with exploring a phenomenon that occurs in a wide range of industries, none of the aforementioned reasons for opting for a single-case study strategy seem to apply. Instead, a broad understanding of the concept of integrated solutions in its contribution towards eco-efficiency is sought. Therefore, a multiple-case study is deemed to be more appropriate. According to literature, when utilising a multiple-case study design, every case should serve a specific purpose within the overall scope of the enquiry. Each case must be carefully selected so that it either predicts similar results (a literal replication) or produces contrasting results but for predictable reasons (a theoretical replication) (Yin, 1994, p. 46). It is important to note that the replication desired when using multiple-case studies has nothing to do with the sampling logic used in experiments – where the sample is thought to represent a larger pool of subjects. The number of cases is therefore a matter of discretionary, judgmental choice (Yin, 1994, p. 48).

☞ Multiple-case study is chosen as the research strategy for this study

3.2.3.1 Multiple-case study

A case study is a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence (Robson, 2002, p. 178). Yin (1994) states that the case study method is suitable for covering contextual conditions and, as mentioned above, it has a flexible design. This means that, compared to fixed designs like experiments and surveys, much less pre-specification takes place and the design evolves, develops and unfolds as the research

proceeds. The case study's unique strength is its ability to deal with a full variety of evidence – documents, interviews, and observations – beyond what might be available in other research strategies.

It is important to note that having a case study protocol is essential if a multiple-case design is used. The protocol is a major tactic in increasing the reliability of case study research and is intended to guide the investigator in carrying out the case study (Yin, 1994, p. 63). The case study approach also draws more heavily on the skills and capabilities of the researcher, compared with other research strategies (Yin, 1994). The researcher should be able to ask good questions and be a good listener. The case study investigator should be adaptive and flexible and not be biased by preconceived notions, including those derived from theory.

3.2.3.2 Prejudices against the case study strategy

Perhaps the greatest concern has been over the lack of rigour of case study research (Yin, 1994). A researcher can be sloppy and allow equivocal evidence or biased views to influence the direction of findings and conclusions. These problems are not different to any other research strategy, but in case study research they may have been more frequently encountered and less frequently overcome. Every case study investigator must work hard to report all evidence fairly. A second common concern about case studies is that they provide little basis for scientific generalisation (Yin, 1994). The answer is that case studies, like experiments, are generalisable to theoretical propositions and not to populations or universes. The investigator's goal is to expand and generalise theories (analytic generalisation) and not to enumerate frequencies (statistical generalisation). A third concern is that case studies take too long, and that they result in massive unreadable documents (Yin, 1994). This is based on confusion with techniques like participant observation. Case studies are a form of enquiry that does not depend solely on ethnographic or participant-observer data. And there are different ways to report case studies, including ones in which the traditional, lengthy narrative can be avoided altogether.

3.2.4 RESEARCH TACTICS

The choice for a multiple-case study as research strategy implies certain data collection techniques, or so-called research tactics. Robson (1993) states observation, interviews and the use of documents and records as possible data collection techniques when applying the case study strategy. Yin (1994) also includes archival records and physical artefacts. The strengths and weaknesses of these different methods are shown in Table 3.5 below.

Since this research problem mainly deals with intangible concepts, like integrated solutions and eco-efficiency, different observation techniques and the use of physical artefacts are not suitable as (primary) data collection techniques. Information on these concepts is likely to be either written down in the form of documents or presentations, or in the heads of the company managers. To retrieve this information, documentation and interviews can be used respectively. Documentation can be used to analyse the contents in relation to different concepts under investigations and interviews are seen as a flexible way to gather data and can be used to find out what people think (Robson, 1993). Finally, since the aim is not to reconstruct a certain event, the use of archival records can be neglected as a data collection technique. Next, the two main data collection techniques – the use of documentation and documentation – are discussed.

Source of evidence	Strengths	Weaknesses
Documentation	<ul style="list-style-type: none"> Stable – can be reviewed repeatedly Unobtrusive – not created as a result of the case study Exact – contains exact names, references, and details of an event Broad coverage – long span of time, many events, and many settings 	<ul style="list-style-type: none"> Retrievability – can be low Biased selectivity, if collection is incomplete Reporting bias – reflects (unknown) bias of author Access – may be deliberately blocked
Archival records	<ul style="list-style-type: none"> [Same as above for documentation] precise and quantitative 	<ul style="list-style-type: none"> [Same as above for documentation] accessibility due to privacy reasons
Interviews	<ul style="list-style-type: none"> targeted – focused directly on case study topic insightful – provides perceived causal inferences 	<ul style="list-style-type: none"> biased due to poorly constructed questions response bias inaccuracies due to poor recall reflexivity – interviewee gives what interviewer wants to hear
Direct observations	<ul style="list-style-type: none"> Reality – covers events in real time Contextual – covers context of event 	<ul style="list-style-type: none"> Time-consuming Selectivity – unless broad coverage Reflexivity – event may proceed differently because it is being observed Cost – hours needed by human observers
Participant observations	<ul style="list-style-type: none"> [Same as above for direct observations] insightful into interpersonal behaviour and motives 	<ul style="list-style-type: none"> [Same as above for direct observations] bias due to investigator's manipulation of events
Physical artefacts	<ul style="list-style-type: none"> insightful into cultural features insightful into technical operations 	<ul style="list-style-type: none"> Selectivity Availability

Table 3.5 Six sources of evidence: strengths and weaknesses (after Yin, 1994, p. 80)

3.2.4.1 Documentation

This type of information can take many forms, like proposals, presentations, reports, and Internet website information. Using documents is an unobtrusive measure, which is non-reactive, in that the document is not affected by the fact that the researcher is using it (Robson, 2002, p. 349). According to Yin (1994) the most important use of documents is to corroborate and augment evidence from other sources. If the documentary evidence is contradictory rather than corroboratory, the case study investigator has specific reason to inquire further into the topic. Also, inferences can be made from documents. However, these inferences should only be treated as clues worthy of further investigation rather than as definitive findings, because the inferences could later turn out to be false leads (Yin, 1994, p. 81). A word of caution is needed, since it is important in reviewing any document to understand that it was written for some specific purpose and some specific audience other than those of the case study being done. The researcher should be constantly trying to identify the conditions under which the documentation was written, so he is less likely to be misled by documentary evidence and more likely to be correctly critical in interpreting the contents of such evidence (Yin, 1994, p. 82).

3.2.4.2 Interviews

Interviews are essential sources in case study information (Yin, 1994). They are particularly suitable in finding out what people do within a company or to find out what people feel, think, believe, and use. Interviews are a flexible and adaptable way of finding things out (Robson, 1993). They may take several forms, like open-ended (unstructured), focused (semi-structured), or survey (fully structured) (Robson, 2002; Yin, 1994). In this study the fully structured approach is not suitable given the exploratory purpose of this study; this approach would imply that the researcher already knows all the ‘right’ questions to ask. On the other hand, given the fact that a multiple-case study strategy is chosen, some degree of structure is required, which precludes the unstructured approach. Therefore, in this study the focused or semi-structured approach is chosen.

In a focused interview, a respondent is interviewed for a short period of time. In such cases, the interviews may still be open-ended and assume a conversational manner, but the researcher is more likely to be following a certain set of questions derived from the case study protocol (Yin, 1994). The interviewer has worked a set of questions in advance, but is free to modify their order based upon his or her perception what seems most appropriate in the context of the ‘conversation’. The interviewer can change the way they are worded, give explanations, leave out particular questions which seem inappropriate with a particular interviewee or include additional ones. The semi-structured character allows flexibility in the amount of time and flexibility given to different topics (Robson, 1993).

☞ The main data collection techniques used are focused, or semi-structured, interviews and documentation

3.2.5 DATA COLLECTION

There are two types of data that can be collected, which both call for different collection and analysis techniques: qualitative or quantitative. The differences between the two data types are detailed in Table 3.6 below.

Data type	Description
Qualitative	<ul style="list-style-type: none">▪ Based on meaning expressed through words▪ Results in non-standardised data requiring classification into categories▪ Analysis conducted through the use of conceptualisation
Quantitative	<ul style="list-style-type: none">▪ Based on meaning derived from numbers▪ Collection results in numerical and standardised data▪ Analysis conducted through the use of diagrams and statistics

Table 3.6 Types of data (Saunders et al (1997) in Cook (2002))

As has been detailed in the previous section, focused interviews and documentation have been selected as most appropriate data collection techniques. These techniques are used to explore the concept of integrated solutions and its contribution towards more eco-efficient offerings. A profound understanding of the concept is sought for, appreciating the complexity of the concept. The meaning is therefore not derived from numbers, but expressed through words. The focused interviews and use of documentation result in non-

standardised data, which requires classification in categories. Based on this, it is clear that in this study qualitative data is collected. A quantitative approach to data collection is considered not to provide the understanding required here.

Finally, it is important to note that data collection is inescapably a selective process, that the researcher cannot and does not ‘get it all’ even though he might think he can and is (Miles & Huberman, 1994, pp. 55 – 56).

☞ Qualitative data is collected in this study

3.2.6 DATA ANALYSIS

As mentioned above the data collection techniques used and the type of data collected has implications for the data analysis. Since qualitative data is collected in this exploration, several data analysis techniques can be used, as listed in Table 3.7 below.

Analysis approach	Description
Quasi-statistical approaches	<ul style="list-style-type: none">▪ Use word or phase frequencies and inter-correlations as key methods of determining the relative importance of terms and concepts.▪ Typified by content analysis.
Template approaches	<ul style="list-style-type: none">▪ Key codes are determined either on an <i>a priori</i> basis or from an initial read of the data. These codes then serve as a template for data analysis; the template may be changed as analysis continues. Text segments which are empirical evidence for template categories.▪ Typified by matrix analysis.
Editing approaches	<ul style="list-style-type: none">▪ More interpretive and flexible than the above. No <i>a priori</i> codes. Codes are based on the researcher’s interpretation of the meanings or patterns in the text.▪ Typified by grounded theory approaches.
Immersion approaches	<ul style="list-style-type: none">▪ Least structured and most interpretive, emphasising research insight, intuition and creativity. Methods are fluid and not systematised. Close to literary/ artistic interpretation and connoisseurship.▪ Difficult to reconcile with the scientific approach.

Table 3.7 Different approaches to qualitative analysis (after Robson, 2002, p. 458)

Quasi-statistical approaches are not appropriate for this study for the same reason given in the choice for qualitative data over quantitative data. Template approaches seem to be an appropriate way of dealing with the data collected from different sources; especially since this study is an exploration. The last two approaches, editing- and immersion approaches, are deemed to be too interpretive for this study.

According to Miles and Huberman (1994) analysis consists of three concurrent activities: data reduction, data display, and conclusion drawing. Firstly, during and after the data collection, the researcher has to reduce the amounts of data through the production of summaries, memos, and coding for example. This needs to be done in order to keep the data manageable. Secondly, data display becomes important, since qualitative data is often in the form of text. Means of organising and displaying data are needed, like the use of matrices and charts. This is important during and after data collection, so the researcher

gets a feel for what the data are telling, what justified conclusions can be drawn and what further analysis are called for. Finally, conclusion drawing and verification is about what things mean from the start of data collection, noting patterns and regularities, and positing possible structures and mechanisms.

There are different methods for data reduction and display, like session summary sheets, document sheets, memoing and the development of coding categories. Of these methods the last method is useful when material is unstructured and difficult to deal with (Robson, 2002). A code is a symbol applied to a section of text to classify or categorise it. Codes are typically related to research questions, concepts and themes. They are retrieval and organising devices that allow the researcher to find and then collect together all instances of a particular kind. Coding is deemed to be an apt data reduction method for this study.

Miles and Huberman (1994, pp. 245 – 246) list thirteen different tactics for generating meaning, or drawing conclusions. These tactics include noting patterns, themes and trends; seeing plausibility; and clustering. They are descriptive tactics to help the analyst see “what goes with what”. To start with, it is essential to note patterns, themes and trends in the data. Next, it is important for the researcher to consider plausibility, i.e. to question whether the trends and patterns that have been identified, make sense. Finally, it is important to cluster, or group, events, places, people, processes, etc. together if they appear to have similar patterns or characteristics. These approaches are considered to be appropriate for this study.

☞ A template approach and coding & clustering tactics are used to analyse data

The specifics of these data analysis tactics are described later in the next section.

3.3 THE RESEARCH PROCESS

In the previous section the theoretical research design considerations have been stated. In this section the research process that has been followed is described. The choices for specific research tactics are explained.

3.3.1 LITERATURE REVIEW

The starting point for this exploratory study was the literature review; which has been reported upon in the previous chapter. This review specifically served the following purposes (using the purposes identified by Hart (1998, p. 27)):

- discovering important variables relevant to the topic;
- enhancing and acquiring the subject vocabulary;
- understanding the structure of the subject; and
- placing the research in a context to show familiarity with state-of-the-art developments.

The researcher was familiar with the concepts of eco-efficient services and eco-efficiency, therefore the concept of integrated solutions was the main focus of the literature review. It has been shown in Section 2.4 that ‘integrated solutions’ is a term, which is widely used by companies and it has different meanings to various authors. Consequently, at the start of the study it seemed almost impossible to pin down the concept of integrated solutions. The literature review was used to define the concept of integrated solutions, its characteristics, and its context. During the studying of literature relevant elements relating to integrated solutions that had been found were organised in a separate document. This was done in order to enhance the understanding of the subject. Attributes related to the context of the phenomenon were grouped under headings like ‘trends’, ‘drivers’, and ‘barriers’. Other attributes related directly to integrated solutions were grouped under headings like ‘value proposition’ and ‘characteristics’. Finally, since integrated solutions are offered by companies, attributes were collected dealing with ‘organisational structure’ and ‘capabilities’ for example. All these headings were selected simultaneously with the studying of literature. The attributes from literature, collected under the various headings, were then grouped and given more-encompassing labels, so as to result in a more comprehensible picture of the concept of integrated solutions. These efforts resulted in Table 2.8 (on p. 41) a summary of findings on integrated solutions. The aim of this summary is to present the diversity and richness of attributes related to integrated solutions in an orderly fashion.

Finally from a methodological point of view, it is important to note that the review of relevant literatures took place on an on-going basis. Moreover, some respondents of the Pilot Study, which is described in the next section, also recommended literatures. Since the concept of integrated solutions is principally a business concept, these were literatures outside the ‘traditional’ academic realms, like reports by Booz:Allen & Hamilton (e.g. Sharma & Molloy, 1999) or McKinsey (e.g. Foote *et al*, 2001).

3.3.2 PILOT STUDY

Before being able to address the research problem (“How can knowledge of the concept of integrated solutions support the development of offers with increased eco-efficiency”) it was thought necessary to gain a more detailed understanding of the concept of integrated solutions, than would be possible on the basis of literature alone. To this end a pilot study was devised.

Since integrated solutions are offered across different industries, as illustrated in Section 2.4, it was considered useful to use multiple cases to make up the Pilot Study. Therefore, an Internet search was undertaken to identify several multinational companies within various sectors that offered integrated solutions to their clients. These companies were then approached to gauge their interest in taking part in the Pilot Study. Of the forty-five companies contacted across eight industries, five companies were willing to take part in the Pilot Study. A brief description of these companies can be found in Table 3.8 on the next page. Further details of the companies and their integrated solutions can be found in Appendix A.

Table 3.8 also details the different sources of information that have been used for each company. It shows that the two main sources of information used were ‘semi-structured interviews’ and ‘documentation’. The use of these two sources has already been discussed previously (Sections 3.2.4.1 and 3.2.4.2).

Name company	Description of company	Sources used
Company A	A very large multinational company providing eBusiness solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with the eBusiness solutions director ▪ Semi-structured telephone interview with a solutions architect ▪ Information from the company's website ▪ Solution architecture methodology document ▪ Online solutions database ▪ <i>Inside the tornado</i> (Moore, 1995) ▪ <i>Crossing the chasm</i> (Moore, 1999)
Company B	A very large multinational company providing medical solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with consultant medical solutions ▪ Information from the company's website ▪ Corporate brochures and papers on the use of the technology ▪ Day in a hospital talking with users and decision makers of medical solutions ▪ CD-ROM with presentation of medical solution
Company C	A very large multinational company providing infrastructure solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with company director ▪ Semi-structured interview with project developer ▪ Information from the company's website ▪ Corporate brochures on the company's solutions
Company D	A very large multinational company providing turnkey solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with company director ▪ Semi-structured interview with sales manager and manager project development ▪ Information from the company's website ▪ Corporate brochure on the company's solution ▪ Corporate journal
Company E	A very large multinational company providing turnkey energy solutions	<ul style="list-style-type: none"> ▪ Semi-structured interview with marketing director and marketing manager ▪ Information from the company's website

Table 3.8 Participants in the Pilot Study and the sources that have been used

A standard list of questions was developed in advance (see Appendix B) and this list was altered, if considered necessary, based on the information that was read prior to the interview. The list with interview questions was sent out to the respondents in advance, which helped them to prepare themselves for the interview. It is important to note that all participants wished to remain anonymous and that data was treated in accordance with this desire.

One of the drawbacks of interviews mentioned in the previous section is 'poor recall'. This aspect was countered by using a tape recorder to tape the interviews. This allowed the researcher to listen to the interviewee, rather than to focus on keeping notes and it helped to provide an accurate record of the interview, which could be played back and was transcribed at a later date. When during an interview or study, further information was

needed, a request to the respondent was made, which generally resulted in the provision of more information. The researcher then converted the tape recordings of interviews and the field notes into transcripts. These transcripts were then sent to the respondents to be checked on their accuracy, after which they were returned to the researcher with the respondents' comments and remarks, if any.

After this, the transcripts and corporate information were analysed. Data that was considered to fit the exploratory nature of this research was then pulled out. As with the literature, the data of the Pilot Study was then grouped in order to get a more comprehensible picture of the findings, i.e. reduce the data (mentioned in Section 3.2.6). For the sake of clarity and ease of comparison, the same structure was used to present the findings of the Pilot Study as was used for the findings of the literature review. These efforts resulted in Table 4.3 (p. 77). Once more, the aim of this summary is to present the diversity and richness of attributes related to integrated solutions in an orderly fashion.

In summary, the Pilot Study data provided considerable insight into the basic issues being studied. This information was used in parallel with an ongoing review of relevant literature, so that the next research steps were informed both by prevailing theories and by a fresh set of empirical observations.

3.3.3 BUILDING THE SOLUTIONS MODEL

In order to find out more about integrated solutions and their role in developing more eco-efficient offerings, the findings from the integrated solutions literature, the Pilot Study, and the eco-efficiency guidelines needed to be made understandable. A useful means of doing this is to put forward a model in which this role becomes apparent.

Before developing a model in which the possible environmental elements of integrated solutions are communicated, it was necessary first to construct a framework based on the concept of integrated solutions alone. The main reason for this was the academic novelty and the lack of clarity about the concept and as a result the absence of an existing framework. The framework to be developed might thus be a useful tool to better comprehend the concept (See research question RQ1, p. 46). Another reason for starting developing a framework was the amount of data that had to be used. It would be more practicable to break the work down into two parts: first develop the integrated solutions framework and then use the framework as a basis for the development of the eco-efficient solutions model.

The framework was developed by merging the findings from the literature review and the Pilot Study, still using the structure mentioned earlier. This time, however, the structure was held lightly and re-examined closely for fitness and power. The various attributes across the different categories (like 'organisational structure', 'characteristics' or 'trends') were closely studied and various new labels were devised. This is in congruence with work done by Miles and Huberman, who state that for all approaches of coding, codes will change and develop as field experience continues; some codes do not work, others decay, and other codes flourish (Miles and Huberman, 1994, p. 61). The new labels, or features, were then further examined, to strive towards a structure that would enable the communication of the various characteristics of the concept of integrated solutions. This resulted in the framework presented in Section 5.2, which shows the nine features of integrated solutions that have been identified.

The next step was to develop the eco-efficient solutions model. In order to do this, environmental consideration had to be introduced. To this end, the characteristics of eco-efficiency, that were included in the literature review (and in Section 5.3.1), were considered to be useful. The features and the data they represented were then studied on their effects on the eco-efficiency of the integrated solution, using the characteristics of eco-efficiency stated in Section 2.2.2. This revealed a number of elements that were considered to influence the eco-efficiency. The relevant elements are attached to the features of the integrated solutions framework, thus providing a comprehensible picture of integrated solutions and their possible role in developing and providing more eco-efficient solutions. This model was used to communicate the findings from the research that had been undertaken until then. The elements presented in the model formed the starting point of further research, in order to find out more about their role in developing and providing more eco-efficient solutions.

3.3.4 THE VALIDATION PROCESS

Once the eco-efficient solutions model was developed, the validation process could start. Its aim was to find out to what extent the model was useful; whether it covered the most relevant issues in terms of integrated solutions and the elements contributing to increased eco-efficiency. It was thought advantageous to contact companies once more in order to discuss the model and try to find out to what extent the elements that were identified were relevant to their business situation. This was important, since one looked-for characteristic of the model would be the connection between eco-efficiency and business reality.

First of all, the companies that took part in the Pilot Study were contacted. Of these five companies only two companies (A and B) were willing and able to participate in the Validation. Therefore, an additional Internet search was undertaken to identify multinational companies within various sectors that offered integrated solutions to their clients. These companies were then approached to ascertain their interest in taking part in the Validation. The research and the model were communicated using a document called *Towards an eco-efficient solutions model*, which is shown in Appendix C. Of the fifty companies across seven industries, a further three companies were willing to take part in the Validation. Finally, since the environmental elements of integrated solutions were the focal point of this stage of the research, it was imperative to include environmental experts. To this end, several environmental consultancies were contacted. This resulted in a further two participants. A brief description of the seven participants which took part in the Validation can be found in Table 3.9 on the next page. Further details of the companies and their integrated solutions can be found in Appendix A.

Table 3.9 also outlines the different sources of information which have been used for each company. This time, given the specific nature of the research, the main source of information used was 'semi-structured interviews'. The use of this source has already been discussed (Sections 3.2.4.2 and 3.3.2). As with the Pilot Study, a standard list with questions was developed in advance (see Appendix D). This list of questions focused on the model and its elements. The interview questions were altered, if judged necessary, based on the information that was read prior to the interview. The list with interview questions was sent out to the respondents in advance, which helped them to prepare themselves for the interview. It is important to note that all participants wished to remain anonymous and that data was treated in accordance with this desire.

Name company	Description of company	Sources used
Company A	A very large multinational company providing eBusiness solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured telephone interview with a solutions architect ▪ Information from the company's website ▪ Solution architecture methodology document ▪ Online solutions database
Company B	A very large multinational company providing medical solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with consultant medical solutions ▪ Information from the company's website ▪ Corporate brochures and papers on the use of the technology
Company F	A very large multinational company providing document solutions to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with managing director, document director, quality director, marketing director, and marketing coordinator ▪ Corporate brochures on the company and the solutions it provides
Company G	A multinational company providing total chemical management to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with customer service engineer ▪ Information from the company's website
Company H	A multinational company providing integrated security systems to business-to-business clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with managing director ▪ Information from the company's website
Consultancy I	A Dutch environmental consultancy providing services to SMEs	<ul style="list-style-type: none"> ▪ Semi-structured interview with consultant
Consultancy J	A leading Dutch environmental consultancy providing leading life cycle assessment software to international clients	<ul style="list-style-type: none"> ▪ Semi-structured interview with managing director

Table 3.9 Participants in the Validation and the sources that have been used

As with the Pilot Study, all the interviews were recorded using a tape recorder. The researcher then converted the tape recordings of the interviews into transcripts. A sample transcript can be found in Appendix E. These transcripts were then sent to the respondents to be checked on their accuracy, after which they were returned to the researcher with the respondents' comments and remarks, if any.

After this, the transcripts of the various interviews were analysed. The analysis focused on the remarks made on the model and its elements. Based on this, it became apparent where changes to the model were necessary, in order to reflect the increased understanding of the elements of integrated solutions contributing to increased eco-efficiency. These efforts resulted in the refined eco-efficient solutions model, shown in Figure 6.3 (p. 92). The refined model is a solution of the research problem, as stated in Section 3.2.2: "How can knowledge of the concept of integrated solutions support the development of offerings with increased eco-efficiency?"

3.4 RESEARCH QUALITY

The trustworthiness or otherwise of findings from flexible, qualitative research is the subject of much debate (Robson, 2002). Ensuring research quality is therefore an important issue in literatures concerned with qualitative research methodology (Miles & Huberman, 1994; Robson, 2002; Yin, 1994). The main evaluative criteria for fixed design research are 'reliability', 'validity', and 'generalisability', assured by direct replication, for example. For flexible design research these criteria are the same, but are operationalised in alternative ways (Robson, 2002). Generalisability is not an issue in this type of study, since it does not involve a selection of a representative sample of settings from a known population. Therefore, only validity and reliability are discussed below.

3.4.1 VALIDITY

The validity of a piece of qualitative research has to do with it being accurate or true (Robson, 2002). Validity can be established by looking at possible challenges to it and how these are tackled in this particular study, like threats of providing a valid description and interpretation. The main problem of providing a valid description of what the researcher has heard lies in the inaccuracy or incompleteness of the data. This suggests that audio-taping should be carried out wherever feasible (Robson, 2002). All interviews during the Pilot Study and Validation were taped to ensure an accurate description. A second difficulty is related to providing a valid interpretation, that of imposing a framework or meaning on what is happening rather than allowing this to emerge from what the researcher learns during his involvement. The eco-efficient solutions model emerged through the analysis of data collected both from literature and the Pilot Study. No pre-conceived framework was used. During the Validation the model that was developed as a result of this analysis was the centre of discussion.

3.4.1.1 Respondent- and researcher bias

Other problems of validity include reactivity, respondent biases and researcher biases (Lincoln & Guba, 1985 in Robson, 2002, p. 172). Reactivity refers to the way in which the researcher's presence may interfere with the setting which forms the focus of the study. This is considered not to be a threat to validity, since this study focuses on integrated solutions, rather than the behaviour of people, for example. Respondent bias can take various forms, ranging from obstructiveness and withholding information to the 'good bunny' syndrome, when the respondent tries to give the answers or impressions which they judge the researcher wants. Again, this is hardly looked upon as a threat to validity, since the focus is on a concept rather than on people and because it is an exploratory multiple-case study rather than a descriptive single-case study. Researcher bias refers to what the researcher brings to the situation in terms of assumptions and preconceptions. These may in some way affect the manner in which they behave in a research setting, perhaps in terms of the persons selected for interview, the kinds of questions asked, or the selection of data for report and analysis. Yin (1994) identifies three strategies to overcome and guard against bias: ask good questions and interpret the answers; be a good listener and not trapped by

ideologies or pre-conceptions; be adaptive and flexible. These were adhered to in this study.

3.4.1.2 Triangulation

Triangulation, i.e. the use of multiple sources to enhance the rigour of research, is considered to reduce the threat to reactivity and researcher- and respondent bias (Robson, 2002; Yin, 1994). Triangulation has generally considered to be a process of multiple perceptions to clarify meaning, verifying the repeatability of an observation or interpretation (Stake, 2000). Denzin (1988 in Robson, 2002, p. 174) has distinguished four types of triangulation:

- data triangulation : the use of more than one method of data collection;
- observer triangulation: using more than one observer in the study;
- methodological triangulation: combining quantitative and qualitative approaches;
- theory triangulation: using multiple theories or perspectives.

In this study data triangulation has been used. This is illustrated by Tables 3.8 and 3.9, which show that data is used from documents, Internet pages, and semi-structured interviews for example. Another way of reducing the above mentioned problems and challenges is by using ‘member checking’, which means returning to respondents and presenting to them material such as transcripts, accounts and interpretations that the researcher has made. This was done at the end of the Pilot Study.

3.4.2 RELIABILITY

Reliability in fixed design research is associated with the use of standardised research instruments. The concern is whether the tool or instrument produces consistent results. At a technical level, the general non-standardisation of many methods of generating qualitative data precludes formal reliability testing (Robson, 2002). Nevertheless, there are common pitfalls in data collection and transcription, including equipment failure, environmental distractions and interruptions, and transcription errors. Researchers using flexible designs do need to concern themselves with the reliability of their methods and research practices. This involves not only being thorough, careful and honest in carrying out the research, but also being able to show others that you have been (Robson, 2002). In this study, this is achieved via an audit trail, in which a record is kept of the research activities, while carrying out the study. This includes raw data, a research journal, and details of coding and data analysis. Besides this, reliability was enhanced by this chapter, which clarifies the research design issues which were encountered during this study. Consequently, this made the research design process more transparent.

The evaluative criteria mentioned above and the tactics that have been utilised are shown in Table 3.10 below.

Evaluative criteria	Case study tactic
Validity <i>The accuracy of a piece of research</i>	<ul style="list-style-type: none">▪ All the interviews have been audio-taped▪ Model and framework emerged during the collection and analysis of data, rather than using a pre-conceived framework▪ Triangulation: using multiple sources of data and collection techniques▪ The findings from the Pilot Study were reviewed by participants▪ The integrated solutions framework and eco-efficient solutions model were reviewed by participants
Reliability <i>Demonstrating that the researcher has been thorough, careful and honest in carrying out the research</i>	<ul style="list-style-type: none">▪ During this study an audit trail has been used, i.e. a record of research activities has been kept▪ In this chapter the research design issues that have been encountered are discussed

Table 3.10 Case study tactics ensuring research quality

3.5 CONCLUSIONS

In this chapter all the research design considerations are discussed and an appropriate research strategy and research tactics are chosen to tackle the research proposition formulated in Sections 2.5 and 3.2.2. The selections that were made during the research design process are summarised in Table 3.11 below.

Element	Methodological decision
Research paradigm	Realism
Research purpose	Exploratory
Research strategy	Multiple-case study
Research tactics	Focused (or semi-structured) interviews and documentation
Data collection	Qualitative data
Data analysis	A template approach and coding & clustering tactics

Table 3.11 Summary of research methodological decisions

This chapter has also outlined the research process that has been followed in this study. It has been made clear that research design methodology and the research problem have been used as a point of departure and guided the research design process. As the previous section illustrates, during the research process sufficient attention has been paid to assuring the research quality of this work.

Having defined the research methodology used here, in subsequent chapters the findings of the study are analysed, starting with the Pilot Study in the next chapter.

4 PILOT STUDY

This chapter analyses the findings of the Pilot Study, which can be considered a more in-depth exploration of the concept of integrated solutions. The aim of the Pilot Study is to get a more intimate understanding of integrated solutions and to elicit elements related to these solutions. In this chapter the findings of the Pilot Study are analysed and elements that are useful for the development of more eco-efficient services and solutions are laid out.

4.1 INTRODUCTION

As established in the previous chapter, the research objective is to find out how knowledge about the concept of integrated solutions can support the development of more eco-efficient services or solutions. In order to determine this, an understanding of the concept of integrated solutions is required. To a certain degree, this can be attained through studying literature. However, as has been explained in the literature review (Chapter 2), the concept of integrated solutions is as yet relatively new and poorly defined. Research into integrated solutions, their features, and their organisational characteristics is still in its infancy (e.g. Davies, 2001; Foote *et al.*, 2001). Add to this limitation, that literature does not discuss the role of the environment in relation to integrated solutions and *vice versa*. It was thus deemed necessary to obtain a more intimate understanding of the concept of integrated solutions by conducting a pilot study.

In the Pilot Study a number of companies across different industries that offer integrated solutions were contacted. The companies and their solutions were studied through the use of semi-structured interviews, corporate literature and information on the companies' websites. The aim of this chapter is to report the findings of the Pilot Study. As has been made clear in previous chapters, these findings form one of the inputs of the development of an eco-efficient solutions model, which is discussed in the next chapter (Chapter 5: Model development).

In the next section, the companies which participated in the Pilot Study and their solutions are introduced. After this, the findings of the study are presented and discussed. In the final section of this chapter, the findings are summarised and conclusions are drawn.

Finally, it is important to note that all the methodological issues concerning the structure, design, and execution of the Pilot Study were discussed in the previous chapter (Section 3.3.2). This chapter does not repeat these issues and is only concerned with the findings of the Pilot Study.

4.2 PILOT STUDY PARTICIPANTS

The companies and the integrated solutions that have been studied in the Pilot Study are briefly introduced in Table 4.1 below. More information on the companies and their solutions can be found in Appendix A (Pilot and Main Study Companies). These companies are anonymous due to confidentiality issues. All the research for the Pilot Study took place within divisions or departments of multinational companies. In order to make this chapter readable, all the departments and divisions of different companies are named ‘company A’, ‘company B’, etcetera.

Company	Description	Integrated solution
Company A	A very large global provider of enterprise technology and solutions	Mobile solutions Life cycle solutions
Company B	A very large multinational company offering medical solutions to business-to-business clients	Picture Archiving and Communication Systems
Company C	A very large multinational company offering infrastructural solutions to business-to-business clients	Infrastructure solutions
Company D	A very large multinational company offering energy and logistical solutions to business-to-business clients	Turnkey power plant solutions
Company E	A very large multinational company offering energy solutions to business-to-business clients	Total energy solutions

Table 4.1 Pilot Study participants

4.3 FINDINGS FROM THE PILOT STUDY

In this section, the findings from the Pilot Study are reported. To give structure to this section, it was thought useful to adopt the layout of the literature review (see Section 2.4.7).

Forces Trends Drivers Barriers	Solutions Characteristics Type Value proposition Solution development	Organisation Organisational structure Capabilities/requirements Relationship Change	Environment
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Table 4.2 Structure of reporting the findings of the Pilot Study

4.3.1 INTERNAL AND EXTERNAL FORCES

In this sub-section the trends that have been identified during the Pilot Study are discussed. After that, the identified drivers and barriers for offering integrated solutions are presented.

4.3.1.1 Trends related to integrated solutions

The rate of innovation in today’s market is perceived as an important trend aiding the emergence of integrated solutions. The development time of products has decreased, as well as their economic lifetime (Company Director, company C). Company B is challenged by shorter product life cycles and increasingly more complex technologies (Corporate brochure, company B). Another trend related to this, is that over the years product margins diminished (Website of company E). Companies have to find ways of dealing with these trends; offering integrated solutions seems to be one of them. New products and services are also needed because of the deregulation of markets (Website of company E) – a trend also identified in literature (Davies, 2001). Finally, a trend that has been identified by company A is that outsourcing can be made possible and profitable through connectivity, i.e. through using information and communication technology (ICT) (eBusiness Director, company A). This enables a company to offer integrated solutions to their clients, since the company can now take over a specific element of a client’s business by using ICT.

Trends related to integrated solutions:

- ☞ Rate of innovation in today’s market
- ☞ Product margins have declined
- ☞ Deregulation of markets
- ☞ Outsourcing can be made possible through connectivity

4.3.1.2 Drivers for offering integrated solutions

As mentioned in literature (e.g. Davies, 2001; Foote *et al*, 2001), the companies in the Pilot Study also indicated that market demand, or market expectation, is an important driver for offering integrated solutions. The companies started developing a solution because there was a more or less clearly articulated market demand. For company B market expectation was even the most important driver (Consultant Medical Solutions, company B). In the energy and logistics market, this market demand emerged because companies had become lean, and neither had the skills nor the capacity to take on certain business aspects themselves anymore (Company Director, company D). This resulted in a concrete market demand for integrated solutions. Demand in the energy market has shifted from buying equipment to turnkey solutions (Sales Manager, company D). In the case of company C, a few years ago the Board of Directors had identified that delivering total solutions would be an important market opportunity. As indeed it has proved, since the company now sells fifty per cent more products through putting their products in the total solutions they offer (Company Director, company C).

The second driver for offering solutions, as indicated by most of the companies, is battling the commoditisation of their products and avoiding cost competition. Products and services that are cutting edge at one stage, but become mainstream over time. Once a product or service is mainstream, it means there are many different parties in a market that are able to deliver a certain product, which in turn means that the competition shifts from

differentiation to cost competition, i.e. who can provide the product at the lowest price? Many companies want to avoid cost competition and look for ways of differentiating their offer: adding value through offering total solutions for example. According to the Consultant Medical Solutions from company B,

“If you do not want to compete on cost, you have to define value in a different way: increased quality or offering total solutions.”

In certain industries environmental regulations can play a part as well. This is the case with hospitals and medical institutions, where there are regulations on the use of chemicals. These regulations affect hospitals in terms of the processing of their celluloid films. This has created market demand for an alternative and made company B’s clients sensitive towards the new solution (Consultant Medical Solutions, company B).

The final identified driver is that companies were able to provide most of the elements of the solution anyway, so that shifting towards offering a total solution was a relatively small step. In the case of company C for example, they realised that over time the company had accumulated a wide range of skills, products, services, and experience. These were all utilised and sold to clients separately. They realised that by combining all these products, services, and skills – offering integrated solutions – there would be a synergetic effect (Company Director, company C).

Drivers for offerings integrated solutions:

- ☞ Market demand
- ☞ Battling commoditisation of products and avoiding cost competition
- ☞ Environmental regulations (on the use of chemicals)
- ☞ Ability to provide most elements of the solution anyway

4.3.1.3 Barriers for offering integrated solutions

As has become clear from both the literature and the Pilot Study, offering integrated solutions is a value-adding strategy. Offering integrated solutions can only be profitable if the solution provider can add enough value – otherwise this strategy does not work. This has been identified by company D as a barrier for offering integrated solutions. So a company should abandon a project if it cannot add enough value (Sales Manager, company D). Many companies which are offering integrated solutions have a product background. This can be a burden when offering solutions. Often the company still thinks in terms of products. They have to force themselves not to think in terms of product sales and separate units; they have to start thinking in processes, which is difficult (Consultant Medical Solutions, company B). A final barrier that was identified by company B is that the clients need to cross a threshold if they switch over to ICT. Company B offers Picture Archiving and Communication Systems (PACS) to their clients, which are digitally integrated solutions for radiological information in hospitals. When a client first approaches the company they often still manage all their radiological data and information in an analogue way. For these clients to shift towards a digital solution means spending, at least initially, extra money, time, and energy. The digital solution has numerous advantages over the old situation, but this initial ‘bump’ can discourage clients from implementing the new digital solution (Consultant Medical Solutions, company B).

Barriers for offering integrated solutions:

- ☞ Not able to add enough value
- ☞ Company still thinks in terms of products
- ☞ Need to cross a threshold if the client switches to ICT

4.3.2 INTEGRATED SOLUTIONS

In this sub-section the characteristics, types of solutions, value proposition, and relevant aspects of solution development are discussed.

4.3.2.1 Characteristics of integrated solutions

Integrated solutions focus on the whole process rather than on discrete products. Company B for example focuses on the facilitation of medical processes (Consultant Medical Solutions, company B). There is an indication that a solution is 'beyond' offering just products and services, as can be discerned from the following quotation:

“And now we are in the phase of implementing a new offering into the market, which is more than CEM [Contract Energy Management], it's more than gas, it's more than CHP [Combined Heat and Power]. It's just trying to do the whole thing; solutions offering.” (Marketing Director, company E)

A characteristic that came up several times during the Pilot Study was that the solution is a non-core activity for the client. Customers are not experts in these activities and should not be, according to the marketing director of company E: the solution provider takes care of these non-core aspects of business. Company B aims to standardise primary processes at clients, thus enhancing efficiency (Consultant Medical Solutions, company B). Company A is earning higher profit margins when offering integrated solutions, since they are solving more of a client's problem (eBusiness Director, company A). Therefore, the aim of a solution provider is to get as high up in the client's decision tree as possible.

An integrated solution consists of a wide range of services, knowledge, expertise and support. Company E for example offers considerable knowledge and expertise to their clients, which enhances the added value of the solution. It is also crucial to be flexible towards clients, in terms of services and financial agreements. Company A and B offer tailor-made service level agreements to their clients for example. This is also one of the selling points; that the new solution is flexible as opposed to the inflexible old situation (Consultant Medical Solutions, company B). Solely using the company's products, when offering an integrated solution, can form a limitation. If a company can look beyond their own products, they might be able to provide a more optimal solution (Project Development Manager, company D). Company B wants to offer total solutions whether or not they can use their own products:

“We're also vendor neutral – we'll work with your preferred suppliers to create an effective healthcare network.” (Corporate brochure, company B)

Integrated solutions usually have a long-term nature. For company B the primary focus is not on short-term solutions but rather on long-term improvements. There are usually long decision trajectories as well, since the integrated solutions that company B offers affects the breadth of the organisation (Consultant Medical Solutions, company B). Solutions are provided through long-term contracts (Marketing Director, company E).

“At [company E] we are building long-term relationships with our customers by offering distinctive services which go beyond the simple supply of energy products.”
(Website of company E)

Companies A and B have experienced that technology has the ability to integrate previously separate elements, thus enhancing efficiencies and sales opportunities. With company B the solution is about integrating elements of a hitherto separated system. Integration results in increased efficiency, productivity and transparency of a client’s department (Consultant Medical Solutions, company B; Company Director, company C). Many solution providers operate performance-based agreements. Performance contracting is only possible when delivering total solutions, since the company is responsible all for the elements involved (Company Director, company C). The motivation for clients to be involved in gain-sharing agreements is cost, not the environment (Marketing Director, company E).

Characteristics of integrated solutions:

- ☞ Focus on a whole process rather than on discrete products
 - ☞ The solution is a non-core activity for the client
- ☞ Consists of a wide range of services, knowledge, expertise and support
 - ☞ Offer solution with or without a company’s own products
 - ☞ Flexibility towards clients
 - ☞ Long-term nature
- ☞ Integrate previously separate elements
 - ☞ Performance-based agreements

4.3.2.2 Value proposition of integrated solutions

All the companies identified that taking over a considerable amount of a client’s risk is an important element of their value proposition. The company takes the end responsibility. According to company B they are able and willing to bear a certain part of the risk involved of the client, because the company is big, diversified and can offer a lot of products and knowledge (Consultant Medical Solutions, company B). This can be done through performance-based agreements, for example, as mentioned above. Another way risk is reduced is through the company’s understanding of market dynamics and trading skills (Website of company E). Another advantage for clients who purchase integrated solutions is that the company takes care of a certain business aspect, which enables the client to focus on their core business.

“[Our aim is] to provide the energy solution that will help you concentrate on what you do best and to allow us take care of your energy needs.” (Website of company E)

The additional advantage of this is that there is no need for the client to have the expertise required for the solution in-house (Company Director, company D). The client therefore wants a solution that is robust, reliable and compatible (eBusiness Director, company A). With integrated solutions, the client has a partner during all stages of a project: in the construction phase, in the integrated planning from project development and financing, via implementation to operation and maintenance (Website of company D). The client has a single supplier that offers an unparalleled range of services across the broad spectrum (Website of company E). Following from this, company E sees it as a challenge of the solution provider to change the views of the client: instead of a burden, they want their client to see the solution,

“... as an asset which can generate new sources of revenue, enhance your business performance, and increase shareholder return.” (Website of company E)

Finally, the solution needs to be a clear improvement on the original situation in terms of money, efficiency, etc. (eBusiness Director, company A). From this it might be concluded that in order for a costly solution to be adopted, it needs to have significant advantages over the old situation.

Value proposition of integrated solutions:

- ☞ Take over (a part of) client's risk
- ☞ Solution enables client to focus on their core business
- ☞ Client should view the solution as an asset instead of a burden
- ☞ Solution is robust, reliable, and compatible
- ☞ An improvement in terms of money or efficiency

4.3.2.3 Solution development

All companies stated that it is important to get closer to the customer. According to company B offering a solution is all about organising and managing the pattern of a client's expectation (Consultant Medical Solutions). Involvement from the start is important, since the company wants to find out what the client's evaluation criteria are. Therefore, the company needs to listen to the client in order to understand his problem (Sales Manager, company D). When a client specifies the system and its requirements, it is important to try and help the client to articulate their (latent) needs (Consultant Medical Solutions, company B). It is crucial in offering solutions to have an intimate understanding of a client's business problem, since the solution is targeted at solving this business problem (eBusiness Director, company A). Company E states that it is important to work in partnership with the client in order to identify and implement the most cost effective solution (Website of company E). The client remains heavily involved throughout the whole development process to get the client's heart and soul in the solution; all crucial decisions (budgets, life-cycle costs, design, etc.) are taken together with the client (Company Director, company C).

Solutions use both predesigned elements and new elements. The predesigned elements are 'a sort of kitbag'; they include tools that address a need that customers have and are relevant to whole industries, like the IT structure, Customer Relationship Management (CRM), and messaging solutions. And there are elements that are specifically developed to aid a vertical industry, like finance or telecommunications (Solutions Architect, company A).

So there is a generic part and a client-specific part (Marketing Director, company E). It is important to acknowledge that only with large projects specific research and development can be allowed; otherwise it cannot be financially justified. Company C was aware of the increased development space they have when considering solutions, but according to the company director this was “not always possible and always difficult” (Company Director, company C). A solution provider has to bring the perceptions of all the different players together into a single functionality.

Company A pointed out they use the theory of the ‘Technology Adoption Life Cycle’ (TALC) developed by Geoffrey Moore (1995, 1999). In high-tech and ‘high-change’ sectors the TALC is a useful tool in determining the solution offered to clients. This concept distinguishes a number of distinct stages in the lifecycle of a technology, which has implications for the type of customers, the marketing strategy, and the kind of product that is offered in each stage. In one of the initial stages of the TALC, called the Bowling Alley, business is conducted according to the ‘Bowling pin model’, which assumes that each niche will require its own whole product to be fully complete before it can adopt the new paradigm. At the same time, a niche finds it much easier to buy in if vendors can supply references from an ‘adjacent niche’, one within which it already has established word-of-mouth relationships. The head bowling pin in this model corresponds to the beachhead segment. Every other pin is ‘derived’ from this head pin, as is shown in Figure 4.1 below.

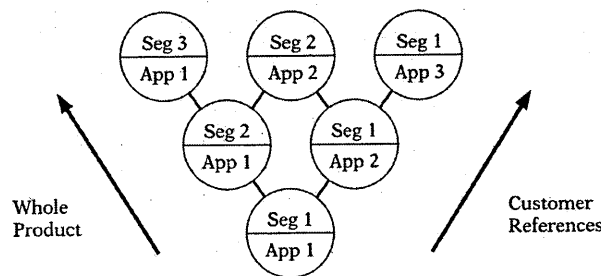


Figure 4.1 Bowling Alley market development (Moore, 1995, p. 38)

The idea behind this figure is simply to leverage the assets acquired by winning the first beachhead. Once the company has gone through the adoption process for a certain product in a certain industry, the company can now bring to them ways they can extend that capability to their other functions. In other functions in the same industry they can build upon the infrastructure that is already in place. Similarly, taking the existing product to new industries offers leverage, this time based upon cloning the whole product. There would be modifications required, typically calling for simplification and cost reduction, but all made possible by leveraging the costs of the initial whole product R&D. Finding additional leverage is critical to high-tech strategy for the simple reason that whole product creation is an expensive and time-consuming process (Moore, 1995).

Industry standards can also be used or developed to create excellent solutions (eBusiness Director, company A), since they specify standards of quality and methods of achieving this. Company A uses a well-defined methodology for developing solutions in which responsibilities of all the stakeholders in the solution are laid out (Solution architecture methodology document, company A). The methodology is expressed as a set of drivers, goals, metrics, principles, models and standards. The methodology also uses different viewpoints during the development of solutions: business, functional, technical, and implementation viewpoints (Solution architecture methodology document, company A).

When developing solutions, it is important to question the functionality of the current product system. When organising the catering in a hospital for example, why not think of a performance contract with a caterer? It saves investing in a kitchen and the client has a competitive deal on their food (Company Director, company C). Company B finds it valuable to define the client's processes in terms of their primary output. Therefore it is vital to make the output of the client's processes explicit and measurable. Process analysis is thus a key element in determining what the client's solution should be (Consultant Medical Solutions). It consists of defining and assessing client's core business processes.

Solution development:

- ☞ Get closer to the customer
 - ☞ Solution uses both pre-designed and new elements
- ☞ Industry standards can be used or developed to create excellent solutions
 - ☞ Lay out the responsibilities of all the stakeholders of the solution
 - ☞ Question the functionality of current product systems
 - ☞ Define client's processes in terms of their primary output

4.3.2.4 Type of solutions

Different types of solutions are offered by the companies, one of which is turnkey solutions. Turnkey is a product or service that is designed, supplied, built, or installed fully complete and ready to operate. The term implies that the end user just has to turn a key and start using the solution. It is an approach that goes beyond the traditional 'Engineering, Procurement, and Contracting' (EPC). Company D offers turnkey power plant solutions. They are involved during all the early stages of the solution; from pre-sales, via design, engineering, project management, and procurement, to implementation and after-sales.

Another type of solution, especially for high value solutions, is the 'Build Operate Transfer' (BOT) approach. This approach has been mainly used as an option for government to outsource public projects to the private sector, but can be initiated in the private sector as well when there are limited funds available and there are not enough resources to execute successfully a required project (Menheere & Pollalis, 1996). With BOT, the private sector designs, finances, constructs and operates the facility and eventually, after a specified concession period, the ownership is transferred to the government (or another private party). Compared to the turnkey approach, BOT projects also cover preliminary studies and the operation and transfer of the project (Menheere & Pollalis, 1996). A slightly different approach to this, which is also used when offering integrated solutions is 'Build Own Operate' (BOO), where the contracting party retains ownership of the facility, makes returns on investment by operating the solution for its useful life, and may sell it at any point at market value. BOT and BOO approaches are used by companies C, D, and E.

Type of solutions:

- ☞ Turnkey solutions
- ☞ Build Operate Transfer (BOT)
- ☞ Build Own Operate (BOO)

4.3.3 INTEGRATED SOLUTIONS AND THE ORGANISATION

In this sub-section the capabilities that are needed to offer solutions are discussed, as well as relationships with other parties and the change from a product-oriented situation to a solution-oriented situation. Finally, the organisational structure is examined.

4.3.3.1 Capabilities

Offering an integrated solution is different from offering 'just' products and services. Reputation, past performance and trust are important characteristics of a supplier when offering solutions (eBusiness Director, company A). Reputation and track record are important issues if you are to engage in partnerships (Company Director, company C; Marketing Director, company E). In new and turbulent markets clients look for a credible and respectable partner and supplier (Corporate brochure, company C). Company E bases their success partly on the long-term trust and confidence of their customers (Website of company E).

The solution provider needs a lot of knowledge of and experience with industry, technology, market, and systems. According to company C, key skills needed when developing total solutions are creative conceptual thinking ability, knowledge and know-how present within the whole company, and market knowledge (Website of company C). Company E supports the importance of this capability:

"... we are constantly looking beyond traditional ways of doing business, beyond the constraints of conventional thinking and beyond the perceptions of the energy industry." (Website of company E)

Extensive product and systems knowledge is necessary to offer a total solution, to enable adequate life cycle costing for example (Company Director, company C). Another important requirement is that the company is able to offer all aspects of a solution. In the case of company C, they offer conceptual thinking, project management skills, world-class engineering, financing schemes, realisation, and maintenance and control of the solution (Website of company C). A solution provider is able to provide an unparalleled range of services (Website of company E). According to company D it is important to have maximized in-house capability to manage a complete project on a turnkey basis (Sales Manager, company D).

The company needs to focus on a market segment instead of products (Consultant Medical Solutions, company B) when providing solutions. Company B regards network design, integration and implementation capabilities as their core competencies (Website of company B). According to company E the pursuit of the highest standards of performance and innovation is crucial to their success as a solution provider (Website of company E). They also consider flexibility to be important:

"Flexibility encourages innovation and cost effective solutions. It maintains competitiveness. It makes it easier to absorb and apply new information and new technologies and to ensure that our basic approach remains relevant over time. Market mechanisms stimulate flexibility and facilitate better solutions throughout the world." (Website of company E)

Company E works closely with regulatory bodies within the industry to ensure that they are able to inform their clients of the latest industry issues (Website of company E). Another reason for working closely with regulatory bodies is to anticipate emerging standards by preparing the company's architecture to accommodate them. Company B participates in several industry committees that are defining tomorrow's technologies and software standards (Corporate brochure, company B).

Although a solution covers a 'whole' business aspect, the solution provider does not need to have all the knowledge involved (eBusiness Director, company A). Company A provides hardware and software for certain business problems, together with other market leaders. The Consultant Medical Solutions of company B discovered a gap in the current market situation: solution providers struggle to deliver the solution and management consultancies lack the technical capabilities. This is an opportunity for various parties to work together.

Capabilities needed for offering solutions:
☞ Reputation, past performance, and trust
☞ Knowledge of industry, technology, products, and systems
☞ Creative conceptual thinking and flexibility
☞ Focusing on a market segment instead of products
☞ Company is able to offer all aspects of a solution
☞ Network design, integration, and implementation capabilities
☞ Working closely with regulatory bodies
☞ Looking beyond traditional way of doing business
☞ No need to have all the knowledge involved

4.3.3.2 Relationships

Most of the solution providers are not afraid to partner with other companies. Partnerships with other companies or parties are often necessary to provide all the knowledge, expertise, and hardware needed (Company Director, company C; Company Director, company D). According to company A, it is important to partner with other market winners in order to offer robust solutions – but this is difficult:

“It is like herding cats.” (eBusiness Director, company A).

In big complex projects, the competition gets blurred, and companies start working together anyway, according to the director of company C. The Consultant Medical Solutions of company B warns that before entering a partnership, it is important to realise what competitive advantage the company is bringing to the partnership, otherwise other parties might take control of the partnership.

Apart from partnering with companies, it appears to be important to forge partnerships with clients (Consultant Medical Solutions, company B). The importance of this has already been discussed in relation to the solution development process. Clients look for more aspects than price and quality: they also look for the opportunities a company can offer them (Project Development Manager, company D). However, clients like to keep the

solution provider at a distance out of fear of manipulation. This initial lack of trust stems from a disparity between what the company supplies and the output of the client's processes. Therefore, some sort of 'honesty' needs to be created, otherwise clients will not let the solution provider assess their processes (Consultant Medical Solutions, company B).

Integrated solutions and relationships:

- ☞ Partner with other market winners in order to offer robust solutions
- ☞ Forge partnerships with clients

4.3.3.3 Change

Most of the companies that are considered in the Pilot Study used to deliver products and gradually moved into providing services as well (Company Director, company D). In a way, they moved into an earlier phase of a project: project development (Company Director, company D). The reason for this was that the company wanted to secure profit margins. After successful project development, the company becomes their own client. In order to change from a product oriented company into solution provider, the company needs more than existing product knowledge and they have to show that they are capable of offering solutions (Consultant Medical Solutions, company B). It is a marketing challenge to reposition the company as a solution provider (eBusiness Director, company A).

Offering solutions means moving from a transaction-based to a relationship-based situation (eBusiness Director, company A). This means that the company has to get used to servicing a solution, for example. This is different to sending out a service engineer. Specific parts of a solution need to be managed by specialists, while the whole solution is coordinated by generalists. As yet, the last group does not exist in the traditional product-oriented organisation. Offering solutions has thus generated a need for generalists in the organisation (Consultant Medical Solutions, company B).

Change from selling product to offering solutions:

- ☞ Need more than existing product knowledge
- ☞ Move into an earlier phase of a project
- ☞ Move from a transaction-based to a relationship-based situation
- ☞ Get used to servicing a solution
- ☞ Need for generalists in the organisation

4.3.3.4 Organisational structure

The solution provider needs to create unexpected connections within the organisation and this way opening up existing knowledge in the wider organisation, so it can be used for the development of a total solution (Company Director, company C). In principle, the company is neither product nor system bound, thus ensuring the development of an optimal solution. Nevertheless, the company works closely with different divisions to ensure potential product sales as early as possible (Company Director, company C). The company is lean and takes on a leadership role. It assembles an expert team per project.

It is thus an organic organisation. The company employs people with new skills, like social geographers, economists, project developers etc. to ensure the development of an optimal solution (Company Director, company C).

Organisational structure of a solution provider:

- ☞ Department opens up existing knowledge
- ☞ Department is neither product nor system bound
- ☞ Department works closely with different disciplines to ensure product sales as soon as possible
- ☞ Department is lean and assembles project teams
- ☞ Department employs people with new skills

4.3.4 INTEGRATED SOLUTIONS AND THE ENVIRONMENT

In this section, several elements that relate to the environment and integrated solutions are mentioned. There were several findings that could have an impact on the environmental characteristics of the solution offered – either on the solution itself or compared to the original situation.

It has become clear that the environment, in terms of a decision criterion in the development of new integrated solutions, is a client and solution specific issue. Company A for example provides ICT hardware and software, which requires a preconditioned area of a certain size. This can be expensive and energy intensive. Consequently, depending on the client's location, the environment can become an issue – but this is usually driven by costs (eBusiness Director, company A). Apart from that, it depends on the environmental awareness of a client (eBusiness Director, company A; Company Director, company C).

The company will not do more than the client specifies in terms of the environmental requirements of a solution (Consultant Medical Solutions, company B). For most clients environmental compliance is enough (Consultant Medical Solutions, company B; Project Development Manager, company D). Sometimes a client wants more, but this always costs extra money (Project Development Manager, company D). Clients usually want proven design, but sometimes clients want to be able to show off by having the nerve to use new technology, e.g. solar panels at their facilities (Project Development Manager, company D).

If clients do not know their processes, there might be waste in terms of inefficiencies in their current processes. Almost eighty per cent of total ICT costs are maintenance, repair, support, and upgrade costs. When company A reveals this to its clients most of them are astonished. This indicates that by making the Total Cost of Ownership (TCO) transparent, a sales opportunity is provided (eBusiness Director, company A). This approach allows hidden costs and inefficiencies to emerge and can promote more (eco-) efficient alternatives. Life cycle costs can thus be used to communicate the benefits of alternatives and can be used as guidelines for solution development (eBusiness Director, company A; Company Director, company C).

Company C has difficulty evaluating the environment because of establishing system boundaries. Generally energy use is well-understood, but material and product use is not (Company Director, company C). Company E wants to relate energy to variables that influence its consumption in order to identify waste (Website of company E). They achieve this through an approach called ‘Monitoring and Targeting’. This is a management technique that aims to control energy consumption and reduce costs by integrating energy management into the existing site management structure. Managers are made responsible for energy use in the areas under their control, in the same way that they are responsible for other controllable (or variable) resources (Website of company E).

The infrastructure solutions that company C offers to their client is about integrating different transport modalities. This is viewed as one of its selling points: that the solution is an addition or augmentation rather than a replacement of existing modalities (Brochure on infrastructure solutions, company C). This element might be useful when thinking about developing more eco-efficient services or solutions.

Finally, the Marketing Director of company E makes it clear that is better to focus on the commercial side of the environment:

“You see all the odd adverts about clouds and animals. I understand that from the heart point of view, but it is not ultimately about that. You aren’t doing it a service by making it about that, because people aren’t going to buy what you offer. So we’re trying to, I guess, get to the heart commercially, and I think we’re going to be more successful by doing it that way.”

Integrated solutions and the environment:
☞ The environment is a client specific issue
☞ If clients do not know their processes there might be waste through inefficiencies
☞ Life cycle cost can be used to communicate benefits of alternatives
☞ Relate energy to variables that influence its consumption in order to identify waste
☞ Difficulty evaluating the environment because of establishing system boundaries
☞ Solution is augmentation rather than replacement
☞ Focus on the commercial side of the environment

4.4 CONCLUSIONS

In this chapter the findings of the Pilot Study have been presented. These findings are summarized in Table 4.3 on the following page. Since the same structure has been used for presenting the findings in this chapter as well as for the findings of the literature review on integrated solutions (Section 2.4), these two sets of findings can be compared relatively easily.

<div><div>Forces</div><div><div><div>Trends</div><div><ul style="list-style-type: none">- product margins have gone down- rate of innovation is driven by shorter product life cycles, and more complex technologies- outsourcing can be made possible and profitable through connectivity- deregulation of markets</div><div><div>Drivers</div><div><ul style="list-style-type: none">- market demand- battling commoditisation of products and avoid cost competition- environmental regulation on the use of chemicals- able to provide most elements of the solution; relatively small step to provide total solution</div><div><div>Barriers</div><div><ul style="list-style-type: none">- not able to add enough value- company still thinks in terms of products- need to cross threshold if the clients switches to ICT</div><div><div>Environment</div><div><ul style="list-style-type: none">- the environment is a client specific issue- if clients do not know their processes there might be waste in terms of inefficiencies- life cycle cost can be used to communicate benefits of alternatives- relate energy to variables that influence its consumption in order to identify waste- difficulty evaluating the environment because of establishing system boundaries- solution is augmentation rather than replacement- focus on the commercial side of the environment</div></div></div></div></div></div></div>	<div><div>Solutions</div><div><div><div>Characteristics</div><div><ul style="list-style-type: none">- focus on an whole process rather than discrete products- the solution is a non-core activity for the client- consist of a wide range of services, knowledge, expertise, and support- offer solution with or without own products- flexibility towards clients- long-term nature- integrate previously separate elements- performance-based agreements</div><div><div>Type</div><div><ul style="list-style-type: none">- turnkey solutions – beyond Engineering, Procurement, and Contracting (EPC)- Build, Own, Operate (BOO)- Build, Operate, Transfer (BOT)</div><div><div>Value proposition</div><div><ul style="list-style-type: none">- take over client's risk- company enables client to focus on core business- have a partner during all stages of a project- view solution as an asset instead of a burden- solution is robust, reliable, and compatible- an improvement in terms of money or efficiency</div><div><div>Solution development</div><div><ul style="list-style-type: none">- get closer to the customer- solution uses both pre-designed and new elements- Technology Adoption Life Cycle- industry standards can be used or developed to create excellent solutions- lay out the responsibilities of all the stakeholders of the solution- question functionality of current product systems- define client's processes in terms of their primary output</div></div></div></div></div></div></div>	<div><div>Solution provider</div><div><div><div>Organisational structure</div><div><ul style="list-style-type: none">- department opens up existing knowledge- department is neither product nor system bound- department works closely with different disciplines to ensure product sales as early as possible- department is lean and assembles project teams- department employs people with new skills</div><div><div>Capabilities/ requirements</div><div><ul style="list-style-type: none">- reputation, past performance, and trust- knowledge of industry, technology, products, and systems- creative conceptual thinking- focusing on a market segment instead of products- company is able to offer all aspects of a solution- pursuit of highest standards of performance and innovation- network design, integration, and implementation capabilities- flexibility- work closely with regulatory bodies and industry- look beyond traditional way of doing business- no need to have all the knowledge involved</div><div><div>Relationships</div><div><ul style="list-style-type: none">- partner with other market winners in order to offer robust solutions- forge partnerships with clients</div><div><div>Change</div><div><ul style="list-style-type: none">- need more than existing product knowledge- move into an earlier phase of a project- move from a transaction-based to a relationship-based situation- get used to servicing a solution- need for generalists in the organisation</div></div></div></div></div></div></div>
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Table 4.3 Summary of findings of Pilot Study

There are numerous aspects that have emerged both in the Literature Review and in the Pilot Study. Examples include outsourcing, decreased product margins, and the use of ICT as trends supporting offering integrated solutions. Both sets of findings state market demand as an important driver for offering integrated solutions. They have both identified that broader skills and capabilities are required; the need to partner both with other companies as well as with customers; and that communication is called for in order to unlock existing knowledge.

There are aspects identified in the Literature Review that have not directly emerged during the Pilot Study, like the need to redefine ways of measuring corporate performance; lack of trust as a barrier between solution provider and customer; and opening the door for securing future orders being a driver for offering solutions. From the Pilot Study a number of new aspects have emerged, that have not been identified through studying the literatures. Examples include the several aspects related to integrated solutions and the environment; not being able to add enough value as a barrier for providing solutions; and the benefit of working closely with industry and regulatory bodies. Overall, no contradictory aspects between the two sets of findings have been found.

This chapter has discussed the findings of the Pilot Study. The next chapter uses these findings, as well as the findings from the Literature Review, to build an eco-efficient solutions model, as a tool to better comprehend the concept of integrated solutions and their contribution towards the development of more eco-efficient services or solutions.

5 MODEL DEVELOPMENT

In this chapter, the results of the literature study on integrated solutions, the Pilot Study, and the concept of eco-efficiency are brought together, making an eco-efficient solution model. This is the first model that shows the different elements that are involved in the development of more eco-efficient solutions.

5.1 INTRODUCTION

In order to find out more about integrated solutions and their contribution to developing more eco-efficient solutions, the findings from the integrated solutions literatures, the Pilot Study, and environmental issues need to be made comprehensible. A useful means of doing this is to put forward a model in which this contribution becomes apparent.

The aim of this chapter is twofold. Firstly, this chapter aims to discuss the development process of the abovementioned model. Secondly, this chapter intends to present this model, which shows the different elements that are involved in the development and offering of more eco-efficient services and solutions. The eco-efficient solutions model development process is represented in Figure 5.1 below.

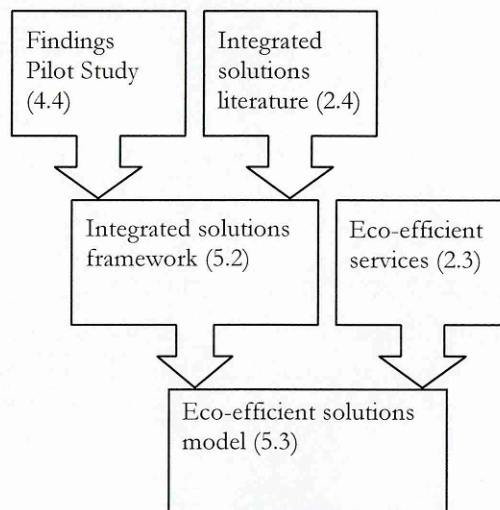


Figure 5.1 The eco-efficient solutions model development process (and the sections in which the corresponding parts can be found)

First, the findings of the Pilot Study and integrated solutions literature are brought together and the integrated solutions framework is developed. After this, eco-efficient services are discussed and the relevant components from this concept are put forward. Next the different attributes from literature and the Pilot Study are examined on their effects on the eco-efficiency of the solution on offer. This examination results in the eco-efficient solutions model: a model that shows the opportunities that have been identified for reducing environmental impact, enhancing efficiency, and creating added value for integrated solutions.

It is important to note that all the methodological issues concerning the structure, design, and execution of the development of the model have been discussed in the chapter on research methodology (Section 3.3.3).

5.2 THE INTEGRATED SOLUTIONS FRAMEWORK

Before developing a model in which the possible environmental elements of integrated solutions are communicated, it was deemed necessary to first construct a framework based on the concept of integrated solutions alone. The main reason for this was the academic novelty and the lack of clarity about the concept, and as a result the absence of an existing framework. The framework to be developed is thus a useful tool to better comprehend the concept. Another reason for developing a framework was the amount of data that had to be used. It would be more practicable to break the work down into two parts: first develop the integrated solutions framework – focusing on the distinctive characteristics of integrated solutions – and then use the framework as a basis for the development of the eco-efficient solutions model – focusing on the environmental attributes of integrated solutions.

This section firstly describes the development process of the integrated solutions framework. After this, the framework is presented and its nine features are discussed.

5.2.1 DEVELOPMENT OF THE FRAMEWORK

After studying integrated solutions literatures, a list with attributes of integrated solutions was compiled (Section 2.4). A similar list was composed after analysing the findings of the Pilot Study (Section 4.4). These two lists were merged in order to aid the development of the integrated solutions framework, since this provided the researcher with an overview of the considerable amount of attributes that were identified. The presence of only one list allowed categorization of the different attributes. Hence, the attributes were grouped and headings were formulated, until the greater part of the attributes was brought under a heading and the result was a graspable number of headings. These headings, or features, were then arranged in order to present a coherent picture. This picture represents the integrated solutions framework.

5.2.2 THE FRAMEWORK

The framework pictured on the next page (Figure 5.2) shows the nine features of integrated solutions: added value, business need, capabilities, customer intimacy, integration, lifecycle, organisational structure, partnerships, and performance. In order to present a coherent and comprehensible picture, the features are arranged around three components involved in offering an integrated solution:

- The integrated *solution* (What is offered?)
- The *organisation* that provides the solution (Who offers it?)
- The *client* who buys the solution (To whom is it offered?)

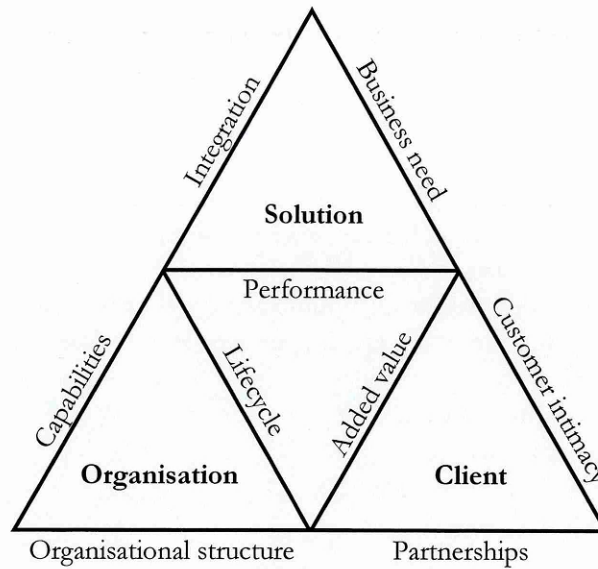


Figure 5.2 The integrated solutions framework

The features of the framework revolve around these three components. Although not all the features belong to just one component, they are related to one or more of these components. Next to these three components, the nine features of integrated solutions are positioned. These features are discussed in the next section.

5.2.3 FEATURES OF THE FRAMEWORK

Next the nine features of the framework are discussed more in-depth.

5.2.3.1 Added value

The first feature of the integrated solution framework is concerned with the source of the competitive advantage of integrated solutions. They appear to be offered in order to respond to a number of related trends: product margins that have gone down (Website of company E), shorter technology and product lifecycles (e.g. Davies, 2001), and stagnant product demand (e.g. Wise and Baumgartner, 1999). As mentioned in literature (Shepherd & Ahmed, 2000) and in the Pilot Study (interviewees of companies B, C, and D), for a product-oriented company an important driver for offering integrated solutions is battling the commoditisation of their products and avoiding cost competition.

In his book *Competitive advantage*, Michael Porter states that,

“Competitive advantage grows fundamentally out of value a firm is able to create for its buyers that exceeds the firm's cost of creating it. Value is what buyers are willing to pay, and superior value stems from offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price.” (Porter, 1985, p. 3)

Based on this, it can be deduced that if a company wants to avoid cost competition, it has to provide unique benefits to the client. Porter goes on to say that,

“In a differentiation strategy, a firm seeks to be unique in its industry along some dimensions that are widely valued by buyers. It selects one or more attributes that many buyers in an industry perceive as important, and uniquely positions itself to meet those needs. It is rewarded for its uniqueness with a premium price.” (p. 14)

Thus, according to Porter the competitive advantage of an integrated solution has to be based upon providing unique benefits, or added value, to a customer. Hax and Wilde (1999) mention ‘customer solutions’ as a distinct strategy to cope with competition. One could say that integrated solutions are differentiated beyond products and that the breadth of a solution is a key differentiator. Finally, the added value that is created when offering an integrated solution, needs to be perceived as such by the client; otherwise the client loses a compelling reason to buy the solution. According to Roegner *et al* (2001) the value of the integrated whole exceeds the value of its discrete components.

5.2.3.2 Business need

Secondly, an integrated solution is concerned with more than just products (e.g. Foote *et al*, 2001). For example, an integrated solution is not about a separate boiler house or steam turbine, but deals with a client’s total energy needs. It thus focuses on a specific business need of a client, rather than a technical need (Shepherd & Ahmed, 2000). This implies that integrated solutions are concerned with an entire business process (e.g. Consultant Medical Solutions, company B). To move successfully into solutions, companies are withdrawing from some activities and taking over a whole set of a client’s activities (e.g. ISS project team, 2000). Part of the value proposition of an integrated solution is that there is no need for the client to have the expertise involved in-house; so the client can focus on his core business (Website of company E).

A solution provider can, by analysing their clients’ processes, reduce inefficiencies in terms of material and energy use and labour utilization, thus leading to cost reductions. Solution providers therefore question the functionality of current products and systems (Company Director, company C). They develop function specifications rather than specifying products (Consultant Medical Solutions, company B).

5.2.3.3 Integration

As the name indicates, another feature of integrated solutions is ‘integration’. Solution providers integrate a wide range of products, services, systems, knowledge, and support into a tailor-made solution for their clients (e.g. Corporate brochure on IT solutions, company B). Integration can result in increased efficiency, productivity, and transparency of a client’s operations (Corporate brochure on IT solutions, company B, 2001). ICT can play an important part in this (Shepherd & Ahmed, 2000), since it has the ability to integrate hitherto separate elements, thus enhancing the efficiency of the solution (e.g. eBusiness Director, company A). Companies have to extend their systems integration activities in order to become successful solution providers (e.g. Davies, 2001), but they often struggle to integrate the full range of products and technical capabilities into customer solutions (Foote *et al*, 2001).

5.2.3.4 Life cycle

Integrated solutions provide increased and continuous revenue (e.g. Shepherd & Ahmed, 2000). They are not a short-term fix but are rather about long-term improvements (Website of company E); integrated solutions are provided through long-term contracts (Marketing

Director, company E). This implies that solution providers remain involved in the solution throughout its life cycle. Therefore life cycle management skills become important (Womack & Fitzpatrick, 2000). When being involved in the solution throughout its lifecycle, feedback loops become essential (Davies, 2001). Information about the operational characteristics of the solution can be fed back to the provider so that the solution can be continuously improved upon. Clients are increasingly receptive to using life cycle costs to evaluate different solutions (e.g. Company Director, company C).

5.2.3.5 Performance

Another feature of integrated solutions is 'performance'. Usually some sort of performance guarantee is involved in the delivery of integrated solutions (e.g. Sales Manager, company D). The solution provider takes care of a certain business problem, ensures a performance level, and the client pays a premium for this. The solution provider is responsible when performance levels are not met. Since the responsibility of cost and performance remains in the same hands (Womack & Fitzpatrick, 2000), the provider has an incentive to enhance the efficiency of the solution, i.e. to assure a certain result while using as little resources as possible. This way the solution provider shares in the risk involved when operating the solution; i.e. there is a greater assumed accountability by the solution provider (e.g. Roegner *et al*, 2001). By agreeing gain-sharing agreements, for example, both the solution provider and client can share in the minimisation of costs.

5.2.3.6 Customer intimacy

Another feature of integrated solutions is 'customer intimacy'. With integrated solutions the customer, plays a crucial role. Providing solutions is not about developing and manufacturing products and selling these to customers in a retail environment. It is about getting closer to the customer and working with the customer to define problems for which solutions are needed (Shepherd & Ahmed, 2000). The solution provider then tailors its offering to the customer's needs. The company thus needs to have the ability to see the problem from the customer's perspective (e.g. Davies, 2001), and needs to understand the client's operational requirements (Davies, 2001; Foote *et al*, 2001). They have to forge close relationships with clients (Consultant Medical Solutions, company B), which might result in customer allegiance (Wise & Baumgartner, 1999). It is imperative for a solution provider to be flexible towards clients, and to be able to offer a wide range of products, services and financial arrangements (e.g. Company Director, company C). The provider also needs to be able to respond to changing customer demand (Shepherd & Ahmed, 2000).

5.2.3.7 Partnerships

'Partnerships' has been identified as another feature of integrated solutions. Partnerships with other companies or parties are often necessary to provide all the knowledge, expertise, and hardware needed for delivering an integrated solution (Company Director, company C; Company Director, company D). It is considered to be valuable to work with other market winners in order to provide excellent and robust solutions (eBusiness Director, company A). Besides that, it is found useful to work with industry associations and regulatory bodies in order to help formulate and to anticipate industry standards affecting the solution (e.g. Consultant Medical Solutions, company B). Working in partnership might prove to be difficult, especially since this might involve sharing information with other parties (Foote *et al*, 2001) and teaming up with competitors to ensure compatible solutions (Shepherd & Ahmed, 2000).

5.2.3.8 Capabilities

Another feature of integrated solutions is ‘capabilities’. When a company moves from selling products to providing solutions, broader skills and capabilities are required (Foote *et al*, 2001). Since a solution provider is responsible for providing a solution to a client’s business problem on a long-term basis, there are a lot of skills, knowledge and capabilities involved in offering solutions. The most important ones are: system integration capabilities, business consulting capabilities, operating services capabilities, technical competence, life cycle management, market knowledge, and soft skills (e.g. Womack & Fitzpatrick, 2000; Shepherd & Ahmed, 2000; Davies, 2001).

Although it is desirable that the solution provider is able to offer all the elements of a solution to its client (Website of company C), there is no need to have all the knowledge and skills involved in-house. Partnering with other market winners, who do have certain skills, can lead to synergy and can lead to the development and provision of excellent solutions (eBusiness Director, company A).

5.2.3.9 Organisational structure

The last feature of integrated solutions is organisational structure. No accepted business model exists as yet (Davies, 2001), but the organisational structure needs to change if a product-oriented company wants to change towards providing solutions (e.g. ISS project team, 2000). A company has to make make-or-buy decisions about acquiring new skills. Besides that, the company has to redefine its role in the value chain (Davies, 2001) and carefully define its competitive advantage (Consultant Medical Solutions, company B). This is especially important when the company gets involved in partnerships. The solution provider needs to be neither product nor system bound (Website of company C); they must be willing and able to provide solutions with or without using their own products. They have to look beyond their own products for the optimal solution. The way the company performance is measured will have to change, since offering solutions is more than just selling products (e.g. Shepherd & Ahmed, 2000). Finally, the company needs to provide space for experimentation in different organisational forms (Davies & Brady, 2000), for setting up the development of integrated solutions.

Foote *et al* (2001) have proposed a new organisational structure with front-end customer based units, product-business units have refocused as back-end supporters, and a top management strong centre is in place to mediate. There is a high degree of interdependence and accountability across units (Foote *et al*, 2001). The organisational structure needs to allow the opening up of the knowledge and skills present in the organisation (Company director, company C).

5.3 THE ECO-EFFICIENT SOLUTIONS MODEL

The next section reports on the development of the eco-efficient solutions model. Firstly, it is explained how the model is developed. Next, the features of the integrated solutions framework are discussed in relation to the concept of eco-efficiency. Finally the eco-efficient solutions model is presented.

5.3.1 DEVELOPMENT OF THE MODEL

As has been made clear in the previous chapters, the central question to this thesis is how knowledge of integrated solutions can support the development of more eco-efficient services or solutions. Hence, first of all, in order to comprehend the concept of integrated solutions, a framework has been presented in the previous section. Next, it is essential to look at the concept of eco-efficient services in order to make a connection between the concepts of integrated solutions and eco-efficient services.

The review of eco-efficient services literatures in Section 2.3 has shown that the concept has not yet been fully developed and the concept covers a broad range of services. Besides that, many different examples of allegedly eco-efficient services are mentioned. This makes it difficult, if not impossible, to determine *the* characteristics of an eco-efficient service. There are only two characteristics of eco-efficient services that all these services have in common. Firstly, they are a mix of products and services, and secondly, they are aiming to be more eco-efficient than present options. Since integrated solutions themselves are a bundle of products and services (e.g. Davies, 2001; Foote *et al*, 2001), this first characteristic of eco-efficient services is paid no attention. This leaves the second; eco-efficient services are aiming to be more eco-efficient than present options.

This is why, to make the connection between integrated solutions and eco-efficient services, the concept of eco-efficiency has been used. (This concept has been discussed in more detail in Section 2.2.2.) According to DeSimone and Popoff (1997) the essence of eco-efficiency is contained in seven simple guidelines (p. 3):

1. Reduce the material intensity of goods and services
2. Reduce the energy intensity of goods and services
3. Reduce toxic dispersion
4. Enhance material recyclability
5. Maximise sustainable use of renewable resources
6. Extend product durability
7. Increase the service intensity of products

In the same publication they state,

“Eco-efficiency harnesses the business concept of creating value and links it with environmental concerns. The goal is to create value for society and for the company, by doing more with less over the entire life cycle.” (p. 10)

The seven dimensions above stress the environmental concerns, but fail to address another facet that is mentioned in the quotation: creating value. Since eco-efficient services are often coined as a way of unlinking value creation from resource consumption (e.g. Goedkoop *et al*, 1999), it was deemed necessary to add ‘creating value’ as an eighth dimension of eco-efficiency.

For the development of the model, the framework as presented in the previous section has been used as a basis. The features and their attributes were examined on their possible effects on the eco-efficiency of an integrated solution. This has been done through using the eight dimensions of eco-efficiency as mentioned above. The relevant attributes were discussed and the main attributes that have been identified to contribute towards increased eco-efficiency were put in the model – then called ‘elements’. These elements form the starting point of further research, which is discussed in the next chapter.

5.3.2 FEATURES OF THE FRAMEWORK AND ECO-EFFICIENCY

Next, the nine features and their contribution towards eco-efficiency are discussed. The main attributes, in terms of eco-efficiency, are highlighted at the end of each subsection.

5.3.2.1 Added value and eco-efficiency

Creating added value as perceived by clients has no direct effect on the eco-efficiency of an integrated solution, but indirectly it does. This has all to do with the eighth dimension of eco-efficiency – creating value – which was introduced in the previous section. By offering something with radically increased value, but with similar environmental impact, the environmental impact per ‘unit of value created’ is reduced. This notion is illustrated in Figure 5.3 below.

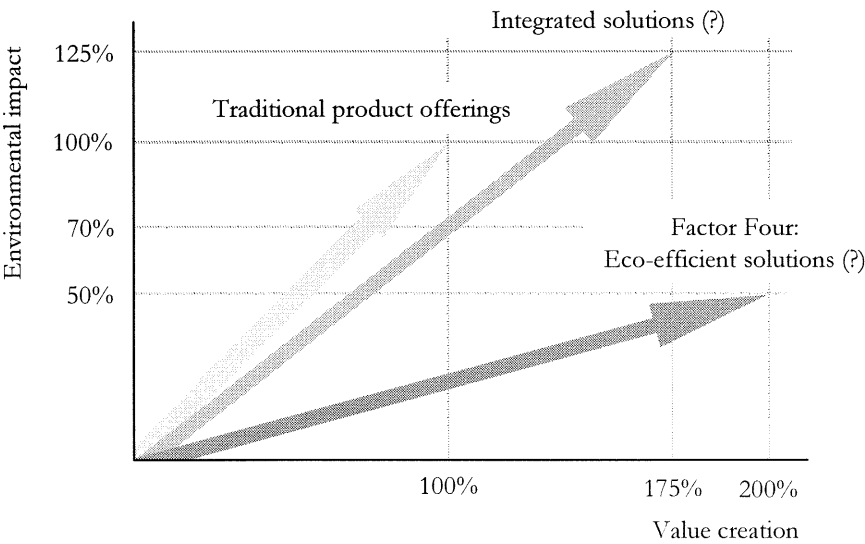


Figure 5.3 Integrated solutions and their speculated environmental impacts

A ‘traditional’ average product offering has a certain environmental impact per unit of value created (see discussion on E2-vector in Section 2.3.4.1). An integrated solution might have a higher total environmental impact, say 125 per cent compared to the original product offering, but the value created is significantly higher, say 175 per cent compared to the original. This leads to the guesstimate that the environmental impact per unit of value created has been reduced by nearly thirty per cent, only seventy-one per cent of the ‘original’ impact per unit of value. There is as yet no proof that these figures are anywhere close to reality, but it illustrates the idea that the average environmental impact can be reduced through the creation of a considerable amount of added value. This notion is further illustrated by the third arrow in Figure 5.3, which stands for ‘eco-efficient solutions’. Again, it is unclear whether this corresponds with reality, but this resembles the strategy Von Weizsäcker *et al* promoted in *Factor Four: doubling wealth, halving resource use* (1997).

☞ Focus on creating value, thus indirectly reducing the environmental impact per unit of service, thereby improving its eco-efficiency

5.3.2.2 Business need and eco-efficiency

Focusing on a whole process or business need, rather than on discrete products might enhance the eco-efficiency of an integrated solution. When focusing on a business need, the solution might be better tailored to the client's needs. As a result there might be less to none redundancy in terms of functionality. This might lead to reduced material and energy intensity per unit of service. For example, in a hospital's radiology department when celluloid films were used, several separate systems covered parts of the radiology workflow, such as the celluloid films, paper patient records, and an electronic hospital information system. In the new digital radiology department the solution provider offers one system which covers the entire workflow within the radiology department. This leads to optimised interdepartmental processes and avoiding unnecessary steps (Corporate brochure on PACS, company B). This example shows enhancing eco-efficiency by increasing the service intensity of products. In this case by multifunctionality; where a product has more than one function leads to reduced environmental impacts. Multifunctionality can be brought into effect by focusing on a whole process. This way the multiple functions can be determined by a single solution provider. Additionally, focusing on a business need might enable the development of novel concepts with radically reduced environmental impacts, since they affect a whole process rather than separate products and services.

When a solution provider takes over entire customer activities, the client, in effect, engages in outsourcing and solution provider becomes an outsource provider. One of the characteristics of outsourcing is that the outsource provider is specialized in certain activities and has a lot of expertise. As a result, the provider might become more efficient, thus reducing the material and energy intensity per unit of service.

If a client does not know their processes, for instance because they have evolved over time, these processes might be inefficient. The solution provider can, by analysing these processes, reduce the inefficiencies in terms of their material and energy use, thus leading to cost reductions. This can be achieved through two approaches: firstly, through capturing the 'low-hanging fruits' by optimizing current processes, and secondly, through a holistic approach. The latter approach might lead to more substantial environmental improvements but this usually involves investment in new products, services and technology; for example, when moving from an analogue to a digital radiology department.

Environmental regulations in a business area can sometimes spark the demand for a certain solution (Consultant Medical Solutions, company B). This enhances the qualities of the solution from an environmental point of view since it actively focuses on the environmental effects of certain elements.

- ☞ Focus on the whole process or business need, rather than on separate products and/ or services – tailor solution, discard inefficiencies and redundancy
- ☞ Outsourcing – enhancing efficiency through specialization

5.3.2.3 Integration and eco-efficiency

The feature 'Integration' is closely related to the previous feature 'Business need', since integration can be made possible through focusing on a business need. The solution might be more effective than the products and services that were used in the 'original situation'

and as a result there might be less redundancy in terms of functionality, thus directly leading to reduced material and energy intensity. Because a solution provider focuses on an entire business need, these system integration capabilities can be extended even further.

Information and Communication Technology (ICT) plays a key role in integration, since it allows the integration of hitherto separate systems. ICT can result in “shipping less physical stuff around” (eBusiness Director, company A). The new products and infrastructure required for the use of ICT, result in additional environmental impacts, but these products and infrastructure can be used to fulfil other needs as well.

☞ Extending systems integration capabilities

☞ Utilising the power of ICT

5.3.2.4 Lifecycle and eco-efficiency

The solution provider is involved in the solution throughout its life cycle. An integrated solution is no short-term fix but a long-term improvement which needs to be profitable and efficient over time. This might result in a more efficient way of fulfilling a business need and reducing the material and energy intensity. Solution providers often rely on an installed-base annuity-stream (Wise & Baumgartner, 1999). This means these companies pursue a different way of securing revenue; not necessary by selling more products but by providing support and knowledge. This might reduce the material intensity over time.

The increased receptivity to life cycle costs among clients (e.g. eBusiness Director, company A), might provide an opportunity for more eco-efficient solutions. Lifecycle costs can be used to communicate the benefits of different options. Lifecycle costs do not just consider the manufacturing stage of the product life cycle but the entire life cycle, including the use and end-of-life stages. Since the solution provider remains responsible for the solution throughout its lifecycle, the company can use lifecycle costs to evaluate different options. This can lead to choosing options that are more (eco-) efficient.

Finally, when offering integrated solutions, the solution provider might use feedback loops in order to enable obtain information on the solution throughout its life cycle. This information can then be used to improve the solution, as well as its efficiency.

☞ Lifecycle costs can be used to communicate the benefits of options

5.3.2.5 Performance and eco-efficiency

With integrated solutions the responsibility of costs and performance often remains in the same hands, enabling the solution provider to guarantee a delivered value and take the responsibility for some portion of the client’s risk. The solution provider will try to maintain a certain level of performance while using less material and energy, thus increasing its profits. This in turn leads to reducing the material and energy intensity of a solution over time. Contractual agreements and the way a solution is provided, can influence the environmental characteristics of the solution and the incentives to drastically reduce energy and resource consumption. One can think of performance contracting, operational leasing, outsourcing, forward integration, integrated resource planning, among other approaches.

Performance guarantees are an appropriate way of minimizing the costs associated with the integrated solution. Minimisation of costs is achieved through optimization, i.e. enhancing efficiency, which means that less material and energy are required to fulfil a certain need.

It is important to note that, although a solution might be more efficient than the ‘original situation’, this does not mean the solution is automatically more eco-efficient. It excludes the toxicity and the relatively unsustainable or sustainable use of material and energy. This raises the following questions: To what extent is a company that pursues efficient operations more eco-efficient? How can companies inevitably select the most eco-efficient material or energy option? How can we ensure efficiency equals eco-efficiency?

☞ Performance guarantees

☞ Efficiency versus eco-efficiency

5.3.2.6 Customer intimacy and eco-efficiency

Through having an intimate understanding of the client’s needs, a detailed insight into a client’s operational requirements can be gained. This might in turn lead to a more tailor-made solution, reducing overcapacity or redundancy, thus enhancing the (eco-) efficiency. Besides that, focusing on the client’s operational requirements, rather than on products, might create radically different concepts with enhanced eco-efficiency.

One of the findings of the Pilot Study is that the environment is a client-specific issue. For example, in industries with a high energy and material throughput, or with a lot of toxic emissions, the environment plays a different role than in the legal service industry. Therefore, any approach to enhancing the eco-efficiency of the integrated solutions also has to differ across different industries. It can thus be assumed that it is important to analyse the client’s situation in order to find out how and to what extent the environment is an issue. After that, the approach to improve the eco-efficiency of the integrated solution, can be determined accordingly.

☞ The environment is a client-specific issue

5.3.2.7 Partnerships and eco-efficiency

Partnerships with other parties are often necessary to provide all the expertise and hardware needed for delivering an integrated solution. Through partnering with market winners, robust and compatible solutions can be provided (e.g. eBusiness Director, company A). This might reduce waste and material and energy intensity, thus having a positive effect on the eco-efficiency of an integrated solution over time. Working closely with industry and regulatory bodies might lead to developing industry standards for example (Corporate brochure on IT solutions, company B). Besides enabling more robust and compatible solutions, these industry standards could include environmental requirements, thus directly leading to more eco-efficient solutions.

☞ Partner with market winners and work closely with industry and regulatory bodies in order to offer robust solutions

5.3.2.8 Capabilities and eco-efficiency

It has become clear that a solution provider needs a wide range of skills and capabilities in order to provide an integrated solution. According to Womack and Fitzpatrick (2000), lifecycle management skills are among these capabilities:

“They will manage the life cycle of their output, rather than ‘throwing it over the wall’ to someone else.” (p. 53)

This means that a solution provider needs to be conscious of the lifecycle of solutions and their corresponding material and energy consumption during the use phase for example. Once he appreciates his solution’s lifecycle, the solution provider might take action to positively influence the (eco-) efficiency of the solution.

Solution providers have to develop various new competences. As stated by Shepherd and Ahmed (2000) it is important to leverage these new competences once they have been developed. This links back to the Bowling Alley market development strategy as coined by Geoffrey Moore (See Section 4.3.2.3), where the company extends their activities to new segments in the same industry and simultaneously to similar segments in new industries. This might ultimately result in the solution provider becoming more (eco-) efficient, in terms of its resource use.

☞ Lifecycle management skills

5.3.2.9 Organisational structure and eco-efficiency

As mentioned earlier in this thesis, no accepted business model offering integrated solutions yet exists (Davies, 2001). This makes it difficult to discuss the organisational structure of solution providers, let alone its environmental implications. However, it is clear that a solution provider, as compared to a product-oriented company, needs a different measurement of success:

“... success is ultimately measured by a customer’s improved business performance rather than by a product’s performance to specification.” (Davies, 2001, p. 87)

The corporate success of product-oriented companies can be measured using the number of products sold as a dimension of success. Success needs to be measured differently for a solution provider, since he aims to meet a business need by using a mix of products, services, and expertise. The throughput of products is not the main criterion of success anymore, but must be something different; like the amount of service and support provided per monetary unit. Once the appropriate units of measurement are in place, the provision of integrated solutions and their contribution to revenue and profits have been made transparent. The solution provider might then be able to enhance the (eco-) efficiency of their whole business operations.

☞ Redefine ways of measuring company performance

5.3.3 THE ECO-EFFICIENT SOLUTIONS MODEL

After examining the various attributes of the nine features of the integrated solutions framework, a number of attributes that might have an effect on the eco-efficiency of an integrated solution, have been identified. These attributes might have an effect on the environmental impact of the solution, its efficiency, or the value created by offering integrated solutions.

On the next page, the eco-efficient solutions model is presented (Figure 5.4). The integrated solutions framework has been used as a basis for this model, since it represents the various features of the integrated solutions concept. The attributes that are relevant from an eco-efficiency point of view are attached to the features of the framework. The attributes that are presented in the model are now called 'elements'. The eco-efficient solutions model provides a comprehensible picture of integrated solutions and their role in developing and providing more eco-efficient services or solutions. This model is used to communicate the findings from the research that has been undertaken and forms the starting point for further research, which is discussed in the next chapter.

5.4 CONCLUSIONS

This chapter has reported on the development process of the eco-efficient solutions model. Firstly, an integrated solutions framework has been presented, which consists of nine features. This framework helps to grasp the comprehensive nature of this novel concept. Secondly, the eco-efficient solutions model has been introduced. This model is based upon the framework and shows the different elements that might be involved in the development and offering of more eco-efficient services or solutions.

These elements might have an effect on the environmental impact of the solution, its efficiency, or the value created through offering integrated solutions. The elements that might directly affect the environmental impacts of a solution are lifecycle management skills; lifecycle costs; and working closely with regulatory bodies. Elements that might influence the efficiency of a solution are focusing on the whole process; outsourcing; lifecycle costs; and extending system integration capabilities. The elements that focus on the value created are focusing on creating value and partnering with market winners. Other elements are a mixture of these three elements: redefine ways of measuring corporate performance; performance guarantees; and utilising the power of ICT. This leaves two elements which are more or less questions affecting the environmental impact of a solution; eco-efficiency vs. efficiency and the environment being a client specific issue.

The elements presented in the model form the starting point of further research. This is undertaken in order to find out more about the role of the elements identified, in developing and providing more eco-efficient services or solutions. This research process and its findings are discussed in the next chapter.

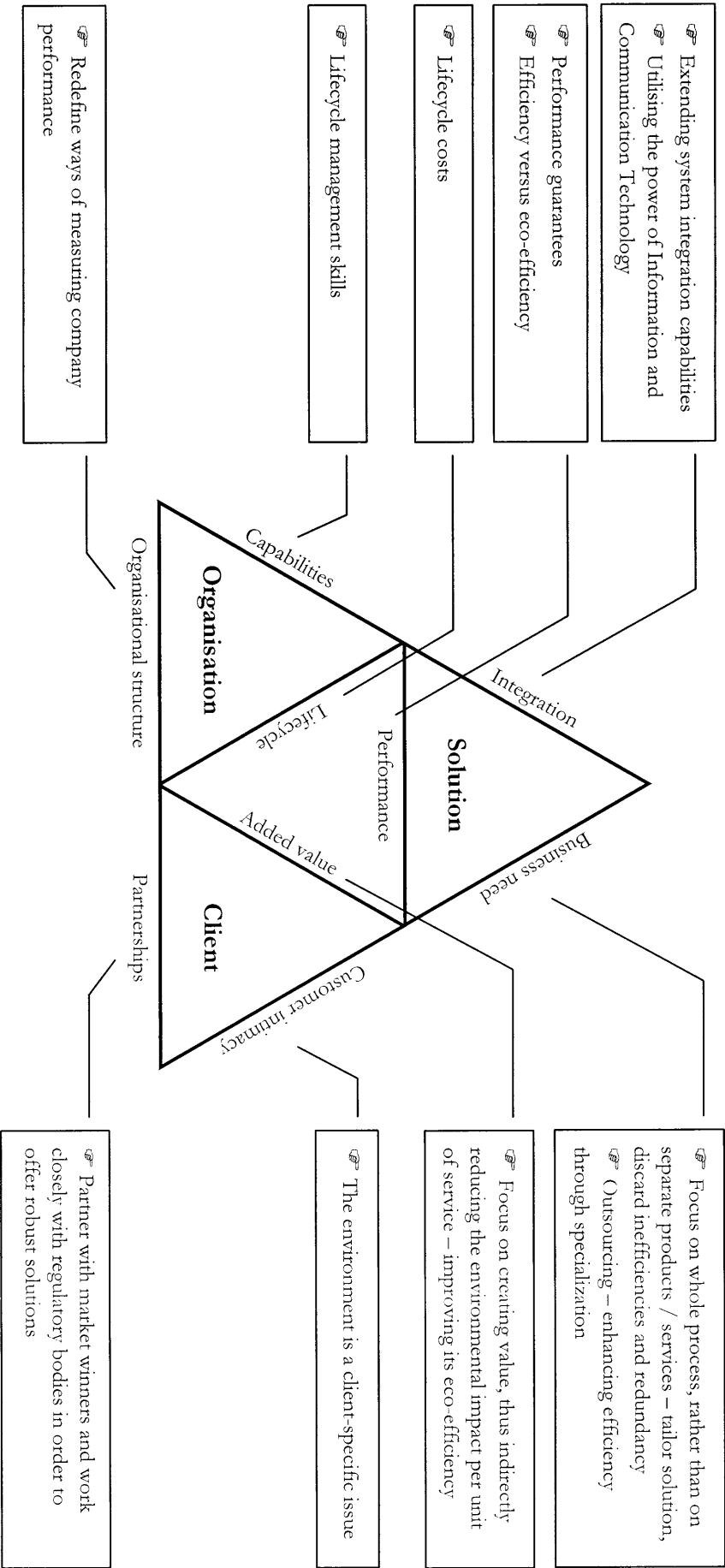


Figure 5.4 The eco-efficient solutions model

6 VALIDATION

The framework and model developed in the previous chapter have been discussed with companies and environmental consultancies. These findings are reported in this chapter. The increased understanding of the elements from the model and their possible contribution towards a more eco-efficient solution are described. Based on this, a refined eco-efficient solutions model is developed and presented.

6.1 INTRODUCTION

In the previous chapter a framework for integrated solutions has taken shape. The framework formed the basis for the eco-efficient solutions model, which was subsequently developed. Both framework and model were based on findings from the Literature Review (Section 2.4) and the Pilot Study (Chapter 4). The model was developed in order to highlight attributes of integrated solutions that were considered to have an impact on the eco-efficiency of an integrated solution.

Following the research design, as described in Chapter 3, the next step in the research process is validation of the model. The purpose of the validation process is twofold; firstly, assessing the quality and usability of the framework and model, and secondly, finding out more about the elements presented in the model and their contribution towards increased eco-efficiency of a solution. This validation process results in increased understanding of integrated solutions and the prospective delivery of eco-efficient services or solutions and leads to refining both framework and model. This is shown in Figure 6.1 below. This chapter aims to report on the Validation and the refined integrated solutions framework and the eco-efficient solutions model.

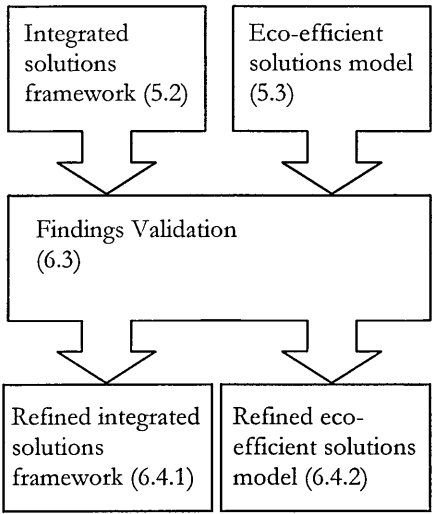


Figure 6.1 The validation process (and the sections in which the corresponding parts can be found)

In the next section, the companies that have participated in the Validation and their solutions are introduced; the findings from the Validation are then presented. In Section 6.4, the findings from the Validation are used to refine both the framework and the model. In this section the refined model is described and notes on its application are made. In the final section of this chapter, the findings are summarised and conclusions are drawn.

Finally, it is important to note that all the methodological issues concerning the structure, design, and execution of the Validation have been discussed in the Research Methodology chapter (Section 3.3.4). This chapter does not repeat these issues and is only concerned with the findings of the Validation.

6.2 VALIDATION PARTICIPANTS

In Table 6.1 below, the companies and the integrated solutions that have been studied in the Validation are briefly introduced. More information on the companies and their solutions can be found in Appendix A. These companies are anonymous due to confidentiality issues. The Validation took place within divisions or departments of multinational companies. In order to make the chapter readable, all the departments and divisions of different companies are named ‘company A’, ‘company B’, etcetera.

Company	Description	Integrated solution
Company A	A very large global provider of enterprise technology and solutions	Mobile solutions Life cycle solutions
Company B	A very large multinational company offering medical solutions to business-to-business clients	Picture Archiving and Communication Systems
Company F	A very large multinational company providing document solutions to business-to-business clients	Total document solutions
Company G	A multinational company providing total chemical management to business-to-business clients	Total chemical management systems
Company H	A multinational company providing integrated security systems to business-to-business clients	Integrated security systems

Table 6.1 Validation participants

The respondents of all companies were familiar with the tenor of the concept of eco-efficiency through, for example, recycling and environmental policies (e.g. company F) or customer requirements and legislation (e.g. company H).

Apart from the five companies mentioned above, two environmental consultancies (consultancy I and consultancy J) have been approached to discuss the environmental implications of the various elements of the model. In addition, the integrated solutions framework and the eco-efficient solutions model have been discussed with two academic researchers in the field of integrated solutions (Davies & Tang, 2002).

6.3 FINDINGS VALIDATION

In this section the findings from the Validation are reported. To give structure to this section, it is useful to first present the findings related to the different elements of the eco-efficient solutions model. After that, the findings related to the framework and the model as a whole are presented. The main findings, in terms of contribution to increased eco-efficiency, are highlighted at the end of each sub-section.

6.3.1 FOCUS ON THE WHOLE PROCESS

Based on the literature and the findings from the Pilot Study, it was seen that focusing on a whole process or business need, rather than focusing on separate products and services, would allow for tailoring of the integrated solution, thus eliminating the inefficiencies and redundancy present in the 'previous' situation.

During the Validation, it became apparent that it is beneficial for companies to look at the processes and their output as the basis for the integrated solution on offer. Company B, for example, defines and assesses their clients' radiological and other medical processes in a systematic manner, and uses the findings to put together their offer for a radiological solution (Consultant Medical Solutions, company B). A company should also look at what their client's customers want to achieve, thus driving them towards realising their respective business goals (Head of Document Solutions, company F). It is also important to consider the interdependencies between, or vested interests of, companies:

"You talk about [an oil company] for example and there is a huge interdependency between them and the vehicle manufacturers. There is no point in them suddenly producing more eco-efficient fuel if nobody buys or uses it." (Managing Director, company F)

"If a company has a vested interest or a motivating force it always goes back to that. Many of our competitors do have vested interests and we say that our selling point is that we don't." (Marketing Manager, company F)

Increased eco-efficiency when focusing on a process should be possible, since a company has more degrees of freedom than when offering a product (Consultant, consultancy I), or as stated by the Head of Document Solutions from company F:

"We do try to promote broadening everything out; the big picture, the end-to-end. Whereas when you ring-fence a particular production area: you can get statistics to do whatever you want, but if you ring-fence something, it shows that they all promote the efficiencies within that area, but overall it is a lot less efficient than it could be."

An issue to keep in mind is the risk of reduced reusability and recycleability of the products in a bespoke solution. It might, for example, be better for a client to slightly change their requirements so they fit existing products, which leads to standardisation and economies of scale (Solutions Architect, company A).

- ☞ Focusing on a whole process or business need, rather than on separate products and services, has the ability to enhance the (eco-) efficiency of the solution
- ☞ Be aware of interdependencies or vested interests in the 'previous' product-oriented situation

6.3.2 OUTSOURCING

In the eco-efficient solutions model it is assumed that efficiency can be enhanced through outsourcing. According to the literature (e.g. Quinn, 1992; Rifkin, 2000) enhanced efficiency can either be achieved through economies of scale or through applying specialised expertise. The basis of efficiency differed for the companies taking part in the Validation. For company F specialisation is a bigger driver than economies of scale, but in the case of company H, the ability to deal with larger security systems allows the incorporation of hundreds of locations into one system, resulting in enhanced efficiency.

Although eco-efficiency is not a rationale for outsourcing for the clients of company F, when explicit attention is paid to environmental issues, outsourcing can be advantageous in terms of eco-efficiency:

“Induce the opportunity to outsource some of their processes. Somebody is going to invest in the technology that is going to enable them to go much faster on that eco-efficiency route than they would be able to do it themselves.” (Managing Director, company F)

There is, however, the danger of over-performance when companies outsource their business operations. This is something that the Managing Director of company F has come across. Some companies want them to achieve, but not exceed, service levels. Otherwise they say ‘You are charging us too much – you are being too efficient’. Thus it seems important to pitch at whatever the service level is.

- ☞ There is a danger of over-performance when outsourcing business activities
- ☞ Outsourcing could accelerate eco-efficient business operations

6.3.3 EXTENDING SYSTEMS INTEGRATION CAPABILITIES

It was understood that efficiency could be enhanced and redundancy could be reduced through integration of previously separate systems. In the past, because of technological limitations, there existed only partial solutions, but they have now grown together into an integrated solution (Consultant Medical Solutions, company B). However, this may take additional effort:

“The solution integration, all service operations, the solution generation is within my group. The reason for that is you don’t want a Frankenstein’s monster sewn together at the end, without having consideration for the bigger picture. That is something we have found produces a better solution.” (Head of Document Solutions, company F)

Considerable gains in efficiency and cost savings are possible through integrating previously separate systems. In an integrated security system for example, a client’s access control, intruder system, and cameras can be integrated into one system, or 800 locations can be linked up to one big system, rather than having 800 separate security systems. Also more and more systems can be integrated, like the car park, front door, vending machine, copier, and even PC access. Eventually, the same system can monitor people going in and out of the building and adjust the lights and heating accordingly.

“It is not being driven by the eco-requirement; it is being driven by the cost-element. But the by-product is eco-friendly.” (Managing director, company H)

6.3.4 UTILISING ICT

In the model the use of information and communication technology (ICT) was seen to increase eco-efficiency, through shipping less physical matter. ICT was also considered to be an enabler for integrating previously separate elements. With integrated security systems, ICT has enabled remote interrogation of systems; thus saving time, energy, and resources. Company H only has to visit one in three systems that breaks down, as it can fix the other two remotely. In company G, ICT has enabled the shift towards a paperless laboratory; they have managed to reduce their paper use by eighty per cent, by using bar-coding utilities and providing digital recipes. They also operate an enterprise resource planning system, in which a customer order cascades down through the organisation. ICT has also enabled an effective continuous improvement programme, reducing waste and the use of resources. In company F, ICT has enabled the shared use of resources in their in-house technology centres, which have an utilisation rate of at least sixty per cent, rather than the five per cent that is typical of resources installed at the client’s site. This reduces the cost down to one piece of equipment and one engineer being used efficiently, rather than using a fleet of equipment and consumables.

According to the Managing Director of consultancy J it is important to look at the energy consumption of ICT during its use phase. The Internet, for example, consumes a lot of energy; in The Netherlands, roughly ten per cent of the national energy consumption is accounted for by the Internet, i.e. for powering servers. It is also crucial to note that if ICT only brings about cost reductions, the eco-efficiency does not change; the budget does not change and people start using more of that product – the ‘rebound effect’ (see Section 2.3.2) (Managing Director, consultancy J). There is discussion about the low costs of adding additional services on to the Internet. It might be useful to look at the environmental impact or energy use per byte of information.

- ☞ Be aware of energy consumption of ICT during use phase
 - ☞ Be aware of the ‘rebound effect’
 - ☞ Be conscious how to use ICT

6.3.5 LIFECYCLE COSTS

It is assumed that lifecycle costs or Total Cost of Ownership (TCO) can be useful to communicating the benefits of different solutions, which might lead to clients choosing the

most (eco-) efficient solutions over their lifetime. There are generally two uses; it can be used to evaluate the different options internally and it can be used to communicate the costs of solutions to clients. The Managing Director of company H often tries to explain to clients the implications of different options for security systems. The option with more up-front costs might be much cheaper and more reliable over its lifetime, whilst with the cheaper options the costs of going over to the client's site to replace equipment have to be taken into account as well.

“So overall, [the one with more up-front costs] is the much better solution and you’ve got the quality in the first place. It is not an easy sell, but any good salesman can sell it, put it that way. So yes, we do push the most efficient options.” (Managing Director, company H)

The client might not always be ready for a lifecycle approach. They can have certain expectations when engaging in acquisition which are based upon a more traditional product selling approach, or they get their budgets allocated in a certain way, which does not allow them to look beyond the up-front costs (Consultant Medical Solutions, company B).

According to the Managing Director of consultancy J it is important to distinguish between the two uses of TCO; one is about improving efficiency in the value chain, and the other is about the costs to the user. There are also limited parallels with environmental lifecycle assessment (LCA), since an LCA ignores elements such as investment costs, capital goods, debits, R&D, and marketing for example. Cost calculation is much more detailed.

☞ Different information requirements for lifecycle costing and lifecycle assessment

6.3.6 PERFORMANCE GUARANTEES

After conducting the Pilot Study, it appeared that guaranteed performance might give the solution provider an incentive to fulfil a need, while using fewer resources. Company F operates performance guarantees but,

“... the industry is increasingly price sensitive, and even if you operate performance guarantees it is difficult to get it right, because of competition and buyer awareness” (Managing Director, company F).

Consulting businesses deliver their services based upon two dominant pricing models. The first is the fixed price model, where functionality is delivered for an agreed upon price. This is usually done when there is a clear understanding of what needs to be provided. The second model is the time & materials model, where the consultancy works together with the client, employing a number of people and charging the client for the amount of time and materials required to provide that functionality. This is usually done when the understanding of a business problem is less clear. There is a commercial reluctance to be too transparent. How much it costs the solution provider to deliver a solution is of his concern; the client obviously values the solution because he is willing to pay for it (Solution Architect, company A).

A crucial attribute of providing a solution is leveraging competencies. If a company delivers a solution to one client it provides the solution at a loss. Moreover, if the same company

delivers the solution to a hundred clients there is leverage and it can make a profit. However, this makes it more difficult to be transparent in terms of costs. A company usually agrees with a client to support a solution for five years with a fixed contract and service level agreements (SLAs). They expect the company to become more efficient over time (Solution Architect, company A).

According to the Consultant of consultancy I, with big contracts a solution provider might try avoiding risk, by putting in additional products, as long as the client is satisfied. This is the case with company B, where sometimes additional equipment is put in place to cover the client's risk as agreed upon in the SLA, because they are short of information about the products themselves. This needs to change by linking sales and maintenance departments together and by collecting data on the performance of their equipment.

☞ Leveraging competencies
☞ Risk avoidance and information of solution

6.3.7 EFFICIENCY VERSUS ECO-EFFICIENCY

Through literature and the Pilot Study it became apparent that integrated solutions possess characteristics that might enhance their efficiency, like the elements presented in the model. However, an important question remains: to what extent is something that is more efficient also more eco-efficient? At first glance the two concepts seem to be alike.

“The distinction between economic efficiency and eco-efficiency is rather tenuous.”
(Solutions architect, company A)

“... there might be the odd exception, but generally they are the same thing”
(Managing Director, company H)

After taking a closer look, however, there appear to be differences between the two concepts:

“You can achieve efficiency but you can still harm the environment; there are certain elements which aren't a cost. So the difference is to find those elements which don't cost the organisation directly, but do cost the environment.” (Marketing Manager, company F)

The difference was also articulated in that efficiency allows for more consumption with more impact on the environment (Marketing Manager, company F). It is therefore imperative to introduce the concept of eco-efficiency if you want to achieve reduction in the environmental impacts, because cost-reduction alone is not enough (Managing Director, consultancy J).

It appears that the difference between efficiency and eco-efficiency has also to do with value association; how do you value time, money, resources, etc.? Apart from that, the 'eco-model' is continually developed and,

“... there are a lot things we still don’t know what is good for eco-efficiency or not. We have a mindset which suggests certain things are more environmentally efficient but that is not necessarily true.” (Managing Director, company F).

Efficiency appears to be about choosing a sub-optimal choice. Eco-efficiency seems to go further; it is looking in a more thorough way at efficiency and it is more critical when looking at the functional unit. This could also be a selling point of your integrated solution (Consultant, consultancy I). According to one of the respondents eco-efficiency should be about demonstrating how it can provide better value. Recycling and refilling printer cartridges has got clear environmental benefits, but apart from that it is unclear how eco-efficiency can provide better value (Solutions Architect, company A). It is also useful to keep in mind that efficiency is only one of the attributes when selling a solution, i.e. targeting a new market segment might also be important. This might not require providing the most efficient solution, but can provide an opportunity for more eco-efficient solutions (Consultant, consultancy I).

- ☞ Eco-efficiency takes externalities into account (which are not yet internalised)
 - ☞ Value association
 - ☞ Lifecycle and environmental information
 - ☞ Link eco-efficiency to providing better value

6.3.8 THE ENVIRONMENT IS A CLIENT-SPECIFIC ISSUE

One of the elements that emerged from the Pilot Study is that the importance of the environment in the delivery of a solution depends on the client. The clients of company A have little real environmental concerns, they are mostly concerned with price, time to market, and customer satisfaction. Company G has a responsibility to check their customers out and find out whether they are economically viable and reliable. Some of company H’s clients are environmentally sensitive, and some clients are required to be. Those that are not required to be, generally tend to be smaller companies where efficiency, or eco-efficiency, is not seen as part of the agenda.

“But if you’re dealing with public authorities, they are now required to have an environmental policy in place, and that requires them to make sure that all their suppliers have a policy in place. So in that sense it is driven by the client... but if we’re dealing with retail operations down the street, then there it is not a requirement.” (Managing Director, company H)

It appears to be important to make a distinction between environmental policy or environmental awareness at solution level and at corporate level. Most of the companies try to comply with the environmental requirements of their clients, but this is not part of an overarching corporate strategy. In company G, for example, ISO14001 is a business requirement rather than a part of corporate strategy. In company F the environment is usually part of the pre-qualification process when dealing with clients. These clients send out questionnaires in order to mark the company’s environmental performance:

“They send out questionnaires to mark our environmental performance. If we don’t score enough points, we’re out.” (Head of Quality Management, company F)

Operationalising a company’s environmental policy seems to be a problem. Company B for example does not communicate this explicitly to their clients. According to the Consultant Medical Solutions of company B they should, and could, be a bit pushier with the information. There may be opportunities for communicating environmental issues:

“What we would be doing is trying to sense what the client is looking for. I mentioned earlier it is the opportunity of shaping client’s expectations and needs down the route which says you need to be more sensitive to the environment and we can help you achieve that, I don’t think has been a big driver historically, but may be something that we can help shape.” (Managing Director, company F)

The Consultant of consultancy I found when pitching their work to companies that it is easier to talk about innovation, but that you can use the environment as an additional selling point: if you do not mention the environment, you are wasting an opportunity.

☞ Link between environmental attitude at solution and corporate level

6.3.9 WORK WITH INDUSTRY AND REGULATORY BODIES

It emerged from the literature and the Pilot Study that it might be necessary to work with other parties in order to provide robust solutions. This is achieved through the sharing of information and the anticipation of industry standards. This could be an opportunity to incorporate environmental considerations in these partnerships. There is a possibility of using purchasing power to influence the qualities of products delivered by suppliers. On the other hand, power and negotiation flexibility plays a role; a company does not want to be too tied into a relationship, since it needs a sound level of competition across the value chain. This force works against collaboration across the chain (Managing Director, consultancy J).

Information overload is another issue that was acknowledged by the respondents:

“I think we tend to be reactive rather than be proactive at the moment. We would do what the government tells us. Partly, because they are telling us so many things, that we are running very fast to stand still. So, you’re not seeking to go one step ahead, because you’re already rushing to catch up. So that’s the problem there.” (Managing Director, company H)

The attitude of government towards environmental issues is important. In The Netherlands for example, the government does not give special treatment to companies that want to provide more environmentally friendly solutions. The government focuses at the minimum level, rather than at the maximum. They tend to focus on ‘regulation’ rather than ‘stimulation’ (Consultant, consultancy I).

☞ Focus of government tends to be on ‘regulate’ instead of ‘stimulate’
☞ Information overload

6.3.10 LIFE CYCLE MANAGEMENT SKILLS

When providing solutions instead of selling products, managing the life cycle of the output of integrated solutions becomes important. Company F monitors equipment downtime and the reliability of their product range, so they can identify the elements that cause them trouble, since ‘the lower the costs the more profitable they are’ (Head of Document Solutions, company F). However, a number of respondents revealed that their companies are still in a transitional stage. In company B, Sales and Maintenance are two separate divisions, but these divisions will have to be integrated (Consultant Medical Solutions, company B). In company G they haven’t had any reports from the clients stating how many wavers they manufactured with their products but,

“this might be relevant and interesting; look not only at the quality but also the functionality of the products” (Customer Service Engineer, company G).

With integrated solutions a company also has the ability to shape client’s expectations (Managing Director, company F), or according to Davies, solutions begin when a client starts thinking about what his problems are. There are many stages up until handing the product over, like pre-bid, conceptualisation, and planning, where solution providers are getting involved and adding services like consultancy and looking at financial models. So the solution’s lifecycle does not begin,

“... after handing it over, but way before, when it is just a little thought in your head.” (Davies & Tang, 2002)

- ☞ Integrate internal functions
 - ☞ Shape client’s expectations

6.3.11 REDEFINE WAYS OF MEASURING COMPANY PERFORMANCE

When a company provides an integrated solution, instead of selling products, different ways of measuring corporate performance may well have to be devised. This could be an opportunity to incorporate environmental considerations. It is essential to change the reward systems within a company, since when they are still based around product sales the move to providing an integrated solution is merely a rearranging of business units. Company H is in the process of switching:

“... sales used to be the major indicator... We are switching to how many hours we are using, because that is the cost driver of the company: how many hours the engineers are taking to do a job” (Managing Director, company H)

The company just gives their clients a price for doing the work because,

“...we are a solutions based company. We don’t charge them for ten detectors; we charge them for supplying an intruder alarm system to meet their requirements. So that can be done through using a number of different products. They’re not product conscious. That’s our job, its performance if you like; solutions to their requirements” (Managing Director, company H)

When a company does change their measures, it is important to make sure that the new measures are not arbitrary; they should be well recognised and not counterproductive, i.e. delivering on the environmental front, but not satisfying stakeholders looking at return on their investments. Using ‘customer lifetime value’ for example seems a useful way of looking at clients, this can be calculated using long-term contracts with clients (Consultant Medical Solutions, company B).

According to the Customer Service Engineer of company G, focusing on functionality rather than on product quality provides opportunities. Although the company is selling fewer products, they might have less operational costs, less wear and tear on their machinery, and less transportation costs.

☞ New measures need to be useful, well-respected and in line with corporate strategy

6.3.12 FOCUS ON CREATING VALUE

Providing integrated solutions is coined as a way to create added value (e.g. Cornet *et al*, 2000, p. 9). If a company manages to increase the added value, whilst not significantly increasing their environmental impact, the environmental impact per unit of service is reduced. The Managing Director of company H is concerned with creating value:

“It is certainly an aspect that I always look for; the added value for the client whenever I am selling a system. What can I give him so that he can say it is improving the security of the building but it is also doing XYZ, whatever that XYZ is, because I am looking for a hook, if I can put it that way, that grasps his attention.”

When looking at solutions, there are problems with establishing systems boundaries, according to the Managing Director of consultancy J. For example, LCA does not appreciate labour. It thus becomes relevant to focus on creating value. Products can be regarded as a vehicle for creating value, so this is defensible from a business point of view and a macro-economic point of view. A company should analyse the value chain and look at occurrences where substantial value is created without significantly increasing the environmental impact. However, it is important to internalise the costs of the whole value chain, in order to maintain stability. A company does not want too advantageous a position, because this might lead to players in the chain collapsing or withdrawing (Managing Director, consultancy J).

☞ Focus on creating value, rather than cost reduction and environmental impact

6.3.13 ADDITIONAL ELEMENTS

During the Validation the respondents have talked about other elements as well. Two of the additional elements are mentioned briefly in this sub-section.

Establishing a benchmark when pricing a solution seems to be important as well. If you include functionality rather than just charging the client per click, the solution provider is going to make sure his document management needs are met. What are you basing that charge on?

“Traditionally we were very eager to say: this is what it costs us and what is a sensible profit to make, add that on top and there is your price. And what we are saying here, this might not be the most appropriate way to price it. Interesting challenge.”
(Managing Director, company F)

Providing solutions can have a rebound effect, as mentioned several times throughout this report (e.g. Section 2.3.4.3). With email for example, sending messages to multiple recipients who print it off several times; all this is beyond the direct control of the solution provider:

“A lot of the things we are looking at is how we can integrate our solutions and take out a lot of the physical elements, but then it probably falls outside our remits or our domain because somebody somewhere is producing more copies than they ever would have produced when they would just have physical photocopies” (Managing Director, company F).

- ☞ Importance of establishing a benchmark
 - ☞ Battle rebound effect

6.3.14 THE FRAMEWORK AND MODEL AS A WHOLE

Overall the framework and model were well received. Some of the companies were even interested in taking the ideas from the model forward. Evidently, the framework succeeded in communicating the rather complex nature of integrated solutions in a comprehensible manner. The Managing Director of consultancy J suggests that to make a distinction between ‘means’ and ‘ends’, there are multiple perspective present in the framework, i.e. integration is part of the framework three times: in the solution, client, and organisation. He points out that the image of a company is an important feature, as well as the social impacts of a company, which seems to be more popular nowadays than the environmental impacts of an integrated solution (Managing Director, consultancy J).

Davies from University of Sussex launched the “world’s first research undertaken on integrated solutions” (Davies, 2001). When he was introduced to the work, he reacted:

“When people say ‘environment’ it doesn’t immediately ring bells for us may be, but the way you’ve just described it, it does. Because there is a real advantage potentially and then it is more efficient, less waste. There are a lot of economic factors involved in this. I think it is quite interesting.” (Davies & Tang, 2002)

He went on to say:

“It is a valid take on [integrated solutions] that we haven’t thought about. It is kind of interesting for us – even if we say that we are not that bothered about the eco-efficiency of it – it is very important.” (Davies & Tang, 2002)

☞ Means and ends
☞ Image and social impacts of the company

6.4 REFINING FRAMEWORK AND MODEL

In this section the findings of the Validation are used to refine both the integrated solutions framework and the eco-efficient solutions model.

6.4.1 THE REFINED INTEGRATED SOLUTIONS FRAMEWORK

During the Validation the framework was well received. According to the respondents it explained the complex nature of integrated solutions in a clear manner. Therefore, the Validation itself has not prompted any changes to the framework. The only alteration made to the framework is the addition of the caption ‘Risk’ to the feature ‘Performance’, as is shown in Figure 6.2 below.



Figure 6.2 The refined integrated solutions framework

After studying additional literature in the area of integrated solutions (e.g. Sharma & Molloy, 1999; Cornet *et al*, 2000), it was reaffirmed that risk – or taking over client’s risk – was an important feature of an integrated solution, but that it was as yet insufficiently recognised in the initial framework. ‘Risk’ has been added to the feature ‘Performance’ since taking over clients risk and guaranteeing a certain level of performance are two sides of the same coin.

6.4.2 REFINING THE MODEL

In this section the elements from the initial model are evaluated and additional elements are added to the model.

'Focus on a whole process or business need' seems to provide sufficient opportunities to increase the eco-efficiency of an integrated solution, when explicit attention is paid to it and it is therefore still deemed to be a useful element. Next to this element 'Acknowledge interdependencies and vested interests' is added, since existing interdependencies between a solution provider and other parties can limit the freedom with which the solution provider can offer eco-efficient solutions.

After the Validation, 'Outsourcing' is considered to be an element not distinct enough to make a useful contribution to the model. This element is therefore omitted in the refined model, but might be regarded an element of 'Focus on a whole business need'.

During the validation process, the element 'Extending systems integration capabilities' overlapped 'Focusing on a whole business need' a great deal; the difference being this element specifically focuses on integrating systems, which can be considered a result of focusing on a whole business need. Consequently, like the previous one, this element is regarded as part of 'Focus on a whole business need'.

The Validation has confirmed the element 'Utilising the power of ICT' to be a useful one; ICT is an enabler with the ability to drastically reduce the amount of resources and transport that are needed for fulfilling a business need. The energy use during the use phase and the possible rebound effect make a critical note about the conscious use of this technology necessary. This is expressed in the refined model by changing the element caption into 'Conscious use of Information and Communication Technology – acknowledge rebound effect and energy use'.

Next, the element 'Lifecycle costs' was considered to be feeble on its own, especially since it became apparent that dissimilar data and a different level of detail are needed for LCC as compared to LCA. During the Validation, collecting and analysing information on the integrated solution throughout its lifecycle appeared to be a void in the current solutions on offer. Specific attention paid to the lifecycle of an integrated solution in the model was deemed essential. This is expressed in the new element with the caption 'Create lifecycle awareness – gathering information of solution throughout lifecycle'. 'Lifecycle costing' can thus be seen as part of this new element. The same goes for the element 'Lifecycle management skills', which is also considered to be weak on its own, as it turns out that most of these skills still need to be developed. Again, creating lifecycle awareness seems to be more pertinent at this point in time.

'Performance guarantees' is a way to deliver the solution and could make a contribution to increased eco-efficiency. This element is therefore maintained in the refined model. The warning 'be aware of over-performance' has been added, since over-performance might nullify the possible positive environmental effects of guaranteeing a certain level of performance.

The elements ‘Efficiency versus eco-efficiency’ and ‘The environment is a client-specific issue’ turned out to be more a point of discussion rather than elements of the model and are therefore omitted in the refined model. One of the conclusions of this discussion, however, has been added to the model. During the Validation it became apparent that if a company wants to offer an eco-efficient solution, it needs to pay explicit attention to the environment, rather than relying on the business forces present when providing integrated solutions. This was not acknowledged in the initial model. Moreover, it also came to light that, more often than not, there is no link between the environmental orientation of a solution and the corporate environmental orientation. These two elements – explicit attention to environment and link between environmental attitude at solution and corporate level – are represented by a globe in the inner triangle of the refined model, representing planet Earth or the ‘environment’. The position of the globe also illustrates that there needs to be a congruent environmental attitude between the other three triangles – Client, Organisation, and Solution.

During the Validation, the element ‘Work with industry and regulatory bodies’ turned out to be not as useful and distinct as initially thought. This element is therefore omitted in the refined model.

The element ‘Redefine ways of measuring company performance’ has turned out to be a useful point of discussion, but it became apparent that new measures need to be useful, well-respected and in line with corporate strategy. This is reflected in the addition to the caption: ‘Redefine ways of measuring company performance – in line with corporate strategy’.

The final element, ‘Focus on creating value’, can be considered an important one when aiming to offer more eco-efficient solutions, since this element goes beyond cost-reductions. This element will thus be maintained in the refined model. Next to this element ‘Battle rebound effect’ is added, as a conscious reminder of the aim of eco-efficient solutions, namely reducing the environmental impact per unit of service.

Finally, a new element has been added to the model, namely ‘Ability to shape client’s expectations’. This is recognised as an opportunity for offering more eco-efficient solutions to clients, which appeals to a company’s initiative to make the environment part of their solutions.

The above constitutes the refining of the eco-efficient solutions model. On the next page the refined eco-efficient solutions model is presented (Figure 6.3).

6.4.3 THE REFINED ECO-EFFICIENT SOLUTIONS MODEL

The eco-efficient solutions model is descriptive in nature. It essentially consists of two layers; the ‘integrated solutions framework layer’ and the ‘eco-efficiency layer’. This is shown in Figure 6.4. The integrated solutions layer is the integrated solutions framework, which describes the nine distinct features of an integrated solution. It has been pointed out in the Literature Review (Section 2.4) that all of the literatures on integrated solutions focus on the shift from product-oriented companies towards becoming solution providers. Partly because of this; and partly because most academics in the eco-efficient services research community have a product-oriented background, this framework looks at integrated

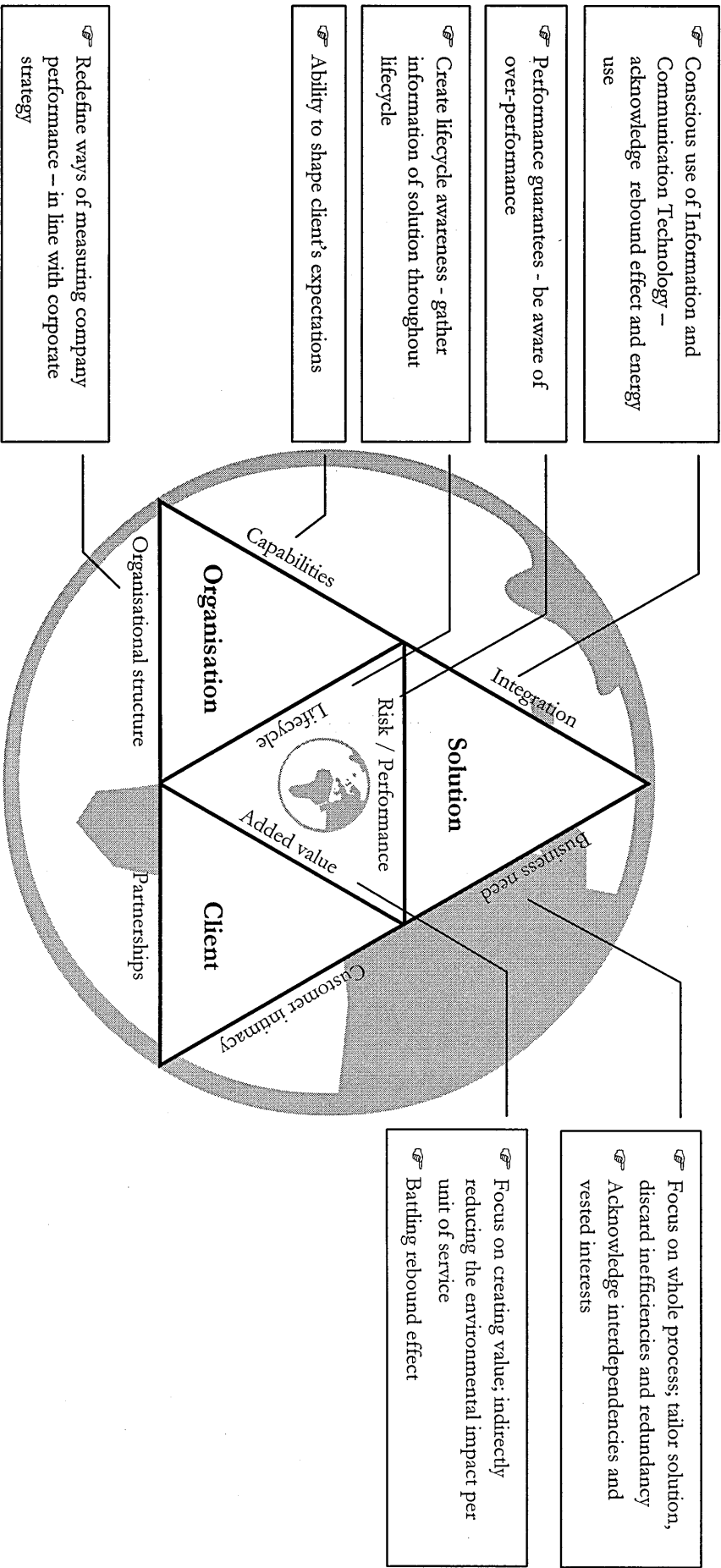


Figure 6.3 The refined eco-efficient solutions model

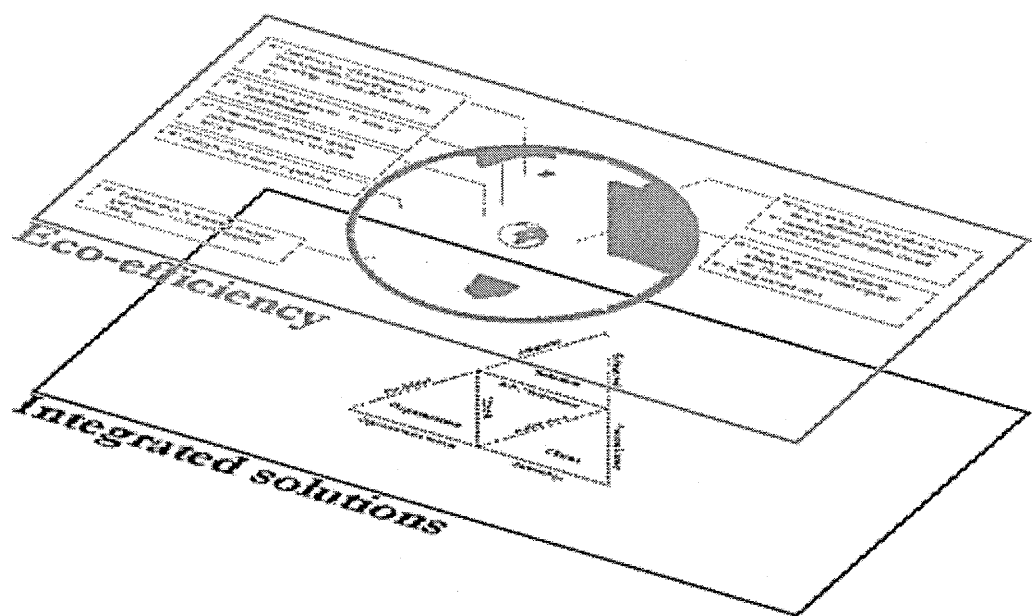


Figure 6.4 The two layers of the eco-efficient solutions model

solutions essentially from a product point of view. It points out the most striking details when a product-oriented company would want to change towards providing solutions. The nine features that are represented in the framework were selected on the basis of this. These features can be considered as points of particular interest when shifting from products towards solutions.

The second layer is the eco-efficiency layer, which consist of nine elements that influence the environmental impacts or the created added value of an integrated solution. As with the features of the framework, these elements can be regarded as points of particular attention from an eco-efficiency point of view. It must not be thought of as a prescriptive set of rules but rather a set of guidelines which can support the further development of more eco-efficient services or solutions. It requires a significant degree of flexibility and generalisability to perform this task and is therefore descriptive in nature.

6.4.3.1 Application of the eco-efficient solutions model

The eco-efficient solutions model describes the distinct features of an integrated solution and the elements that can influence the eco-efficiency of a solution. The model, and more specifically the framework, enables academics and practitioners in the eco-efficient services research field to identify the features that need to be taken into account when product-oriented companies successfully want to shift towards providing solutions. For example, the model stimulates these practitioners to consider 'Customer intimacy'; how can this be achieved or how can customer intimacy contribute to the commercial success of a particular solution? It thus provides a business design framework for developing environmentally or sustainability focused approaches.

The model also shows elements related to the eco-efficiency of a solution. These provide useful points for thought for academics and practitioners in the eco-efficient services research field to enhance the eco-efficiency of eco-efficient services and integrated solutions. These elements can be incorporated as development considerations into existing

service concepts or provide inspiration for the development of new eco-efficient service of solutions concepts. For example, one of the elements is 'Redefine ways of measuring company performance'. This is an important element to take into account when developing and offering eco-efficient services or solutions, since this offer and corporate metrics need to be geared to each other if it is to contribute to enhanced eco-efficiency. It is thus important to acknowledge the wider implications of developing eco-efficient services or solutions. The elements of the model also provide useful directions for future research into issues related to the eco-efficiency of services and solutions. When looking at the same element for example, future research can be carried out to find substitutes for measuring company performance.

Finally, the eco-efficient solutions model can be transformed into a communication tool for researchers and business practitioners, to communicate the features of integrated solutions and the elements that might influence the eco-efficiency of a solution. The application and limitations of the framework and the model are further discussed in the next chapters.

6.4.3.2 Validity of the eco-efficient solutions model

The eco-efficient solutions model is valid. During the research process, certain tactics have been used to ensure the research quality – see Section 3.4. The eco-efficient solutions model was built on a robust foundation of knowledge. This was developed from data elicited from multiple sources – substantive literatures and primary sources. A considerable degree of triangulation was achieved between and within the data sets. For a more detailed description of the overarching research methodology please refer to Chapter 3.

6.5 CONCLUSIONS

This chapter has reported on the Validation and presented the refined integrated solutions framework and refined eco-efficient solutions model. During the Validation it has become apparent that a company needs to pay explicit attention to the environment if the company wants to offer eco-efficient solutions, rather than just relying on market forces. It has also become clear that it is important to acknowledge vested interests in the existing situation. There is the threat of over-performance when utilising performance guarantees, but the solution provider also has the ability to shape the client's expectations. The Validation has also reinforced the point that the focus on creating added value is imperative.

Overall, the Validation has made the necessary differentiations to the various elements of the model. Outsourcing for example, can accelerate the development of more eco-efficient offers, but also bears the risk of over-performance. It has also become clear that ICT is not a panacea for a sustainable future, but issues like energy consumption and the rebound effect still need to be tackled. Finally, eco-efficiency has emerged as a more 'sophisticated' form of efficiency, because it takes additional externalities into account. So if a company wants to develop more eco-efficient solutions, they need to explicitly address the environmental impacts.

In the next chapter the findings of the Pilot Study, the Model Development and the Validation are discussed and expanded upon.

7 DISCUSSION

In this chapter the findings of the Pilot Study, Model Development and the Validation are discussed and expanded upon. Useful insights on substantive literatures and current thinking within the integrated solutions and eco-efficient services domains are gained.

7.1 INTRODUCTION

This chapter aims to discuss and expand upon the findings of the research in direct relation to the research questions formulated in Chapter 3. These research questions are used as a guideline for the first part of this chapter. Thus, in the next section, the concepts of integrated solutions and eco-efficient services are discussed and measured up to each other, so as to cope with the first two research questions (RQ1a-c and RQ2a-c). In Section 7.3 the contribution of the knowledge of integrated solutions towards the development of more eco-efficient solutions is discussed, thus considering the last two research questions (RQ3 and RQ4a-b).

The second part of this chapter examines remaining elements of discussion that came up during the course of this study. First, the different types of solutions are discussed; next, the importance of corporate environmental awareness when offering more eco-efficient solutions; and finally, the need to tailor a possible environmental strategy according to the type of solution that is being offered. These elements of discussion are shown in Figure 7.1 below.

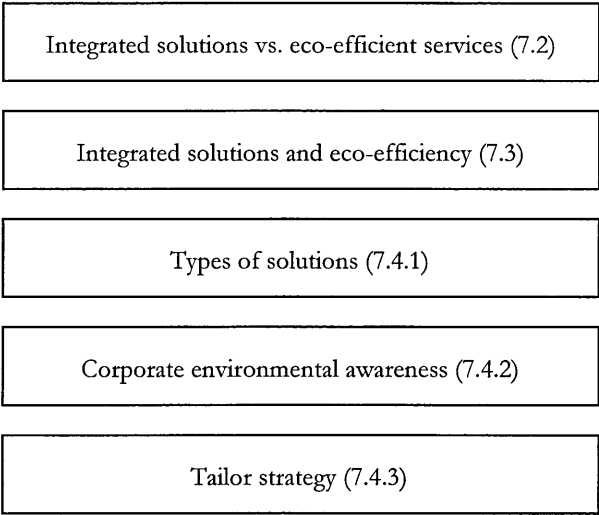


Figure 7.1 Elements of the Discussion (and the sections in which the corresponding parts can be found)

This chapter ends with conclusions on this discussion.

7.2 INTEGRATED SOLUTIONS AND ECO-EFFICIENT SERVICES

In this section the concepts of integrated solutions and eco-efficient services are discussed and the differences and similarities between the two concepts are made clear.

7.2.1 INTEGRATED SOLUTIONS

The first research question of this study deals with increasing the understanding of the concept of integrated solutions (RQ1a: What is an integrated solution?). This question was posed because of the, on the face of it, complex and comprehensive nature of the concept. Based on this question, first the substantive literatures on integrated solutions were reviewed (see Section 2.4). This resulted in several different approaches to and definitions of integrated solutions being identified. After this, it was thought useful to conduct a Pilot Study to further the understanding of the concept of integrated solutions. This resulted in an integrated solutions framework (see Section 5.2), after which the framework was validated and refined (see Section 6.4.1). This refined framework is useful for grasping the nature of the concept of integrated solutions. Based on this, integrated solutions can be defined as follows:

“Offering integrated solutions is a business design strategy creating added value to the customer by focusing on an entire business need and integrating previously separate elements. The provider takes over a certain amount of the client’s risk, guarantees a level of performance, and remains involved in the solution throughout its lifecycle. Offering integrated solutions has far-reaching consequences for the organisational structure, the capabilities required, and the level of customer intimacy and partnerships needed.”

This definition simultaneously shows with lucidity the comprehensiveness of integrated solutions and adds to the understanding of the concept.

7.2.2 ECO-EFFICIENT SERVICES

The next two research questions deal with eco-efficient services and eco-efficiency respectively (RQ1b: What is an eco-efficient service?; RQ1c: What is eco-efficiency?). Sufficient understanding of these concepts could be gained through studying the substantive literatures on eco-efficiency (see Section 2.2.2) and eco-efficient services (see Section 2.3). From this review the following definitions are reiterated:

“Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfies human needs and brings quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the Earth’s carrying capacity.” (DeSimone & Popoff, 1997, p. 47)

“Eco-efficient services are all kinds of commercial market offers aiming at fulfilling customer needs by selling the utilisation of a product (system) instead of providing just the product. Eco-efficient services are services relating to any kind of product, in which some of the property rights are kept by the producer.” (Meijkamp, 2000, p. 35)

As has been shown in the literature review on eco-efficient services, different typologies exist, but the category of ‘result services’ are of particular interest in this study. They can be defined as follows:

“This strategy is aimed at the satisfaction of customer needs regardless of the material product, meaning that the producer guarantees a certain ‘result’.” (Hockerts, 1999)

With this approach the product is owned and run by the supplier, who therefore has an incentive to intensify and optimize the product’s operation, and to increase its service life. It has also been shown that this approach could increase the eco-efficiency of the service on offer compared to ‘traditional’ product offers (see Section 2.3.4).

7.2.3 INTEGRATED SOLUTIONS VS. ECO-EFFICIENT SERVICES

This study opened with the notion that the concept of integrated solutions bears some resemblance to that of eco-efficient services, and especially the abovementioned result services. In order to determine how much resemblance these two concepts bear, this notion was turned into a research question for this study (RQ2a: To what degree are integrated solutions and eco-efficient services alike?). To this end, the similarities (RQ2b) and differences (RQ2c) are discussed.

7.2.3.1 Similarities between integrated solutions and eco-efficient services

Several similarities between the two concepts can be identified. First of all, both concepts take the customer’s need as the starting point for what is offered. Just selling products is no longer the primary goal; satisfying customer’s needs has become most important. Obviously, products are still used in both cases to satisfy these needs, but they are of secondary importance; i.e. they are only a means to an end. For eco-efficient services this shift is important, since it gives the service provider more degrees of freedom to enable the intensification and optimisation of a product’s operation, possibly resulting in increased eco-efficiency. This focus is equally important for integrated solutions, since the solution provider receives a premium for providing a true solution to a specific customer’s problem. With products being of secondary importance, the provider has the freedom to tailor the products that are utilised in order to cater for a bespoke solution that justifies this premium. It is likely that there might be a conflict of interest between the customer’s need for a solution and the provider’s desire to sell as many products as possible to enhance profitability. It is therefore important to note, for both concepts, that appropriate payment and reward structures need to be in place; otherwise, the traditional dogma of maximising products sales creeps in again, undermining the value proposition of both concepts.

A second similarity between the two concepts is that both providers of integrated solutions and eco-efficient services remain involved in their offer throughout its lifecycle. In the ‘traditional’ situation a manufacturer would produce a product and sell it to a customer, either directly or through a distribution channel. After the sales stage, the manufacturer would have little or no involvement in the products that were produced. This is radically different with both integrated solution and eco-efficient service providers. Since the client wants a solution or a result on an ongoing basis, both providers need to remain involved in the solution or result they provide. In both cases, the provider is usually responsible for the operation and maintenance of the offer. The solution and service providers have the product and process knowledge to deliver a better solution or service and are able to

guarantee a certain level of performance. The customer does not care how this performance is achieved or maintained, as long as it is done. This performance guarantee, or taking over of a part of a customer's risk for a premium, is usually an explicit element of the value proposition of an integrated solution.

The increased involvement throughout a service or solution lifecycle dovetails with forthcoming European environmental legislation, like the Waste of Electrical and Electronic Equipment (WEEE) directive, in which the manufacturers of electrical and electronic equipment are forced to take back their products at the end of their useful life. This obligatory interest in the end-of-life situation of their products might support the development of market offers similar to eco-efficient services. This possible 'use' of eco-efficient services has also been identified by Cook (2002).

Another similarity between integrated solutions and eco-efficiency is that both concepts focus on creating added value. With integrated solutions the rationale behind this focus is a justification of the premium paid for the solution by the customer. If a solution provider is not able to provide enough added value, the customer will inevitably look for cheaper options. The rationale behind the added value focus for eco-efficient services relates to the E2-vector mentioned in Section 2.3.4.1. As has been made clear previously, eco-efficient services aim to unlink environmental impacts from value creation. Thus, if an eco-efficient service can generate a lot of added value, while at the same time reducing the environmental impacts, the eco-efficiency per unit of service is radically enhanced.

Finally, through the elements mentioned above, both approaches aim to satisfy a customer's need in a novel way. An integrated solution provider will always look how previously separate elements within a business can be integrated and how added value can be created. An eco-efficient service provider will always look how certain results can be achieved while reducing their environmental impacts. In both cases products are only of secondary importance which gives both providers more degrees of freedom to develop their solution or result, which opens the door for innovative offers.

The similarities between integrated solutions and eco-efficient services are:

- ☞ Customer need is starting point
- ☞ Involvement of provider throughout lifecycle
- ☞ Guarantee a level of performance
- ☞ Focus on creating added value
- ☞ Innovative approach: beyond products

7.2.3.2 Differences between integrated solutions and eco-efficient services

Although we have seen that there are various similarities between the two concepts, several differences can be identified as well. The most important difference lies in their orientation; integrated solutions have a business orientation, while eco-efficient services take an environmentally-oriented approach. A solution provider thus offers an integrated solution because the solution contributes to corporate revenue streams and profitability. According to the substantive literatures, eco-efficient services are developed and offered first and foremost to reduce the environmental impacts per unit of service.

The second difference follows from this. Integrated solutions are offered as part of corporate strategy. Management makes a fundamental decision and commits itself, in the belief that offering integrated solutions is the best business design for their company and they consequently align their whole business operations to this new strategy. Eco-efficient services, on the other hand, have a design focus. As has been made clear in the Literature Review, the concept has been mainly developed and researched by academics and practitioners with a product design or ecodesign background. The concept of eco-efficient services is by and large considered to be another solution to a (eco-)design problem. The intention is that by changing the institutional arrangements in which products are used, the design of these products can change and can be made more eco-efficient, through eliminating built-in obsolescence for example. This could result in awkward situations, since decisions made within the design department to shift from selling products towards providing eco-efficient services have far-reaching consequences for the organisational structure and business operations of a company, which are not necessarily supported by senior management.

Another difference between the two concepts seems a minor one at first glance. Although both concepts take a customer's need as a starting point for their offers, integrated solutions focus on a corporate business need, while eco-efficient services focus on results. Integrated solutions therefore have a much wider focus than eco-efficient services. The latter are by definition closely linked to products and focus on novel ways to provide the result, or functionality, of a product. The provider of integrated solutions looks at a whole business need and tries to find ways to integrate previously separate elements. This wider focus might also be appropriate for eco-efficient services because as the scope of improvement is enlarged and covers more elements, the opportunities for improvement of eco-efficiency are enhanced (Van der Zwan & Bhamra, 2001).

Finally, as yet, integrated solutions are limited to business-to-business (B2B) markets, while eco-efficient services can be offered both in B2B and B2C (business-to-consumer) markets. Examples include car sharing, laundry services, repair and maintenance services in a B2C market and chemical management services, energy services, and document services in a B2B market. Section 7.4.1 further discusses the different types of solutions and the possible implications for offering integrated solutions in new markets.

The differences between the two concepts are:	
Integrated solutions	Eco-efficient services
☞ business-oriented	☞ environmentally-oriented
☞ strategy-focused	☞ design-focused
☞ focus on business need	☞ focus on result
☞ focus on B2B	☞ focus on both B2B and B2C

7.3 INTEGRATED SOLUTIONS AND ECO-EFFICIENCY

Having focused on the first two research questions in the previous section, the third and fourth research questions are discussed in this section. Research question RQ3 ‘What are the characteristics of integrated solutions that might affect the eco-efficiency of the solutions offer?’ is dealt with by developing and refining the eco-efficient solutions model. This is discussed in Sections 5.3 and 6.4.2 respectively. In this model the elements of integrated solutions that might affect the eco-efficiency of the solutions offer have been identified. These elements have been discussed in the previous chapter. The next two sections are similar; they both concentrate on eco-efficient offers, but each section discusses a different concept. The next section focuses on eco-efficient services and discusses how the findings can support the eco-efficient service development (RQ4a), and section 7.3.2 focuses on integrated solutions and discusses how the findings can support the development of more eco-efficient offers (RQ4b).

7.3.1 FINDINGS AND ECO-EFFICIENT SERVICE DEVELOPMENT

It has been shown above that the concepts of integrated solutions and eco-efficient services are similar, to a great extent. However, as has been mentioned in the previous section, the eco-efficient service concept has an environmental focus and is short of the business focus of integrated solutions. Yet, although developing a service that is four times as eco-efficient as its alternative seems commendable, for this increased eco-efficiency to pay off, the new service needs to be accepted by industry and its customers. To date, the strategic and commercial aspects of the concept of eco-efficient services appear to have shed insufficient light in order to ensure market success. Given the great extent to which the concepts of integrated solutions and eco-efficient services are alike, the integrated solutions framework that has been developed provides a useful strategic basis for further eco-efficient service development.

In this respect, the service elements and their competitive leverage identified by Lovelock (1994) can be used as an illustration. He distinguishes four service elements:

- *Do or die* elements; performing the core service. If a company can not perform the core service satisfactorily, it is eventually going to go out of business.
- *Do or decline* elements; service elements, when the company performs poorly, they will appear incompetent and uncaring. The company will be setting the stage for a steady decline.
- *Match 'em* elements; service elements where it will suffice simply to offer the industry standard of performance.
- *Beat 'em* elements; service elements where superior performance will yield meaningful competitive advantage.

It seems reasonable to assume that an eco-efficient service consists of these same elements. To use this classification, the integrated solutions framework, i.e. a framework based on a successful business concept, can be used to support the identification and subsequent tackling of the do-or-die elements from a business design perspective, associated with eco-efficient services. For example, one of the features of the framework is ‘Added value’. It is

thus important for a service provider to clearly articulate and communicate the added value of an eco-efficient service. Just offering a more eco-efficient service might not be perceived as offering added value to the customer. Thus, an eco-efficient service needs to have added value which is perceived as such by the customer (Van der Zwan & Bhamra, 2002).

Apart from identifying the do-or-die elements of the eco-efficient service, the framework and the eco-efficient solutions model can be used to identify other service elements as well. The model and framework provide leads for identifying the so-called beat 'em elements. For example, one of the features of the framework is 'Business need'. This gives the service provider an incentive to think about the bigger picture and to look at the specific business needs the eco-efficient service could fulfil. This can result in opportunities for the development of new types of eco-efficient services.

Finally, the different aspects of the eco-efficient solutions model support the development of eco-efficient services by providing helpful pointers on increasing the eco-efficiency of a service, like 'Performance guarantees'. Contractual agreements and the way a service is provided can influence the environmental characteristics of the service and the incentives to drastically reduce energy and resource consumption. One can think of performance contracting, outsourcing, and operational leasing among other approaches. Some of these approaches have been touched upon by academics in the field of eco-efficient services, but this is something to be explored even further for the development of eco-efficient services (Van der Zwan & Bhamra, 2002).

The above shows that the framework, the model and indeed knowledge of integrated solutions augments the concept of eco-efficient services.

The findings support the development of eco-efficient services as follows:

- ☞ Provide a useful business design framework
- ☞ Identify opportunities for development of new types of eco-efficient services
- ☞ Provide helpful directions for enhancing the eco-efficiency of a service

7.3.2 FINDINGS AND ECO-EFFICIENT SOLUTIONS DEVELOPMENT

As mentioned in Chapter 3 during the definition of the research problem (Section 3.2.2), given the limited take up of eco-efficient services as yet, it can be questioned whether eco-efficient services is the most appropriate academic concept to be transferred into industry. Therefore, the concept of integrated solutions has been studied and opportunities for improving the eco-efficiency of a solution have been identified – within a business context! The eco-efficient solutions model thus provides the business reality for integrated solutions and the different aspects provide leads for companies and researchers to enhance the eco-efficiency of a solution. It could thus be argued that a solution provider who takes the different aspects of the eco-efficient solutions model into account and acts upon them could provide a more eco-efficient solution than a traditional solution provider. For example, one of the aspects is 'Ability to shape client's expectations'. A solution provider has the ability to shape the client's expectations, especially during the pre-bid and

conceptualisation stage of a solution. Thus, a company can try to find ways to shape these expectations, while including eco-efficiency or even sustainability considerations. Obviously, a solution provider needs to have the will to incorporate these considerations. The importance of corporate environmental awareness is discussed in the next section.

It is clear from the different aspects that have been identified, that this study gives only the initial impetus to an eco-efficient solutions model. This is the first study that looks at the environmental aspects of integrated solutions. The model can therefore be used as a starting point for future research. The different aspects that have been identified are directions for future research in themselves, like ‘Redefine ways of measuring company performance – in line with corporate strategy’.

The findings support the development of eco-efficient solutions as follows:

- ☞ Provide useful pointers for enhancing the eco-efficiency of a solution
- ☞ Provide directions for future research

7.4 REMAINING POINTS OF DISCUSSION

Apart from discussing the research questions, a few elements have emerged during the course of this study. They are discussed below.

7.4.1 TYPES OF SOLUTIONS

The integrated solutions that have been studied in this research across different industries all focus on the business-to-business (B2B) market and are relatively high-value – worth tens of thousands, in some cases even millions, of pounds. As the previous section has shown, the applicability of knowledge of the concept of integrated solutions in the development of eco-efficient services in a B2B market seems to be straightforward. But the concept of eco-efficient services also focuses on the business-to-consumer (B2C) market. The question is to which extent can knowledge of integrated solutions support the development of eco-efficient services in a B2C market?

There are important differences between the two types of markets, such as the geographic concentration, size and the number of buyers, the purchase decision process, and the buyer-seller relationship (Boone & Kurtz, 2000). Since in general the B2B market is more geographically concentrated than the globalised consumer market, the solution provider in a B2B market is closer to their customers than a provider in a B2C market. This ‘intimacy’ enables the desired lifecycle support of the integrated solution by the solution provider. Additionally, tailoring a solution for one hundred customers with high value contracts is more feasible than tailoring solutions for one hundred thousand customers worth the same revenue. Keeping contact with these thousands of customers is not practical, let alone developing a bespoke integrated solution for all these customers. It has become apparent during the Pilot Study and Validation that a solution contract needs to have a certain size, to offset the costs to provide a tailor-made solution. If a company does want to offer

integrated solutions for smaller contracts, the only profitable way of doing this seems to be, using ‘prefabricated building blocks’ from which a customised solution can be assembled. Thirdly, the purchase decision process directly relates to the size of projects, since this process is more elaborate in a B2B market when dealing with high value solutions (e.g. buying a medical imaging and archiving solution), rather than in a B2C market when dealing with low value contracts (e.g. buying a mobile phone). Finally, the buyer-seller relationship is related to the number of buyers. The more buyers there are, the more difficult it becomes to create the ‘customer intimacy’ required for the development and provision of integrated solutions.

Based on the above, knowledge on integrated solutions seems to be mainly useful for relatively high value eco-efficient services in a B2B market, like total chemical management. This means that, as yet, the concept is considered not to be appropriate for eco-efficient services in a B2C market nor for the low-value eco-efficient services in a B2B market. There is, however, a desire to look into making integrated solutions profitable and suitable for increasingly lower value offers (Consultant Medical Solutions, company B; Davies & Tang, 2002). This challenge is shown in the schematic graph in Figure 7.2 below.

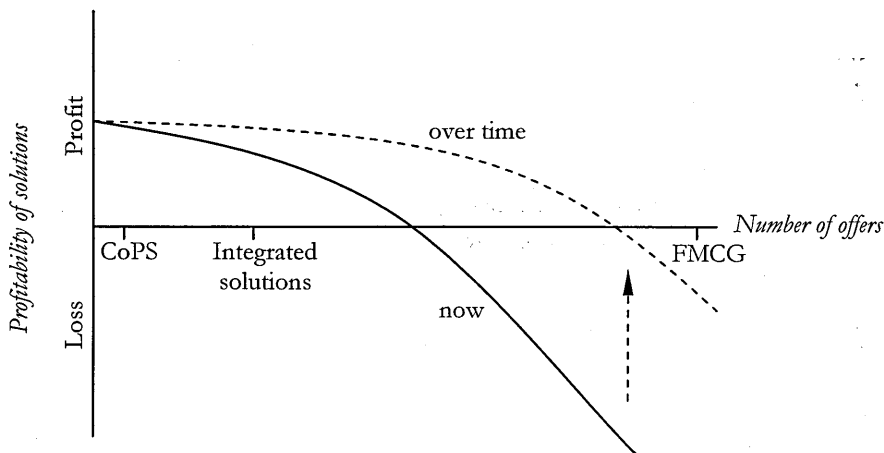


Figure 7.2 Enhanced profitability of smaller integrated solutions over time

On the one end of the spectrum there are high value offers such as CoPS (complex products and systems) (see Section 2.4.1) and on the other end there are low value offers like FMCG (fast moving consumer goods). The profitability of a solution decreases when the value of the solution decreases and the number of offers increases. At the moment, offering integrated solutions is only profitable at the CoPS-end of the spectrum. In order to make the concept of integrated solutions suitable and profitable for low value solutions, the concept will need to be adapted. Here are opportunities for future research. Until then, the framework and model can still provide inspiration for developing eco-efficient services in a B2C market or low value eco-efficient services in a B2B market.

- ☞ Knowledge about integrated solutions is useful for relatively high value eco-efficient services in a business-to-business market
- ☞ Provide directions for future research
- ☞ Provide inspiration for the development of eco-efficient services

7.4.2 CORPORATE ENVIRONMENTAL AWARENESS

As mentioned in Section 6.3.8, it appears to be important to make a distinction between environmental awareness at solution level and at corporate level. It is thought to be important that there is a connection between the two levels, since (radical) changes in the eco-efficiency of a solution, often require (radical) changes at corporate level. This is illustrated in Table 7.1, where the necessary changes and their corporate implications are stated.

Objectives	Change required
I. Reduce material intensity	Incremental improvements can be achieved relatively easy, but fundamental reductions in material intensity (factor four to twenty) are more difficult to achieve and require radical changes in product/ solution design. <i>Business implications:</i> commitment to radical design is needed, but results in reduced material costs and waste.
II. Reduce energy intensity	Incremental improvements can be achieved relatively easy by targeting the stages in the lifecycle with most impacts for improvement, but fundamental reductions in energy intensity (factor four to twenty) are more difficult to achieve and require radical changes in product/ solution design. <i>Business implications:</i> commitment to radical design is needed, but results in lower energy costs.
III. Reduce toxic emissions	Depends on the product/ solution, but it might be necessary to radically change the product/ solution design. <i>Business implications:</i> necessary commitment to radical design might be needed, but results in reduced health and safety risks.
IV. Enhance material recycleability	This involves changing the design, using different materials and technologies. <i>Business implications:</i> it involves setting up reverse logistics to disassemble the products and recycle the materials.
V. Maximise sustainable use of renewables	This might involve radical changes in product and manufacturing process design. <i>Business implications:</i> commitment to radically changing product and manufacturing processes, while there is no abundance of incentives as yet.
VI. Extend product durability	Making the products suitable for repair might only require minor design modifications; making products more durable might require more radical design modifications. <i>Business implications:</i> it involves setting up a service and maintenance department and rethinking business strategy.
VII. Increase service intensity	Making products suitable for sharing might only require minor design modifications; upgrading involves using platform design; multifunctionality involves integrating different products. <i>Business implications:</i> A company must rethink business strategy when increasing service strategy and commit to changes in product and organisational structure.

Table 7.1 Eco-efficiency and change

As this table illustrates, significantly improving the eco-efficiency of a solution is not an easy task. It is important to have some sort of corporate environmental awareness to overcome these hurdles. However, even if this awareness is there, it still remains difficult. For example, Ray Anderson, the chief executive officer of Interface, a carpet manufacturer,

was ‘converted’ from being a polluter to a business man with a conscience (Anderson, 1998, 2001). He has been leading the change on all environmental and sustainability issues top-down, but is still struggling in the market place! As became apparent during both the Pilot Study and Validation, further environmental legislation is imperative to push environmentally oriented concepts, like eco-efficient services and solutions, further and realise the envisaged environmental improvements.

It seems to be important for companies to tie their activities in with the bigger picture, i.e. look at the impact of their operations on global sustainable development and adjust their strategic actions accordingly. Metrics to this end are already being developed, like EcoPro at Bell Laboratories (Dickinson, 1999; Mosovsky *et al*, 2000). It quantifies environmental impact and resource productivity at the firm, location, and product levels. This might as a result show for example, that it is much more fruitful from an environmental perspective to focus on the CO₂ generated during transport, than concentrating on eliminating the last litres of water wasted during production. This type of metrics seems to be essential for guiding companies to take strategic decisions about new product development.

Company A has its own vision on corporate environmental awareness:

“Our company strategy has always been ‘delivering what the customer wants’. If they wanted video conferencing facilities, which would enable them to travel less, we would install that. If they wanted effective booking systems, because they wanted to travel the world, we would deliver that. We pass no judgement decision on our clients on what is environmentally friendly. Society will do that for us.” (Solutions Architect, company A)

☞ Corporate environmental awareness is needed to bring about the desired improvements in eco-efficiency

7.4.3 TAILOR STRATEGY

The final point in this discussion emerged during this study as a peripheral phenomenon, but is nevertheless not to be omitted in this report. One could say that the environmental research community has a difficult balancing act to do. On the one hand, it is important for environmentally conscious concepts and methodologies that are developed that they tie in with business expectations and that they support profit generation. On the other hand, there needs to be a genuine environmental focus, if these concepts and methodologies want to bring about the desired change (Van der Zwan & Bhamra, 2001). Within the field of cleaner production, a plethora of tools and strategies have been proposed to bring about these improvements in eco-efficiency. Unfortunately, it appears that companies can not see the wood for the trees anymore. The concept of eco-efficient services alone can be regarded as comprising leasing, sharing, repair, and result ‘strategies’ among others. However, not all the strategies are equally suitable for each product category or industry; a chemical company might need to adopt a different strategy to a law firm in order to become more eco-efficient. One of the ways to avoid the ‘eco-strategy overload’ could be for the research community to take the product or industry characteristics into account when further developing environmentally conscious concepts and methodologies, rather than pursuing a one-size-fits-all approach.

Table 7.2 below shows an initial list with possible product attributes derived from both eco-efficient services and marketing literatures. (The list is by no means exhaustive!)

Attributes derived from eco-efficient services literature	
End result versus means to an end ^c	Low versus high utilisation rate (seasonal, weekly, bound to stage in life) ^{a, b, e, f}
End product versus component ^c	Durable versus consumable product ^{e, f}
Material or energy consumption during use ^f	High versus low use impacts compared to manufacturing impacts ^f
Size of operation costs versus total ^f	Existing versus new technology ^d
Size of disposal costs versus ^f	Need for limited versus unlimited accessibility to the product/ service ^{b, d}
Product has significant value at end-of- life ^f	Price of the product ^{a, d, e}
Rapid versus slow technological change, regulatory change ^{e, f}	Necessity versus luxury product ^b
Flexible versus standardised product ^f	Few versus many different product types ^b
Use of product does involve specialist skills ^f	Duration of use of the product ^b
Fixed versus variable effectiveness/ efficiency ^f	Size of product (storage space, transport) ^{a, b, e}
Lifetime of product greater versus shorter than average customer use period ^f	
Expenditure for maintenance ^a	
Attributes derived from marketing literature (Kotler <i>et al</i> , 1999)	
Product sold to specific age groups or not	Fragmented industry versus volume industry
Branded product versus White product	Frequency of purchase
Business-to-business versus business-to-consumer	Global versus local
Capital items versus by-product	Industrial product
Distribution channel (retailer versus wholesaler)	Elastic versus inelastic demand (price elasticity)
Heavy versus little competition	Intensive distribution
Convenience product versus specialty product	Mass customisation
Price of product	Materials and parts
Stage of life cycle product is in (introduction, growth, maturity, decline)	Packaging
Salutary products versus desirable products vs. deficient products versus pleasing products	Product-support services
Durable product versus non-durable product	Product quality
Product subject to fashion	Seasonally
	Unsought product
a = IZT <i>et al</i> (2002), b = Mont (1999), c = Rocchi (1997), d = Roy (2000), e = Schrader (1999), f = White <i>et al</i> (1999)	

Table 7.2 An initial list of product attributes

Looking at these product attributes it becomes clear that different qualities call for different strategies. For example, when talking about the ‘price of a product’, it is clear that the environmental impacts of a paperclip are different from that of a personal computer and that different strategies are needed to enhance their eco-efficiency. When considering ‘transaction costs relative to product price’ for example, renting a hairdryer sounds preposterous. Since transaction costs are high compared to the product price, it might be much cheaper and much more convenient buying a hairdryer rather than renting one. Though, for expensive garden tools that are used once or twice every year it becomes a different story altogether. Therefore, it is important to state that there is not a universal answer to today’s eco-inefficient product and service offers. A company needs to know what type of product or service they are dealing with and, for example, at which stage of

the product lifecycle the biggest environmental impacts occur. This is something that might be taken into account when developing future strategies. This ties in with the eco-efficient services discussion, as has been made clear in the literature review (Section 2.2.2) that an eco-efficient service is not more environmentally friendly *per se* – or to put it more accurately; cannot be applied with the same success to each product or in each industry.

☞ Take the product and industry characteristics into account for future environmentally conscious strategy development

7.5 CONCLUSIONS

In this chapter, the findings from this study have been discussed, using the research questions as a guideline. A definition of integrated solutions has been put forward that reflects the comprehensiveness of the concept in a clear manner. This chapter has shown that the concepts of integrated solutions and eco-efficient services are considerably similar. The customer’s need is the starting point of the offering for both concepts. For both concepts there is involvement of the provider throughout its lifecycle and a guaranteed level of performance. Both concepts focus in an innovative way on creating added value, which goes beyond products. The differences between the two concepts have also been established. Integrated solutions are business oriented with a strategy focus, while eco-efficient services are environmentally oriented with a design focus. Integrated solutions focus on a business need in a B2B market and eco-efficient services focus on a result in both B2B and B2C markets.

It has been shown that knowledge of the concept of integrated solutions is useful for the development of relatively high value eco-efficient services in a B2B market. This study provides a useful business design framework and can be used to identify opportunities for the development of new types of eco-efficient services. This study can provide helpful pointers for enhancing the eco-efficiency of a service or solution. The findings also offers directions for future research on eco-efficient services and solutions.

Finally, it has been considered that corporate environmental awareness is needed to bring about the desired improvements in eco-efficiency, and it has been illustrated that it is imperative to take the product and industry characteristics into account for future environmentally conscious strategy development.

In the next chapter the conclusions of this study are presented.

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8 CONCLUSIONS

This chapter presents the conclusions of this study. It shows that the research aim and objectives have been met and reflects upon the research process. The contribution to knowledge made by this study is shown and, in light of this, areas for future research are identified.

8.1 REVIEWING THE AIM AND OBJECTIVES

In chapter 1 the aims and objectives of this research were detailed.

Research aim

The overall aim of the research was to provide those who wish to promote the development of eco-efficient services and solutions with an understanding of a useful business design framework and an understanding of factors that might lead to increased eco-efficiency of these types of services or solutions.

Research objectives

- To critically review substantive literatures, useful theoretic literatures and other necessary secondary sources in relation to:
 - the rationale, origins, and attributes of the concept of integrated solutions
 - the rationale, origins, and attributes of the eco-efficient services concept
 - eco-efficiency and sustainability issues
 - theoretical perspectives on business strategy
- To develop a conceptual framework that describes the characteristics that are specific to the concept of integrated solutions.
- To identify the specific elements of integrated solutions that might affect the eco-efficiency of an offer.
- To ascertain how the characteristics of integrated solutions and the elements affecting the eco-efficiency of a service or solution can be used to support the development of eco-efficient services and solutions.

Both the aim and objectives of the research have been met. It was found from the review of literatures and from primary sources that the concept of integrated solutions was developed and successfully taken up by industry, while the concept of eco-efficient services was formed in academic and policy making circles.

In order to understand how knowledge about the concept of integrated solutions may support the development of eco-efficient services and solutions, it was necessary to first grasp the concept of integrated solutions. Therefore, an integrated solutions framework was developed. This framework was based on a robust foundation which was elicited from multiple sources; the findings from substantive literatures as well as the findings from the

Pilot Study. The integrated solutions framework was then used as a basis for the initial eco-efficient solutions model – in which elements are presented, that have an effect on the eco-efficiency of a solution. Next, the framework and model were subject to evaluation during the Validation. The findings from the Validation were discussed and incorporated into the initial framework and model, which resulted in the refined eco-efficient solutions model.

Thus, by identifying the attributes of integrated solutions that may contribute to enhanced eco-efficiency of a solution and by providing a business design framework through the eco-efficient solutions model, the aim of the research was met.

8.2 CONCLUSIONS FROM THE THESIS

A number of key conclusions emerged from this thesis. These are summarised below:

- Academics and policy makers in the field of eco-efficient services would like eco-efficient services to be taken up by industry, but to date they struggle to find the much-needed demonstration projects and pilots to generate knowledge of and experience with eco-efficient services.
- To date, little academic research has been undertaken into the concept of integrated solutions.
- The concepts of eco-efficient services (especially result services) and integrated solutions are similar in a number of ways. For both concepts the customer need is the starting point of the offer; the provider is involved throughout their lifecycle; they both guarantee a certain level of performance; and both focus on creating added value.
- There are differences between the concepts of eco-efficient services and integrated solutions. Integrated solutions are business oriented with a strategy focus, while eco-efficient services are environmentally oriented with a design focus. Integrated solutions focus on a business need in a B2B market and eco-efficient services focus on a result in both B2B and B2C markets.
- Offering integrated solutions is a business design strategy creating added value to the customer by focusing on an entire business need and integrating previously separate elements. The provider takes over a certain amount of the client's risk, guarantees a level of performance, and remains involved in the solution throughout its lifecycle. Offering integrated solutions has far-reaching consequences for the organisational structure, the capabilities required, and the level of customer intimacy and partnerships needed.
- It is imperative to focus on creating added value rather than just on cost reduction in order to bring about absolute reductions in environmental impact.
- It is crucial to actively battle the rebound effect in order to realise net enhancement of the eco-efficiency of a service or solution.
- It is not enough to rely on market forces; corporate environmental awareness is needed to bring about the desired improvements in eco-efficiency. However, environmental legislation is needed to push concept eco-efficient services and solutions forward.

- Knowledge about the concept of integrated solutions is especially useful for the development of high-value eco-efficient services in a B2B market.
- The integrated solutions framework provides a useful business design framework for the development of eco-efficient services.
- The refined eco-efficient solutions model helps to identify opportunities for the development of new types of eco-efficient services and provides suggestions for enhancing the eco-efficiency of a service or solution.
- Product and industry characteristics ought to be taken into account for future environmentally conscious strategy development.

8.3 THE ECO-EFFICIENT SOLUTIONS MODEL

As noted above, the findings from the review of substantive literatures and the analysis of data collected in the Pilot Study and Validation were used to develop an integrated solutions framework and an eco-efficient solutions model. This framework identified nine distinctive features of an integrated solution and the model, based on this framework, identified twelve elements that might influence the eco-efficiency of a solution. Both the framework and model were then evaluated in the Validation and a deeper understanding of the known features and elements was obtained and further features and elements were identified. This resulted in a refined framework and model respectively.

8.3.1 SUCCESS AND LIMITATIONS OF THE MODEL

When discussing the success and limitations of the model, it is necessary to make a distinction between the integrated solutions *framework* and the eco-efficient solutions *model*. The framework makes the complex concept of integrated solutions comprehensible and it can be used as a tool to communicate the different features of integrated solutions. Davies and Tang (2002) noted this on the usability of the framework to this end. The eco-efficient solutions model links the elements which might have an effect on the eco-efficiency of a solution to the different features of the framework. The model is particularly useful to those developing eco-efficient services or wishing to develop eco-efficient solutions. It provides a set of guidelines for enhancing the eco-efficiency of a service or solution. In order to realise the opportunity that the framework and the model provide, it is necessary to consider the limitations of the conceptual framework.

While a number of limitations are known to the author, it was not within the scope of this thesis to address these. Instead a number of limitations are detailed below and areas of future research are identified in subsequent sections to address these. Four limitations of the framework and model are of concern:

1. The eco-efficient solutions model is only suitable for high value eco-efficient services.
2. The model does not describe offers for the B2C market.
3. The model does not prescribe specific actions.
4. Little attention is paid to the explicit implications of the model for the concept of eco-efficient services.

Firstly, the eco-efficient solutions model is only suitable for high value eco-efficient services. This point came up in the discussion in the previous chapter. It has been made clear that the concept of integrated solutions, and indeed the eco-efficient solutions model, will need to be adapted in order to address the specific characteristics and challenges faced when offering lower value solutions. Here are opportunities for future research. Until then, the framework and model still provide inspiration for those wishing to develop low value eco-efficient services or solutions.

Secondly, the model does not describe offers for the B2C market. Yet, the eco-efficient services research community focus a considerable part of their efforts on the B2C market. As stated previously, the concept of integrated solutions, and therefore the eco-efficient solutions model, just focuses on the B2B market. It seems reasonable to assume that the findings from this study, represented in the framework and model, can be useful to B2C services and solutions, but further research needs to be done in order to find out to which extent this is the case and how the model will need to be adapted so as to make it suitable for the B2C market.

Thirdly, the eco-efficient solutions model does not prescribe specific actions. The model describes the distinctive features of integrated solutions and different elements that might influence the eco-efficiency of an service or solution, but it does not prescribe how to tackle these elements. This is due to the exploratory nature of this study. This research has explored the concept of integrated solutions in relation to eco-efficiency/ eco-efficient services and has identified for example that it is important to redefine ways of corporate performance if a company wants to offer more eco-efficient solutions. How a company needs to do this should be the focus of further research.

Finally, little attention is paid to the explicit implications of the model for the concept of eco-efficient services. This is because it was thought important to focus on the concept of integrated solutions as much as possible, rather than to force the findings of this study into an eco-efficient services 'straightjacket'. The insights gained from the model might be taken up by the eco-efficient services research community, so as to adapt it in order to facilitate more eco-efficient solutions offers. However, the scope of this research project prohibited further research activities necessary to determine how this should be done.

To sum up, the eco-efficient solutions model provides a robust foundation of knowledge which can be used by those wishing to promote and develop eco-efficient services and solutions. However, the framework has certain limitations and subsequent research will need to be undertaken to address these limitations. The limitations above were not addressed in this thesis as they were not within the scope of the research.

8.4 GENERALISABILITY OF THE FINDINGS

The findings from the research have been generated from data elicited from multinational companies across various industries. There was a variety in the value, type, and scope of the solutions that were studied. Add to this the significant input from the substantive literatures on integrated solutions, which also discussed a wide range of solutions, and it is

therefore possible to utilise this framework and model across different industries. The nine features of the integrated solutions framework that emerged from the analysis of data from literatures, Pilot Study and Validation are of a sufficient level of abstraction to generalise to this degree. The same goes for the nine elements that have been identified in the eco-efficient solutions model. This broad application was especially sought for in this exploratory study, as has been made clear in the research methodology chapter. However, it might be useful when the model is transformed into a more prescriptive tool, to focus on specific industries. It seems reasonable to assume that the language and design of the framework and model may need to change in order to provide utility as a 'eco-efficient business design tool'.

It has already been made clear in the Discussion and in the previous section, that because of the high value and the B2B focus of integrated solutions, the findings of this model are less usable for lower value services or solutions in a B2C market. On the one hand, further research can be used to explore how the framework and model can be adapted for lower value solutions or for a B2C market. On the other hand, the point made in the final section of the Discussion still holds: it is important to acknowledge the differences between the various products, solutions and industries. The 'integrated solutions approach' might simply not be suitable for these other types of services or solutions, because of certain product and industry characteristics. Further research might determine to which extent the eco-efficient solutions model can be used across different industries.

8.5 CONTRIBUTIONS TO KNOWLEDGE

The academic contribution to knowledge made by this thesis has been to explore the concept of integrated solutions in a B2B context and identify how the concept can support the development of eco-efficient services and solutions. Three areas are of particular importance.

Firstly, this study makes a significant contribution to theoretical knowledge through a novel definition of the concept of integrated solutions and the identification of distinctive features of integrated solutions. This is supplemented by a state-of-the-art review of substantive literatures on integrated solutions. The review, framework, and definition facilitate understanding this comprehensive concept. This study provides a useful starting point to those wishing to undertake further research in this area. This work adds significant value to the integrated solutions domain.

Secondly, this study also makes a significant contribution to substantive knowledge through the refined integrated solutions framework. As mentioned before, this framework presents nine key features of integrated solutions; features that are 'prerequisites' for a commercially successful integrated solution. Thus, the framework provides a useful business design framework for those wishing to develop eco-efficient services or solutions that take business design considerations into account. This work adds significant value to the environmentally, design-oriented eco-efficient services domain.

Finally, this study also makes a contribution to knowledge through the refined eco-efficient solutions model. The model identifies nine elements that influence the eco-efficiency of a

solution or service. These elements provide a set of guidelines to those wishing to develop eco-efficient services or solutions. They can either be taken into consideration when developing eco-efficient services or be used for the development of new types of eco-efficient services and solutions and or be used as directions for future research.

8.6 RECOMMENDATIONS FOR FUTURE RESEARCH

Due to its exploratory nature, this study raises many further questions. The main effort of this study focused on exploring the concept of integrated solutions. This study has only scratched the surface in terms of the knowledge of integrated solutions towards increased eco-efficiency. During the course of this research a number of areas which should be the concern of future research have been identified:

- The most obvious future research would be to undertake work that addresses the limitations of the integrated solutions framework and eco-efficient solutions model:
 - Firstly, further research should focus on lower-value services and solutions. The eco-efficient solutions model is only suitable for high-value eco-efficient services. This research would enable an understanding of the contribution of the knowledge of the concept of integrated solutions towards the development of these types of services and solutions.
 - Secondly, further research should identify to what extent the eco-efficient solutions model is useful in a B2C environment and how the model will need to be adapted to make it appropriate for this market.
 - Thirdly, the eco-efficient solutions model has identified nine elements that might influence the eco-efficiency of a solution. All the elements that have been identified are suggestions for future research in themselves. Further research should focus on (one of) these elements and explore how these elements can be operationalised.
 - Finally, further research should focus on the explicit implications of the eco-efficient solutions model to the eco-efficient services domain. It should look at how the model should be adapted to support the development of eco-efficient services.
- The framework and model that have been developed in this study focus on integrated solution in general. Further research should produce industry- or solution-specific models. This should address the specific characteristics of and (environmental) issues in a given industry.
- This study has focused on exploring the concept of integrated solutions and proposed an eco-efficient solutions model. Further collaborative research could be carried out in order to develop eco-efficient solutions and thus generate knowledge of and experience with these specific types of solutions in practice.
- Further research should focus on the contribution that the concept of integrated solutions could make to other sustainable business approaches, such as corporate social responsibility.

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APPENDIX A: PILOT AND MAIN STUDY COMPANIES

This document provides more detail on the five companies that were considered during the Pilot Study as reported in Chapter 4 and the seven companies that were consulted during the Validation as reported in Chapter 6. A brief company profile and a description of the solution are given here.

A.1 COMPANY A: EBUSINESS SOLUTIONS

Company profile

Company A was founded twenty years ago and is a leading global provider of enterprise technology and solutions. The company designs, develops, manufactures and markets hardware, software, solutions and services, including industry-leading enterprise storage and computing solutions, fault-tolerant business-critical solutions, communication products, and desktop and portable personal computers that are sold globally. The two types of solutions that have been considered in the Pilot Study are ‘mobile solutions’ and ‘lifecycle solutions’.

Solution profiles

Firstly, the company offers complete mobile Internet solutions, resulting from a combination of Internet technology and wireless telephony. The company offers horizontal solutions, like mobile messaging, customer service management, and sales information systems. They are also developing, industry by industry, specifically focused solutions, like an end-to-end solution for the banking industry. This solution offers complete consultancy and implementation services, plus full support to customers including integration, connecting to phone networks, access devices, and accessing personal data and banking services. The sales proposition for mobile Internet solutions is round-the-clock access to rich information, greatly enhanced customer relationship management, increased customer satisfaction, and higher employee productivity and job satisfaction.

Secondly, the company offers lifecycle solutions, based on the notion of Total Cost of Ownership (TCO). The company aims to create an awareness of these costs and then offers lifecycle solutions to improve the efficiency of their client’s complex PC environment. The company can provide different levels of help to their clients: at the lowest level they can provide tools and information and at a higher level they can manage their PC environment for them, from acquisition to end-of-life and anywhere in between. The sales proposition for lifecycle solutions is reducing IT costs, keeping PC users happy, increased reliability, and enabling clients to execute their PC strategy. Lifecycle solutions can support planning, deployment, management and transition stages.

A.2 COMPANY B: MEDICAL SOLUTIONS

Company profile

Company B is one of the largest suppliers of healthcare equipment in the world. The company is renowned for its innovative products, services and complete solutions, ranging from imaging systems for diagnosis and therapy equipment for treatment, to electro medicine and hearing instruments to IT solutions that optimize workflow and increase efficiency in hospitals, clinics and doctors' offices. They also offer a variety of data management solutions for customers. In this study the complete solutions the company offers for the support of radiological workflow are considered: Picture Archiving and Communication Systems (PACS).

Solution profile

PACS is a system which networks all imaging modalities (like CT and MRI) in a filmless hospital. Reporting, distribution, archiving, documentation, and management of radiological image data: everything is digital. Ultimately the system integrates the Radiology Information System (RIS), the Hospital Information System (HIS) and the Electronic Patient Record (EPR). The system also has workflow management tools to optimise the radiology workflow. Images can be viewed through a local PC or by using a web server accessed from several wards or the whole hospital. The sales proposition for PACS is improving efficiency, productivity, and quality while reducing costs and integrating modalities from different companies, various information systems in different departments, all connected into one homogeneous system. The company offers continuous support and maintenance, and ready to implement changes and new equipment whenever needed. They have their own professional service and support organisation and offers different levels of service with their solutions. The basic after-sales service focuses mainly on quality and safety. The augmented services include diagnosis and recovery, and the top services include the costs and delivery of parts. The company has developed a range of financing options, including traditional purchase options, leases that incorporate an upgrade program, usage-based plans such as pay-per-patient or pay-per-megabyte, and risk-sharing arrangements that align technology payments to the client's revenue streams or savings.

A.3 COMPANY C: INFRASTRUCTURE SOLUTIONS

Company profile

Company C started five years ago and provides infrastructure solutions. By setting up the company, they tapped into the growing demand from the market to be involved at an early stage in large-scale projects. The company develops and implements these projects in-house or with third parties. The company acts as a concept and project developer, which not only thinks of innovative ideas, but is also able to execute those using in-house technologies. The company focuses on projects with a high technological component.

Solution profile

Company C offers infrastructure solutions to business-to-business clients. The company integrates the use of advanced electronics, tailored ICT solutions and an efficient logistics apparatus, with architecture. This results in refreshing, creative possibilities for new and existing sports centres and shopping centres to fully utilise all possible facilities. They focus on the following major areas: mobility (e.g. developing a new railway system); health care (e.g. offering a turnkey hospital); urban development (e.g. building a train station or a football stadium); and sports and culture (e.g. providing an innovative public library). The minimum size of a typical project undertaken by the company is approximately fifteen million Euros.

A.4 COMPANY D: TURNKEY SOLUTIONS

Company profile

Company D is a multinational company specialising in the turnkey supply of integrated solutions in different fields, such as combined cycle power plants and energy distribution systems. The company is one of the world's leading vendors of power plant technology, offering a complete range of services and products for cost-effective, environmentally compatible power generation. Company D plans and designs power plants, builds them on a turnkey basis, handles project management for parts of the plant, or provides consultancy services and supervision of erection and commissioning, or supplies plants, systems, and components. This approach proves to be effective in minimizing project life cycle costs.

Solution profile

The company provides turnkey, 'tailor-made' solutions for the conversion of existing open cycle gas turbine installations to combined cycle power plants. This provides the client with a considerable increase in electric power output using the same quantities of fuel; no need for separate steam generation; additional revenues due to increased sale of electric power; and opportunities for government subsidies. The complete turnkey solution consists of seven stages. It starts with pre-sales, in which feasibility studies and a thorough evaluation of the client's requirements are made. The process then moves into the design stage in which the thermodynamical process is optimised. After this, in the engineering stage, a well-considered choice of the main components is made. Company D also takes care of the project management and procurement stages. The next stage is implementation, which covers the delivery of equipment, installation, commissioning and testing periods, and the training of client's personnel. After-sales is the final stage, in which the necessary assistance and maintenance is provided.

A.5 COMPANY E: ENERGY SOLUTIONS

Company profile

Company E was created at the beginning of 2001 and focuses on developing and delivering cleaner energy solutions. The company is responsible for developing and delivering energy offers within the energy market. The company offers a customer-focused, integrated group of products and services aimed at improving energy efficiency, managing energy portfolios; and improving environmental performance throughout industry. They reduce the client's price exposure through innovative contracts and trading options, managing their fuel supply or developing a combined heat and power plant to enhance efficiency and lower emissions.

Solution profile

Company E offers total energy solutions to business-to-business clients. They are provided through a long-term contract – typically 10 years. This is developed in conjunction with the client, in an open book manner and as necessary includes provision for contract energy management (CEM), combined heat & power (CHP), and energy procurement. Apart from energy services, the company also offers consulting services directly related to the consumption and management of energy products. One of the consulting services is Monitoring and Targeting (M&T). This is a management technique that aims to control energy consumption and reduce costs by integrating energy management into the existing site management structure. The aim of any M&T system is to relate energy to the variables that influence its consumption in order to identify and quantify waste. Results are provided in a clear manner to enable necessary actions to be taken to improve performance and cut energy costs.

A.6 COMPANY F: DOCUMENT MANAGEMENT SOLUTIONS

Company profile

Company F provides outsourced document management solutions and business support services to over one thousand clients across Europe and North America. The company helps business work faster and smarter with high-end, business-critical solutions and sophisticated distributed printing enabling rapid on-demand dissemination of information or material to global offices. With over sixteen thousand employees, the company handles nearly ten million pieces of mail per day, prints over two million pages every hour and manages a fleet of over twenty thousand copiers, digital printers, and fax machines around the globe. It concentrates on building long-term relationship with its customers. The company is ISO9000 certified and they are seeking to obtain ISO14001.

Solution profile

Their integrated services cover the entire document management life cycle, including document creation, production, distribution, archiving and retrieval. Their combination of

people, process and technology, combined with their independence from technology providers, allows them to select and integrate 'best-in-class' technologies to provide document management solutions in partnership with their clients. Specific services that the company provides are automated document solutions, creative services, document management, fleet and asset management, mailing and distribution services, print management, among others.

A.7 COMPANY G: TOTAL CHEMICAL MANAGEMENT

Company profile

Company G comprises sites across the world making and marketing products and services for the semiconductor and circuit board industry. They offer ultra pure chemicals, printed board chemicals, wafer reclaim and thinning services, photomask and pellicle manufacture, analytical and total chemical management services. The company is ISO14001 certified.

Solution profile

The company offers total chemical management (TCM). Its headline services include planning and start-up management and project management; on-line control of all liquid chemicals; inventory control and Just-In-Time delivery, equipment management, quality and process control; health, safety and environmental controls; waste management, and management of continuous improvement. A flexible and integrated TCM package can be customised to meet exact customer needs and phased to match operational evolution. The company is also able to make local agreements with gas suppliers to enable them to provide a total chemical and gas management service if required.

A.8 COMPANY H: INTEGRATED SECURITY SYSTEMS

Company profile

Company H was formed in 1986 in the UK to provide specialist services in the design, installation and maintenance of security and building monitoring services. The company is recognised as one of the most technically accomplished of the specialist access control and integrated security firms operating within the security industry. It has developed substantial in-house expertise within its specialist fields. The company is ISO9002 approved in respect of its Intruder Alarm, CCTV (closed circuit television), and Access Control activities. The company also operates an environmental policy. It provides services to national and international clients in the corporate sector and to the public sector.

Solution profile

The company offers a cost effective solution to their client's security needs by offering integrated security systems. The company designs, installs and maintains security systems that match most closely the needs of each client. It offers high quality installations, state of the art technical capability in all security disciplines, including: access control, CCTV,

biometric readers, alarm monitoring, and perimeter security. They provide full UK and European coverage using their network of branches and affiliate organisations and they have a full network capability linking multiple remote sites to one central location.

A.9 ENVIRONMENTAL CONSULTANCY I

Company profile

Consultancy I is a consultancy firm based in The Netherlands and Belgium and specialising in finding cost reducing solutions to environmental issues. The consultancy helps its clients to improve their environmental and resource efficiency performance and to make money in the process. Specific areas it focuses on include cleaner production, environmental management, monitoring clients' environmental performance, training for local authorities and intermediaries, integrated chain management, environmentally sound product development, occupational health and safety, and sustainable housing. Its team of mostly academically trained consultants works directly for the private sector and for governmental institutions, both in the Netherlands and abroad. The consultancy has been able to build up an extensive experience in pollution prevention projects in industrial and other enterprises, many of which were successfully implemented on a "no cure no pay" basis. The consultancy has a wide range of private and public sector clients: over six hundred industrial and non industrial companies, several Dutch governmental institutions involved in economic development, environmental affairs and development cooperation, and governmental agencies and intermediary organizations outside the Netherlands.

A.10 ENVIRONMENTAL CONSULTANCY J

Company profile

Consultancy J is an environmental consultancy firm based in The Netherlands and specialising in lifecycle assessment (LCA). The mission of consultancy J is to develop and implement practical, yet scientifically sound tools to improve the environmental performance of a company's products or services. Further, the consultancy has over ten years of experience in offering a range of services. They have undertaken projects ranging from small company screening to large ISO compatible studies. The company is involved in database and LCA methodology development, environmentally conscious design, eco-indicator methodology, LCA studies and reviews, and trainings and seminars. They are also involved in education; they give lectures internationally on LCA, product oriented environmental management, and product-service combinations.

APPENDIX B: PILOT STUDY QUESTIONS

This document shows the standard list of questions developed for the Pilot Study, which is discussed in Section 3.3.2 and Chapter 4. This list provided the basis for the semi-structured interviews held with the representatives of various companies. Documentation was used to prepare for the interview and to alter the questions asked and/ or the sequence if deemed necessary.

B.1 INTERVIEW QUESTIONS

Name:

Company:

Date:

Location:

Topic:

B.1.1 BACKGROUND OF COMPANY X

- The activities of company X
- The typical client of company X
- Definition of the industry company X is active in
- The level of competition in industry
- To what extent have legislation and regulations shaped your industry?

B.1.2 WHAT DOES COMPANY X OFFER?

- Description of the integrated solution offered by company X
 - Describe aspects of the solution (e.g. equipment, infrastructure and knowledge involved, competitive advantage, relationship with client)
- The history of the solution
 - Since when does company X offer solution?
 - What was the previous market offering? How has the old situation changed into the new one?
- What is the size and scope of a typical solution project (in terms of money, equipment, and time)?
- To what extent are concepts like your solution mainstream business practices?

B.1.3 WHY DOES COMPANY X OFFER ITS SOLUTION?

- What are the drivers for company X to offer the solution (e.g. cost, environment, or competition)?
- Wherein lies the added value of the solution (e.g. knowledge, service, convenience) compared to other more traditional offers?
 - What do clients perceive as the key benefits of the solution?
- What are the incentives for company X?
How does company X get rewarded? (Per job or per amount of products used by the client for example)

B.1.4 HOW DOES COMPANY X DEVELOP THEIR SOLUTIONS?

- Assume that I am a new client of company X, could you go with me through the solution (development) process?
- How do you find out what the qualities of the solution need to be?
- How are the client's needs defined? How specific?
- Tailoring solutions
 - Is the company in a position to drastically redesign 'the system', or is it just a matter of picking different pre-designed components?
 - Do specific customer needs spark new R&D at company X?
- Are you aware of increased 'development space' when taking a solution approach instead of just selling products and services?

B.1.5 ENVIRONMENTAL QUALITIES

- To what extent are environmental pressures present in the business company X is operating in?
- Would clients be receptive to radically increasing the resource productivity?
- The efficiency rate of the new solution vs. the old product offer.
- Which indicators do you use to measure this? (e.g. cost, material and energy use, etc.)

B.1.6 FUTURE DEVELOPMENT

- Any future developments in the area of your solution?
- Would it be possible to speak to one of your clients about the solution you are providing?
Find out:
 - What are the perceived benefits of the solution?
 - What are the perceived qualities of the solution?
 - What were the drivers to go for the solution?
 - How close is your solution to the core business/ primary processes

APPENDIX C: PRESENTATION OF MODEL

This appendix shows the document 'Towards an eco-efficient solutions model', which has been prepared to inform the companies, taking part in the Validation, about the project. The document was sent out to companies in a four-page format.

TOWARDS AN ECO-EFFICIENT SOLUTIONS MODEL

Introduction

The point of departure for this research project is the need for companies to drastically cut down the environmental impact of their products and services in order to contribute towards a more sustainable future. This effectively means reducing the amount of materials and energy used and toxic emissions generated per unit of product or service. For the last decade, companies have focussed on improving elements of their products and services from an environmental perspective. Now there is a call for a more holistic approach. Within the environmental research community there is an interest in looking beyond the products sold by companies. By focussing on providing results to customers, rather than just selling products, the space for (environmental) improvement increases; looking at a whole 'need fulfilling system' has much more potential for improvement than just looking at a product component level for example. The provision of a mix of products and services to satisfy the customer needs, i.e. offering integrated solutions, is the area of interest of this research. The environmental research community has little to no experience in the development of these 'environmentally friendly results'. Therefore, within this research project we would like to learn from companies that are offering integrated solutions, so as to transfer this knowledge into the future development of 'eco-efficient solutions'.

So far in this research, an integrated solutions model has been developed and opportunities for improving the environmental performance, i.e. the eco-efficiency, of integrated solutions have been identified. Next the integrated solutions model is presented and its features are described. After that, the concept of eco-efficiency is introduced, and then the opportunities for environmental improvement are presented. Finally the research questions of this part of the research project are stated. These are the subject of discussion during the interview.

The integrated solutions model

The model below (Figure 1) presents the different features of integrated solutions that have been identified. The model is based around three main elements: the integrated solution itself, the organisation that provides the solution, and the client that buys the solution.

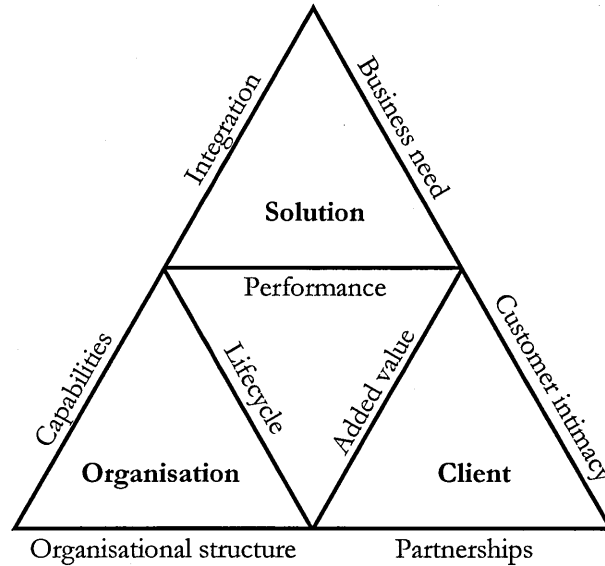


Figure 1: The integrated solutions model

Alongside these elements, the nine features of integrated solutions are positioned. These are discussed next.

Adding value

Battling commoditisation of their products and avoiding cost competition are among the main drivers for a company for offering integrated solutions. The integrated solution that is offered must be perceived by the client to have a certain added value compared to existing possibilities.

Business need

An integrated solution focuses on more than just products. It focuses on a specific business need of a client. A solution provider takes over an entire set of client's activities. The provider can, by analysing their clients' processes, reduce inefficiencies in terms of material and energy use, thus leading to cost reductions.

Integration

Solution providers integrate a wide range of products, services, systems, knowledge, and support into a tailor-made solution for their clients. ICT can play an important part in this, since it has the ability to integrate previously separate elements, thus enhancing the efficiency of the solution.

Life cycle

Integrated solutions are not about a short-term fix but rather about long-term improvements. Solution providers remain involved in the solution throughout its life cycle. Therefore life cycle thinking becomes important.

Performance

When offering integrated solutions, usually some sort of performance guarantee is involved. The solution provider takes care of a certain business problem, ensures a performance level, and the client pays a premium for this. The solution provider is responsible when performance levels are not met. The provider has got an incentive to

enhance the efficiency of the solution, i.e. to assure a certain result while using as little resources as possible.

Customer intimacy

With integrated solutions the client plays a crucial role. It is about getting closer to the customer and getting the customer involved. The solution provider then tailors its offering to the customer's needs. Therefore it is important to understand the client's operational requirements and forge close relationships with clients.

Partnerships

It is important to work with (other) market winners in order to provide excellent and robust solutions. Besides that, it is found useful to work with industry associations and regulatory bodies in order to help formulate and to anticipate standards affecting the solution.

Capabilities

A lot of skills, knowledge and capabilities are involved in offering solutions. The most important ones are: system integration capabilities, business consulting capabilities, operating services capabilities, technical competence, life cycle management, market knowledge, and soft skills.

Organisational structure

The organisational structure needs to change if a company wants to change towards providing solutions and the company also has to redefine its role in the value chain. The way the company performance is measured needs to change, since offering solutions goes beyond selling products.

Eco-efficiency

This research project focuses on the possible reduced environmental impact of integrated solutions compared to existing options. The aim to reduce the environmental impact of a product, service or system is called 'eco-efficiency'. The essence of eco-efficiency is contained in eight simple guidelines:

☞ Reduce the material intensity of goods and services

Mining and processing materials requires energy and creates pollution and waste, which can be expensive. Using materials more efficiently and sustainably makes sense both for the environment and for business.

☞ Reduce the energy intensity of goods and services

Energy is consumed during most stages of the life cycle of any product or service. Producing and consuming this energy creates pollution and waste. Making life cycles more energy efficient creates environmental benefit. As energy is costly even today, reducing the energy intensity will also create economic benefit.

☞ Reduce toxic dispersion

Some substances that are emitted to the environment can cause negative environmental and health impacts. Reducing health and safety risks of business operations to humans and the environment is part of a business' corporate responsibility.

☞ Enhance material recyclability

Material and energy utilisation can be improved by reuse in the same or another system. Recycling avoids the energy and waste costs of mining or creating virgin materials.

☞ **Maximise sustainable use of renewable resources**

Fossil fuels and some of the key materials on which our modern world is built are finite. Using renewable resources often tends to create less environmental impact over the life cycle and might create economic benefits.

☞ **Extend product durability**

Resource productivity can be increased by extending the useful life of products. This results in less frequent replacements, which in turn can mean less waste and the use of fewer materials and energy resources. Product-life optimisation can be used to gain competitive advantage.

☞ **Increase the service intensity of products**

Eco-efficiency can also be improved by increasing service intensity while reducing or holding constant service impacts, like shared use, upgrading and multifunctional products. This might generate economic benefits.

☞ **Create added value**

The goal of eco-efficiency is to create value for society and for the company, by doing more with less over the entire life cycle. When added value is created, while reducing or holding constant environmental impacts, the environmental impact per unit of service is decreased.

As has become clear from the explanation above, eco-efficiency is not just about the reducing the environmental impact in the manufacturing phase, but about reducing the environmental impact across an entire (product) life cycle (See Figure 2).

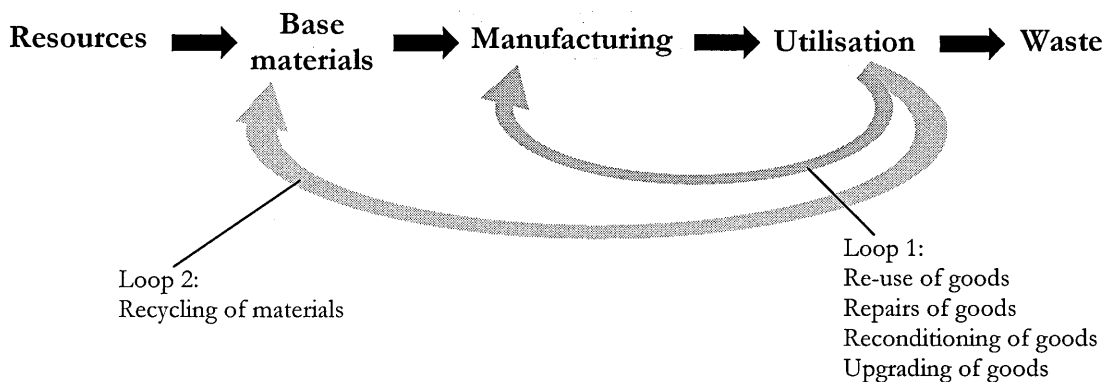


Figure 2: The (product) life cycle with two closed material loops

Towards an eco-efficient solutions model

The following twelve aspects of integrated solutions, that might be able to influence the eco-efficiency, have been identified so far:

1. Focus on creating value

Indirectly reducing the environmental impact per unit of service, thereby improving its eco-efficiency

2. Focus on the whole process or business need

Rather than focussing on separate products or services, tailor the integrated solution, thus discarding the inefficiencies and redundancy

3. Outsourcing

Enhancing efficiency through specialisation

4. Extending systems integration capabilities

Enhancing efficiency and reducing redundancy through integration

5. Utilising the power of ICT
Increased eco-efficiency through shipping less physical matter around and the ability to integrate previously separate elements
6. Life cycle costs
Communicating the benefits of options over their life cycle might lead to choosing environmentally preferable options
7. Performance guarantees
Guaranteed performance gives an incentive to fulfil a certain need using fewer resources
8. Efficiency versus eco-efficiency
The major question is to which extent is something that is more efficient also more eco-efficient?
9. The environment is a client-specific issue
Whether the environment is considered to be important or not depends on the client
10. Work with industry and regulatory bodies
Providing robust solutions through information and anticipation of industry standards
11. Life cycle management skills
Manage the life cycle of the output of integrated solutions
12. Redefine ways of measuring company performance
Instead of product sales, different ways of measuring corporate performance have to be devised when providing solutions

Research questions

The aim of this research project is to find out whether the aspects mentioned above are useful and appropriate attributes of integrated solutions that can be influenced in order to promote more eco-efficient solutions. This leads to three questions:

- ☞ How useful are the twelve aspects that have been identified in your situation?
- ☞ Could you think of other specific aspects that can aid the development of more eco-efficient solutions?
- ☞ To what extent do these twelve (plus) aspects contribute to increased eco-efficiency of an integrated solution?

The SOLiD project

The acronym SOLiD stands for Service Oriented Life cycle Design. The project is funded by the UK Engineering and Physical Sciences Research Council (grant nr.: GR/M54834). The project started in October 1999 and has a duration of 3 years. The principal investigator is Dr. Tracy Bhamra, and the two PhD researchers working, one of which is Frank van der Zwan MSc.

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APPENDIX D: VALIDATION QUESTIONS

This document shows the standard list of questions developed for the Validation, which is discussed in Section 3.3.4 and Chapter 6. This list provided the basis for the semi-structured interviews held with the representatives of various companies. Documentation was used to prepare for the interview and to alter the questions asked and/ or the sequence if deemed necessary.

D.1 INTERVIEW QUESTIONS

Name:
Company:
Date:
Location:
Topic:

Preparation for interview

Please read *Towards an eco-efficient solutions model*, in which the research project is introduced, the concepts of ‘integrated solutions’ and ‘eco-efficiency’ are presented, and twelve aspects of integrated solutions that might contribute to increased eco-efficiency are stated.

Purpose of interview

Discuss the twelve aspects of integrated solutions that have been identified and try to find out a) to what extent they play a role in existing integrated solutions and b) to what extent they contribute to enhanced eco-efficiency.

D.1.1 THE COMPANY AND THE ENVIRONMENT

- In *Towards an eco-efficient solutions model* the concept of ‘eco-efficiency’ is introduced. Were you familiar with this concept?
- To what extent is your company environmentally conscious?
 - e.g. EMS, environmental department, sustainability indicators

D.1.2 FOCUS ON THE WHOLE PROCESS OR BUSINESS NEED

Rather than focusing on separate products or services, tailor the integrated solution, thus discarding the inefficiencies and redundancy

- Has the company been able to come up with radically different concepts since focusing on a whole process rather than focusing on separate products?
 - If so, could you give an example? If not, what has prevented this from happening?

APPENDIX D: VALIDATION QUESTIONS

- Has the efficiency improved since focusing on a whole process? If so, where are the biggest efficiency gains for your solution?
- Could your solutions be more efficient through focusing on the whole process or business need? If so, how would you aim to achieve this?

D.1.3 EXTENDING SYSTEMS INTEGRATION CAPABILITIES

Enhancing efficiency and reducing redundancy through integration

- To what extent is 'integrating systems' part of the solution you offer?
- Do you feel you can go further with integrating products and systems since you started providing solutions?
- To what extent has integrating systems made your solution more efficient?
- What would the specific elements be you would want to integrate if you wanted to make your solution more eco-efficient?

D.1.4 OUTSOURCING

Enhancing efficiency through specialisation or economies of scale

- Are your clients in effect outsourcing their business activities to you?
- Which elements of the solution have become more efficient as a result of specialisation or economies of scale?
- What incentives have you got for providing your solution as efficient as possible?

D.1.5 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Increased eco-efficiency through shipping less physical matter around and the ability to integrate previously separate elements

- What is the role of ICT in the provision of your solution?
- To what extent has the solution become more efficient using ICT?

D.1.6 PERFORMANCE GUARANTEES

Guaranteed performance gives an incentive to fulfil a need using fewer resources

- Do you operate performance guarantees?
 - If so, could you describe this performance contract? If not, why not?
- How do you think using performance guarantees can make your integrated solution more eco-efficient?

D.1.7 LIFE CYCLE COSTS

Communicating the benefits of options what might lead to clients choosing environmentally preferable options

- (How) do you use life cycle costs?
 - e.g. to communicate the benefits of your solutions or to evaluate different concepts during the development stage?

- How do you think life cycle costs can be used to improve the eco-efficiency of the integrated solutions you offer to your clients?

D.1.8 EFFICIENCY VERSUS ECO-EFFICIENCY

To what extent is something that is more efficient also more eco-efficient?

- How do you measure your efficiency?
- Can you imagine measuring your eco-efficiency? How would you do that?
- In your company-specific situation, have you got any idea to what extent when striving for efficiency, you are becoming more eco-efficient?

D.1.9 THE ENVIRONMENT IS A CLIENT-SPECIFIC ISSUE

Whether the environment is important or not depends on the client

- To what extent are your clients sensitive to the environment?
 - What environmental specifications do your clients demand?
- How would you make your clients more environmentally sensitive?

D.1.10 WORK WITH INDUSTRY AND REGULATORY BODIES

Providing robust solutions through information and anticipation of industry standards

- With which other parties do you partner to provide your solution?
- Do you link up with regulatory bodies in order to develop industry standards?
 - What are the drivers/ barriers not to engage in these partnerships?
- How could you make your solution more eco-efficient when working with industry and regulatory bodies?
 - Would it be possible to incorporate the environment/ eco-efficiency into industry standards?

D.1.11 LIFE CYCLE MANAGEMENT SKILLS

Manage the life cycle of the output of integrated solutions

- What skills did you have to acquire to when you started providing solutions - during the following stages: Pre-sales stage, Sales stage, Implementation stage, Use stage, and End-of-life stage?
- What skills do you need to make your integrated solution more eco-efficient?

D.1.12 REDEFINE WAYS OF MEASURING COMPANY PERFORMANCE

Instead of product sales, different ways of measuring corporate performance have to be devised when providing solutions

- To what extent is selling products to your clients still the main objective of your company?

APPENDIX D: VALIDATION QUESTIONS

- How do you measure the effectiveness of your integrated solutions since they are a mix of products, services and expertise?
- How could you make your solution more eco-efficient when redefining ways of measuring your company performance?
 - e.g. amount of profit generated per unit of resources used, amount of resources used per unit of service
 - Could you see this happening?

D.1.13 FOCUS ON CREATING VALUE

Indirectly reducing the environmental impact per unit of service

- How are you creating added value for your customers?
 - Do your clients pay a premium for your integrated solution? If so, what characteristics justify the premium price of the solution?
- The aim of eco-efficiency is to unlink creating value from impacts on the environment. Do you think this is also true for your solution?
 - If so, can you explain how this is achieved?
 - If not, could you see this happening? What would need to change?
- How could you further enhance the added value created for your solution?

D.1.14 XIII. OTHER ASPECTS?

- Are there aspects you have missed that might affect the eco-efficiency of your integrated solution? Can you think of other important aspects?

D.1.15 FINALLY...

- If you had to focus on one of the above aspects, which one would it be?
- Which of the above aspects do you think would most contribute to enhanced (eco)-efficiency?
- Do you think the concept of 'eco-efficiency' is congruent or at odds with today's business reality?
 - If you think it is not congruent with today's business reality, what would have to change to improve its congruence?

APPENDIX E: SAMPLE TRANSCRIPT

The following sample transcript is an excerpt from an interview conducted as part of the Validation. The interviewee was the Managing Director of a leading integrated security company.

INTERVIEW WITH MANAGING DIRECTOR, COMPANY H

Researcher: FvdZ

Managing director: MD

[...] : added for clarity or replaced for confidentiality by researcher

FvdZ *[Introducing the work done so far, explaining the purpose of the interview, and going through the concept of eco-efficiency] ...To what extent are there any environmental pressures in your industry? I noticed on your website that you operate an environmental policy...*

MD Yes. There are certain, certainly within the, what is called, construction and design regulations, there are requirements now which state that you have to specify how you are going to remove equipment at the end of the installation of a contract. That is certainly only come in the last three or four years. That is a requirement that is built into all our major contracts. We have to say how we are going to dispose of the equipment, which does make people think how they are going to dispose. Apart from that, there isn't an enormous amount of pressure within our industry on reducing waste at this point in time. But I suspect that this is going to increase. People are becoming more aware of these factors, in terms of designing products, in terms of, for example, the guarantees given on products. Once upon a time twelve months or three months in some cases was acceptable, now some of the more focused suppliers talk about five years. That just changes the whole context, the whole attitude. When you get five years guarantees on products, then we are much happier to give a five year maintenance contract, which in effect means that the product is going to be certainly there for five years, and is not going to be thrown away after three years. So that is a very significant change. So in that sense: yes, it is happening, but it is not going as quickly as it should. But it is certainly happening.

FvdZ *Is your industry also affected by the forthcoming WEEE-directive – which stands for Waste of Electrical and Electronic Equipment, where producers have to take back their products at is useful lives?*

MD No one has yet has made any announcements to that yet. But it is bound to have an impact, particularly... we use a lot of batteries in our products in our industry. And batteries particularly are very difficult to dispose of now, because it is seen as an unfriendly product, environmentally, so people don't want to take it. So the manufacturers will have to develop their recycling facilities. And so it will be part of our policy that we will only buy from people who will take back and exchange the used items. As I say, that is the most damaging eco-product that we have;

batteries. So yes on that one... In terms of the other products: Cameras have all moved over to CCD – they don't have the valves anymore, which were economically difficult to get rid off. Then they moved over to what they call coupled charge devises, so they are much easier to recycle. So there is more of that going on. So in that sense: yes, there is that aspect changing.

FvdZ I noticed on your website that you say you offer an integrated security solution. That was basically one of the reasons why got interested in your company. I was just wondering whether this has enabled you to come up with radically different concepts or whether you still more or less offer the same products that other security companies offer as well.

MD The products for integrated security have primarily come from the United States. They have required these products to make security more effective. As a by-product of that, there are more eco-friendly, in the sense that, for example, if you are installing a system here and they were all independent – independent entry system, independent access control, independent camera, independent intruder alarm – they would all have a separate control panel, they would all have a separate PCB based collect control panel. So you would have five or six computer systems in one location. Whereas with an integrated system you only need one and all the information is fed back to one point and that is certainly beginning to alter people's approach to integrated security. Our problem is that we are probably five years ahead of the market here, that we were selling a concept that nobody understood and didn't know why they wanted it. And as a company we were too small to push it. But now, because suddenly the American companies [over here] use it – we are very effective in selling that concept to American companies, because it is an open door – they understand the concept, that's what they want. So we install lots of integrated systems to American companies. It is only just beginning to become accepted in the UK, for UK companies to follow that route. For example, I was talking to [an insurance company] last week and they are talking of standardising all their systems into one location, so controlling all their systems in one location. So, instead of having 800 PCs in 800 locations, they will have one major PC in the centre and all the other locations will feed back to that PC. And then their guarding station will supervise all these 800 locations. If there is any alarm, they will notify the police directly. So they will no longer have 800 guarding companies looking after 800 separate locations. So that is a huge change in attitude, which got an enormous benefit in eco-system technology, in the sense that whereas you had 800 PCBs you are now just having one big PCB controlling all those locations. It will take a while to implement that throughout [the insurance company], but that is the concept that is beginning to take hold. We have also got a lot of other people seeing the benefits as well. Another one we had, had ten different floors all got their own intruder alarm system for each floor, so they had ten. Now they realised they could do it with one system, and that system just can control the whole building and the information is led back through to a centre. So there is lots of potential savings there. It is not being driven by the eco-requirement; it is being driven by the cost-element. But the by-product is eco-friendly.

FvdZ That has definitely also been my approach in terms of trying to look at a successful business concept that is out there. If you look at integrated solutions, one of the characteristics is that it drastically enhances efficiency if you're able to integrate previously separate systems. This is great from both the cost perspective and from an environmental point of view. As you have already said, the efficiency has improved since you are offering integrated security systems. I was wondering

- where the biggest efficiency gains lay in your solution.*
- MD In terms of costs... it depends on the type of customer. For in the companies where man-guarding is major aspect of their business, being able to remove the need for man-guarding is the biggest saving by a long way. Because, we are for example putting a system into Southampton for [the insurance company]. Now it is costing them £ 50,000 a year for man-guarding for those premises. Putting this system in which will cost half that, will allow it to be monitored at [one central point], and they have saved £ 25,000 the first year and then they save £ 40,000 the year thereafter. So there are huge savings just on that one aspect. So the case is overwhelming in favour for an integrated security system.
- FvdZ *The next element about extending systems integration capabilities ties in directly with focusing on a whole business need.*
- MD "Can you go further?" The answer is absolutely 'yes'. More and more systems can be integrated. I mean, once upon a time you had a separate system on the car park, and a separate system on the front door, and a separate system internally. Now they are all being brought into one system. So one access card allows you to do all those things. But on top of that it allows you to use the vending machine for coffee, it allows you to use the photocopying machine, it allows you to even use your computer. So it is building the concept and its own mix together. One card allows you to have access into various premises. Somebody in a company, once upon a time, would have six or seven separate ID-cards for six or seven buildings, now you need just one. So you cut down the amount of ID-cards, plastic cards, you need. Then you would use a separate card to get into the vending machine, and you'd use a separate card to go to the photocopier. So all those things are now being replaced by one card, which is the microchip with all the information on it. So yes; as systems develop, as the concept develops, the idea of adding more and more products, more and more items within a building that can be added to the systems. All the alarm, plant systems are all monitored. You can have your access control system monitor who comes through the door and then puts the lights on, and when there is nobody in the building the PIR – the passively infrared sensor – identifies that there is nobody in the building so all the lights go off. So that's all being gradually brought together as part of an integrated solution.
- FvdZ *Do you work together with facilities management companies as well?*
- MD Yes, we do do systems with them. A lot of these kinds of ideas are talked through with the consulting engineers at the design stage, rather than with the facilities manager once the system is installed. You have got to get in early.
- FvdZ *When talking about outsourcing, when you're offering an integrated solution, the client does not have to worry about these elements anymore; you're taking care of the whole package. When you're reading literature on outsourcing, basically what they say is that there are two ways of getting these enhanced efficiencies: this can either be through economies of scale or through specialisation and the utilisation of knowledge. So where would you say you get the efficiencies from? Would that be the fact that you are able to deal with bigger systems or ...*
- MD I would say so. That is where our skill is, in terms of being able handle the bigger systems and incorporate hundreds of locations into one system.
- FvdZ *One of the components of an integrated solution is ICT, which is more or less an enabler to integrate separate systems, shipping less physical matter around. Is this also the case with your solution?*
- MD Yes, because we can interrogate systems remotely. For example, we install systems throughout Europe. If there is a problem with our system we will talk to Chicago,

and then we will talk to Munich and Montpellier and other places, identifying where the problem is and get it right, without going to visit the site. So that is saving an enormous amount of time, and energy and eco-efficiency. So, that type of approach is being utilised much more in all aspects of intruder networks and security. With intruder systems, we generally... ten years ago we would have to go to every system that broke down to see what the problem was. Now it is probably one in three we actually visit, the other two and three we would do it remotely by checking the system remotely through the Internet or the telephone system. So that certainly saves a lot of time and money and resources.

FvdZ If you talk to a client and install an integrated security system on what sort of contract basis do you do that? Do you use performance guarantees, where you promise a level of performance and share the rewards when you are doing better and pay penalties when you don't?

MD I don't think the industry is that sophisticated, so we don't use that at the moment. Our guarantees are that we will attend within four hours of a breakdown; that is as far as our guarantees go. If we can do it over the telephone that is so much the better. That gives us an incentive to make sure that we do less and less by visiting sites and more and more by doing it remotely. So we won't need to visit, that's the incentive to use fewer resources and to be much quicker and do it remotely.

FvdZ Can you imagine operating these sorts of performance guarantees or do think it is not really suitable for your industry? In a way the result that you are providing is a safe environment, generating an amount of trust...

MD We are a member of an organisation called NACOSS, which is the ISO9000 accreditation operation in the UK for the security companies. Now, they set up performance guarantees that we have to abide by if we want to maintain our accreditation under ISO9000. So in a sense it is not the customer who is driving that, it is the ISO9000 – quality. With those we have to attend signs of certain percentage levels, the number of false alarms has to be below a certain percentage. So they are all performance requirements, but as I say they are not driven by the customer, but they are driven by the ISO9000 accreditation.

FvdZ So these are almost like prerequisites if you want to be able to offer solutions to your customers?

MD Yes. These [pointing to ISO9000 certificates on the wall] are all for different types of security: access control, intruder alarms, and CCTV. So we have got to be able to maintain this performance guarantee. The reason the customer doesn't drive this is because the customer is not into the technicalities of how often the system should break down. He just wants to know it is not breaking down. If it breaks down, he wants to know it is going to be repaired in a reasonable amount of time.

FvdZ Do you find by offering integrated solutions that you now look much more to the whole lifecycle of the products and services that you offer? I quoted something from your website which says something like 'we appreciate that we are not always the cheapest but we think that the integrity of the system is important' etc.

MD The answer is: we are trying to sell that benefit, but it does not always get accepted by the client. Because if he has got a choice of paying, let's say, £ 600 for a camera and our price is £ 1200, we will explain to him that that £ 1200 camera will last five years. It is going to cost him £ 250 a year, where this £ 600 camera will last eighteen months to two years. So although in the short term that is much the cheaper option, in the longer term this is by far the better option. We don't always take that on board, but that is something that we're trying to develop the concept of. Because it is not just the cost of the camera that you are going to take into account, it is the cost of going and changing, replacing the camera with another

one, the labour involved going back and forward because it is not working so well. So overall, that is the much better solution and you've got the quality in the first place. It is not an easy sell, but any good salesman can sell it, put it that way. So yes, we do push the most efficient options.

FvdZ *One of the questions I ask myself is to which extent is something that is efficient also more eco-efficient. With integrated solutions there are a lot of incentives or elements that enable the enhanced efficiency, but the big question is, to which extent is that also more eco-efficient.*

MD I am an economist, so efficiency has a particular meaning in economics. Are you an economist, or ...?

FvdZ *No, I've got an engineering background.*

MD I mean in economics efficiency is almost always interpreted in terms of financial saving benefit. I can't think of a situation where something that is eco-efficient will not be efficient or more efficient than something that is not eco-efficient. Almost by definition, if you're improving the eco-efficiency of something, you're going to improve the efficiency, and the other way around. If you improve something and make it more efficient, then most times you're going to make it more eco-efficient. I can't think of... there might be something to do with power, whereas it might be more efficient to use, let's say, coal and gas, and coal might be much more damaging to the environment than gas is, for example. There might be an argument there to say well, something that is more efficient is not more eco-efficient. But I can't think of many instances in business, where you can make something that is more efficient, because not automatically make it more eco-efficient. Because you're reducing resources, and at the end of the day most of the resources that you are dealing with are fewer, whether it is material resources such as wood or energy, or whatever, or personnel. If you are using fewer people or fewer energy resources then you're going to save on the environment. I can't, other than perhaps the argument on power, I can't see the one not automatically produce the other. In that sense, yes, they are definitely totally the same thing.

FvdZ *'The environment is a client-specific issue'. Are your clients sensitive to the environment at all?*

MD The answer is: some clients are and some clients are required to be. And those that are not required to be generally tend to be smaller companies where efficiency, or eco-efficiency, is not seen as part of the agenda. But if you're dealing with public authorities then they are now required to have an environmental policy in place, and that requires them to make sure that all their suppliers have a policy in place. So in that sense it is driven by the client. And similarly, if you're dealing with major companies, invariably they have some requirements along those lines, especially if they are in the pharmaceutical or the petrochemical industries; they seem to be much more tuned to it. But if we're dealing with retail operations down the street, people like that, then there it is not a requirement.

"Industry and regulatory bodies": I think we've already touched on that. The regulations are forced on us to be more eco-efficient and also the regulations that are coming through about, as I said, batteries, they are making us more conscious about the environment, whether we like it or not we have to abide by those. I mean, I don't have a problem with that, I think it is a good idea. It is a good idea to make suppliers take back equipment once it is past its useful life, because that forces them to become more eco-efficient as well.

FvdZ *Do you work together with regulatory bodies, like the BSLA?*

MD I won't say we don't participate in a major way, but we do sit on various committees but I wouldn't say that is a key element of our business.

- FvdZ* Do you see this as a way of pushing those sorts of more environmental related issues?
- MD* I think we will tend to be reactive rather than be proactive at the moment. We would do what the government tells us. Partly, because they are telling us so many things, that we are running very fast to stand still. So, you're not seeking to go one step ahead, because you're already rushing to catch up. So that's the problem there.
- FvdZ* ...To which extent is your solution a mix of standardised and customised elements?
- MD* It is probably 95 per cent standardised products. The customisation comes in knowing what products will link together, because in our industry there are probably forty or fifty thousand different components, supplied by perhaps three or four hundred suppliers. You've got to know that certain types will fit and others won't. Because there isn't an open architecture within the security industry, so there is no basic requirement that everybody has to be compatible. And it certainly is a major element of our work to know what is compatible and what isn't. Because the last thing you can do is put a camera system in linked in to an access control system and find that they don't work together and can't work together. You have to be aware of all that. So, that is the sense of the big items, but also there are a lot of tiny items, which if you put the wrong component in, the whole system will literally not work. So you have got to understand the tiny parts of the system as well as the big parts of the system. So the customisation is our knowledge of what will work together and what won't. We don't manufacture anything ourselves, but we do have a facility to write software. So sometimes when two pieces of software don't work together, we can write the software to make them work. But we try to minimise that, because that is very expensive and if you are doing that for one off systems it becomes very expensive for the client. So instead of paying £ 10,000 for a system, the price will now be £ 15,000 or £ 20,000, which is not... it doesn't make sense.
- FvdZ* One of elements companies are struggling with when moving from products to solutions is the way they define or measure their corporate performance. If you still measure your company's success by measuring the amount of products that you sell, you don't really have an incentive to make the solution more efficient. I was just wondering what the main indicators of your company are.
- MD* We are in the process of switching; sales used to be the major indicator, how much sales you'd taken or how much in sales you'd invoiced them. We are switching to how many hours we are using, because that is the cost driver of the company: how many hours the engineers are taking to do a job. So the whole concept of sales now is how many hours do you sell and how many hours are you using and measuring efficiency of the use of those hours. We are becoming more focused on how long it is taking, and the next stage will be 'can we make it quicker' and can we do it more efficiently.
- FvdZ* And do you invoice your customer with the products that you use in your contracts or ...
- MD* No, we will just give them a price for doing the work, because we are a solutions based company. We don't charge them for ten detectors; we charge them for supplying an intruder alarm system to meet their requirements. So that can be done through using a number of different products. They're not product conscious. That's our job, its performance if you like; solutions to their requirements. If they want people to not come into their building, we'll tell them how to do it and give them a price for doing it, but we don't tell what products are in there.
- FvdZ* Does this give you an incentive to use the most efficient products in terms of functionality? Or

have got fixed arsenals of products that you use?

MD We've got a range of products that we prefer to sell. We can sell most people's products, but we have a preference based on our requirements that we install systems that have minimum maintenance costs involved, that have the longest lifecycle. We are not looking for cheap business to get the order, because we want a lifetime customer and if you put in a cheap system you won't get a lifetime customer, you get a customer for the next two years. So that's the focus; we would be looking at reliability, a value for money type of approach.

FvdZ *Can you envisage different ways of measuring company performance? For example I have written down 'the amount of profit generated per unit of resources used' or 'amount of resources used per unit of service'...*

MD Well, by focusing on hours, in a sense, that is what we are doing. Because we are identifying how much profit we are getting from each hour of installation. With unit of service the same approach: if it takes us four hours to do a service on average, we would then try and bring that down to three hours. So yes, we are looking at how we can do that more efficiently, through planning of resources, planning of territory, and so on. These are all issues that will start to come out of the focusing on the amount of time that it is taking us to do a job.

FvdZ *One of the basic things of an integrated solution is that you're offering something with added value, which justifies the premium. [Explain providing added value while not drastically increasing the environmental impact.]*

MD The answer: yes, that should be a by-product of what we are doing. It is certainly an aspect that I always look for; the added value for the client whenever I am selling a system. What can I give him so that he can say it is improving the security of the building but it is also doing XYZ, whatever that XYZ is, because I am looking for a hook, if I can put it that way, that grasps his attention. That hook might be you're reducing the costs of your photocopying because lots of people are using it, or you're improving the staff welfare because they can get coffee when they like or something like that. These might be side issues, but if you give them a standard security package and then add on value by some other way then it just pushes them towards your concept. One of the immediate sell items is that you say you don't need man-guarding with our system because you can monitor it twenty four hours a day remotely and you can do a hundred sites, just by having three or four people sitting in one room on one location, and they could look after a hundred sites. What you're doing at the moment is having one hundred sites all visited by a man-guard, by a man-guard on the premises. So there is a huge potential of savings. Until you talk to them about this, they don't grasp it themselves. It is not the type of thinking that a security man will do automatically, because he will be thinking that man-guarding company is not very good, I must replace it with another one. He won't think there is an alternative. My job is to say there is an alternative and this is what it is, OK it might cost you £ 5000 to install this system, but it will save you £ 2500 a year, so within two years you've paid for it. So that's where you're making them focus on the wider issues.

FvdZ *I think also because these separate systems have evolved over time. Everyone is very comfortable within their own niche and suddenly realise that these systems can be integrated...*

MD We have got a lot of competition now from building management companies, because building management companies approach this same concept from a different way, where all the controls in a building are handled by a building management system. So this could be heating, lighting, gas, electricity, whatever...

it's all being monitored by one system. Now they are realising 'well we can just as easily add security onto this, and add the intruder alarm' and so on. So they coming at it and say 'we'll add these onto the system, it doesn't cost you much', and we're coming in from the other end and say 'we'll give you the security system and add on the monitoring of the fire system and the monitoring of the gas and so on and it doesn't cost you much'. So we're getting this competition in the middle now.

FvdZ I was wondering whether you could still think of other elements that could have an effect on the environmental qualities of a solution that you're providing.

MD I think the biggest impact is the fact that networking, network solutions, you can deal with the problems from here and sort out any difficulty in Scotland, the south of France, Germany, or whatever. And by doing that the amount of money you save by not travelling to those places or arranging for people in those places to go to that location is enormous. And in itself has got to contribute... it is in the millions of pounds. But the industry is only slowly adjusting to that fact. So that I would say is the biggest potential saving from the eco-efficiency of integrated systems. Because once it is integrated, then it is networked and if it is networked then you can link it to a wide area network and once you can do that, you've got this facility for checking it from any point anywhere. And our engineers now can look at hundreds of our systems from here and see what the problem is and change things. The Americans seem to be three, four years ahead of us and they've been doing this for a certainly few years. But we're now into the mainstream of it.

FvdZ I've also looked at how eco-efficiency might affect your company...