Enhancing Sustainable Innovation by Design.

An Approach to the Co-creation of Economic, Social and Environmental Value.

Duurzame Innovatie: Co-creatie in het ontwerp
van product-dienstcombinaties.

Thesis

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by
Simona Rocchi
born in Cesena, Italy

Doctoral Committee

Promoters: Prof.dr. W.A. Hafkamp
                 Prof.dr. E. Manzini

Other members: Prof.dr.ir. J. Rotmans
                 Prof.dr.drs. F.H.A. Janszen
                 Dr.ir. S. Silvester

To André Rotte

Acknowledgements

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INTRODUCTION

1 Foundations and framework of this study

1.1 Premise

It is estimated that the world's population will almost double from the present 6.2 billion to around 8 to 10 billion by 2025 and, as a consequence, will increase both the demand on resources as well as the environmental impact resulting from human activities (United Nations, 2002). Since the earth is a closed ecosystem, it will not be possible to support such an exponentially increasing population within the traditional growth-oriented economic models. Therefore, a shift in the current economic and socio-cultural framework is required: a transition from a traditional material and product paradigm[1] to an emerging knowledge and service paradigm (Andersen et al., 2000); a transition in which the research into *sustainability* shifts from a technological and product-related innovation process to a broader techno-socio-cultural innovation process.

In this perspective, companies can promote a change both in the way products and services are produced, marketed and distributed (new patterns of production), and the way in which products and services are used (new patterns of consumption). They can offer a whole set of initiatives whose goal is to favour a change from one non-sustainable mix of products and services to a more sustainable one, while still being economically successful.

1.2 Goal and context

Traditional eco-design methods, which generate environmental incremental product's improvements by technical changes, are necessary but not sufficient instruments to stimulate the creation of sustainable solutions. Companies exploring the path to develop sustainability-based business propositions require different instruments. They require design methods able to go beyond 'eco-efficient' results towards environmental, and socio-economic 'effective' results.

The matter is not just to improve what already exist in the company's product portfolio, but to re-think the business offer by considering:

- a deep understanding of people's values and needs in their local living conditions
- the possibility of creating the most appropriate market propositions together with partners having complementary capabilities and expertise.

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[1] Paradigm, in its general meaning, denotes a worldview that consists of shared, non-contradictory assumptions and values.

In this context, the overall goal of this study is to develop a flexible and practical methodological design approach to envisioning innovative product-service systems that are able to figure out economic value for business, as well as environmental and social benefits for society.

The aim is to outline a comprehensive qualitative approach that can contribute to today's business innovation process and its value propositions by assuring the integration of the following three fundamental ingredients.

- A triple bottom line[2] steering framework in terms of sustainability-related guiding principles, design criteria and filters considered at the very beginning of the concept ideation phase.
- A dynamic of value co-creation for the definition of new global-local propositions involving various stakeholders, within and outside the company, with different competencies and expertise.
- A view of *product-service systems* as combinations of product and service components that can modify their functions, and eventually growth, over time.

The approach, as defined above, covers one step of the business value chain / network: the concept creation. Its contribution towards the diffusion of sustainable solutions has to be considered in relation to its specific task: the ideation of concepts and design scenarios in the respect of a set of given requirements. As such, this approach can help the business in the achievement of the expected results by making available the best design options among the various ideas generated in the creative session. Per se, it has no ambition of claiming measurable economic, environmental or social benefits. Indeed, sustainability related performances depend also on the way of carrying out concept implementation through the other phases of the value chain / network.

The experimentation of this approach takes place within the business context of Royal Philips Electronics, specifically within its global design service unit: Philips Design. The field of investigation is digital networking and information communication technology, with a particular focus on the electronics and consumer electronics sectors in Western markets[3].

1.3 Research hypotheses
For the purpose of this study, four main research hypotheses have been defined.

- We are currently living in a product-service oriented market, where stand-alone and finished products and services are increasingly paving the way for a new and more

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[2] 'Triple bottom line' is a business terminology used to indicate the simultaneous pursuing of economic prosperity, environmental quality and social equity.
[3] Sustainable development, in its different aspects, is a challenge that affects people over consuming and people under consuming. The choice of this study falls into western societies: it addresses a target audience that typically can afford Philips products.

complex combination of tangible and intangible assets that generate open, flexible and customisable *product-services systems* (added-value solutions).
- These richer and more competitive business answers are rarely generated by a single company. They are instead the outcome of a complex value co-creation process involving different stakeholders - including local actors and end-users - with various competencies and expertise.
- Sustainability-related principles and practices on the one side, and digital technology on the other, are transforming production and consumption patterns inherited from the Industrial Age. The combination of a triple bottom line approach with an appropriate use of Information Communication Technology (ICT) can - potentially - generate new ways of doing business, and new business ideas, in line with more sustainable lifestyles.
- Design can assume a strategic role in the business innovation process by bridging technological innovation with social innovation. It can facilitate the mix and match of multiple knowledge and inputs needed to create new added-value solutions. These are solutions that require radical and discontinue changes in order to satisfy - in a sustainable manner - the needs and desires of an exponentially increasing population.

1.4 Objectives
Four main specific objectives have been met by this study.

- To understand the drivers for, and the features of, new business models emerging from the promotion of sustainability-oriented *product-services systems* in the ICT, electronics and consumer electronics sectors.
- To understand the role that design can play in stimulating sustainable innovation by helping business to move from product-related, technology-based eco-design measures to system-related, socio-cultural-based design-for-sustainability practices.
- To outline a few design scenarios of *product-service systems* - generated for selected families of digital applications in the Philips context - by considering the lessons coming from these new emerging business models flourishing in advanced markets.
- To outline the design process - and the tools applied to envision the design scenarios as well as their underpinning business rationale - in the outcome of the experimental phase of this study.

1.5 Structure
This study is divided into two parts.

Part One provides an insight into the theoretical debate around the concept of *product-service systems* and its business and design logic. Theoretical references have been substantiated by several empirical experiences of sustainable *product-service systems* present in the market, together with two detailed case studies.

Part Two is experimental. It explores a broadly applicable methodological design approach developed within the business framework of a product-service re-orientation of Philips'

product offering. It is supported by the use of a few examples (design scenarios) extracted from the outcome of two workshops organized to define and test such an approach.

1.6 Methodology

This study was conducted using an action-research methodology. An iterative process linking theory and experimentation was used throughout the investigation: the results produced in the testing phase were used to shape, enrich and complete the initial approach.

The knowledge required to 'feed' this iterative process was acquired by addressing:

- a critical review of the literature dealing with the theoretical conceptualisations of new emerging business and design practices promoting *product-service systems*
- desk research (using specialized magazines, the Internet and the proceedings of international conferences) intended to discover empirical examples of sustainable *product-service systems* in the areas of the convergence of electronics / consumer electronics, information technology and telecommunication
- two case studies developed for a better understanding of the main business and design implications emerging from the promotion of new and more sustainable *product-service systems*
- interviews with key stakeholders working at Philips and Philips Design in the field of innovation (new business development units, marketing intelligence departments, design research and trends and strategy groups, etc.)
- two creative workshops organized on different occasions to develop and test the methodological design approach subject of this explorative study. The first involved participants from different departmental units / groups of Philips and academic representatives. The second involved participants from different departmental units of Philips, together with external stakeholders (end-users included) being considered as possible potential partners.

Concerning the use of literature a couple of considerations have to be mentioned. The thesis has reviewed scientific publications dealing with the notion of *product-service systems* since the very beginning of the debate - early 90's - until the time of its delivery, December 2004. However, general literature quoted in the references of this study represents only a critical selection of key academic contributions, which outline the most used definitions and classifications of *product-service systems*. Particular attention instead has been reserved to business/marketing strategies and design methods related to the subject. Specific scientific publications on 'how' to design *product-service systems* came out relatively scarce: only two major innovative research projects carried out by European universities and research centres where considered important to create the basis of the experimental part of this thesis. Specific business literature addressing new ways of working in the framework of an emerging product-service market orientation replaced the terminology of *product-service systems* with words such as 'system-solutions' or more

simply 'solutions'. This change had probably a reflection on the reduction of number of publications under the name of *product-service systems* (a terminology that today seems mainly in use within the European universities and research centres, which initiated the debate).

Concerning the experimental part of this study, it has to be said that the authentic contributor of the thesis' author is the definition and articulation of the proposed methodological design approach and its tool-kit; the concepts and the scenarios produced during the workshops are instead the results of a collective effort of all parties involved in the creative process.

1.7 New insights and their limits

Throughout the wide-ranging theoretical approaches and practical experiments in the field of *product-service systems*, the new insight offered by this action-research study is a practical way of making 'sustainability' part of the design briefs that characterize business innovation projects. By bringing environmental and social parameters - and the 'voice' of the users - into the new concepts creation process, the methodological 'co-design' approach developed here can increase the chances for business to provide competitive, user-centred value propositions with limited environmental impact. It cannot be defined a 'scientific method' in its traditional meaning: a creative process - as such - will never be able to product the same results. By considering the right competencies, criteria and tools, it can however to provide the decision makers with the most appropriate solutions among those generated according to their specific requirements.

This approach is fundamentally based on qualitative knowledge. The sustainability value and the economic benefits that could potentially be achieved by its application are not, therefore, meant to be measured in quantitative terms at this stage of the creative process. It should be considered only as a preliminary to those quantitative methods normally used at later stages: specifically, in the concept development phases, when the environmental and social performances are being measured. Nor does it replace conventional eco-design practices and technological changes applied to gain incremental environmental product or service improvements: it is an instrument of a different nature. It acts beyond technological changes towards social innovation, stimulating radical transformations of industrially-oriented patterns of production and consumption.

1.8 Guidelines for the reader

As already mentioned, Part One of this study (Chapters 2 to 5) provides the theoretical background underpinning new emerging *product-service systems* and their related business and design logics. Part Two, in contrast, is experimental (Chapters 6 to 10) and explores the practical methodological design approach elaborated here. It capitalises on the theoretical knowledge of Part One, and on the lessons gained with the two workshops carried out within the selected business context of application.

Following the introduction, Chapter 2 addresses the business challenge of sustainable development, and the new opportunity for the dematerialization of current production and consumption systems: an opportunity offered by what has been defined as the 'age of access' to functions and intangible benefits, with its correspondent product-service market orientation. Chapter 3 illustrates concrete business experiences of *product-service systems* and their commercial strategies. It starts with an overview of general examples emerging in the electronics and the ICT sector, before narrowing its focus to two cases analysed in depth in terms of type of offerings, sustainability of related value and business practices. Chapters 4 and 5 provide a theoretical understanding of the main features of new ways of doing business and of innovative design approaches required by the promotion of sustainable *product-service systems*.

Chapter 6 introduces the business context of experimentation for the development of the new design approach: the subject of this study. It explains Philips' current business and design practices, and its new ambitions for the creation of sustainable value propositions based on a triple bottom line approach. In line with these new ambitions, Chapters 7 and 8 describe the design processes adopted and the scenarios created with the two creative workshops carried out in 1999 and 2002 respectively. Chapter 9 explains the co-design approach that resulted from this exploration: it provides in detail twelve practical steps and their tasks, tools and timelines for envisioning new sustainability based *product-service systems*. Chapter 10 lists a series of conclusions and recommendations based on reflections emerging from the theory discussed in Part One, and on the lessons gained from the experimentation.

PART ONE
Product-service systems versus products:
theory and practice

2 An economy in transformation

This chapter addresses the business challenge offered by sustainable development. It also addresses the new opportunity for the dematerialization of current production and consumption systems opened up by what has been defined, by business literature, as the 'age of access' to functions and intangible benefits. In this regard, the chapter explains the transformation occurring in advanced economies and societies (in terms of product-service market orientation), as well as the features and drivers characterizing new emerging business offers (so called *product-service systems* or *system-solutions*) at higher competitive value and lower environmental impact. The trends here reported refer to up-stream promising situations rather than mainstream common practices; it is difficult to predict if these trends will growth in the future.

2.1 Economic development and sustainability

Environmental issues such as global warming, ozone depletion, loss of bio-diversity, accumulation of wastes and emissions in the environment, and wasteful use of natural resources are already serious, and put short-term economic gratification in direct conflict with the long-term survival of the planet. This is why a drastic increase of the eco-efficiency[4] of the current economic patterns needs to be addressed.

In the coming decades, companies will have to learn how to compete while decreasing the total production and consumption of physical goods, and advanced societies will have to learn how to live while relying on only 10% of the environmental resources that are being used (per capita) today. While primarily an environmental challenge, this is also a socio-cultural, economic and political challenge. Indeed, to be eco-efficient merely by optimising the level of industrial production processes is, although a required change, insufficient to satisfy - in a sustainable manner - the 'needs' and the 'wants' of 8 to 10 billion people in the years to come. Production and consumption systems should give more attention to values, elementary human needs, product and service functions and local conditions. Indeed, *sustainability* does not imply only an environmental status[5].

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[4] Eco-efficiency can be defined as "*a management strategy based on quantitative input-output measures which seeks to maximise the productivity of energy and material inputs in order to reduce resource consumption and pollution/waste per unit output, and to generate cost savings and competitive advantage*" (Geyer-Allély, Eppel, 1997). A similar definition can be found in many of the reports of the WBCSD, which consider eco-efficiency as a strategy for value creation per unit resource input. It is an idea essentially equivalent to maximising resource productivity at the company level rather than simply minimising wastes or pollution associated with a certain product (Ayres, 1995).

[5] 'Environmental sustainability' refers to the conditions of a system in which human activities do not overstress the natural environment. More precisely, it can be defined as "*a form of organisation of human activities whereby, on a worldwide and a regional level, the ecosystem isn't disturbed beyond the threshold of its 'resilience' (its capacity to tolerate disturbance without irreversibly losing its equilibrium). As a result, no irreversible degradation phenomena are set in.*" (Manzini, 1997).

Thanks to two worldwide summits on the subject (the Rio Summit in 1992 and the Johannesburg Summit in 2002), **sustainability is now broadly recognized as a comprehensive concept that implies "a desire for greater equity, quality of life[6] and environmental well being today and for future generations"** (WBCSD, 1998). It is, ultimately, a scheme to improve our habitat.

In this scheme, companies will be seen increasingly to play a crucial role: they can become powerful engines of innovation able to provide solutions that enable people to live better while consuming less environmental resources. In other words, they can offer alternative solutions that are *environmentally* valuable as well as *socially* and *economically* attractive; solutions that will be successful if new (and more sustainable) combinations of products and services are recognized by users as offering a better approach to personal, social and environmental problems than the existing ones.
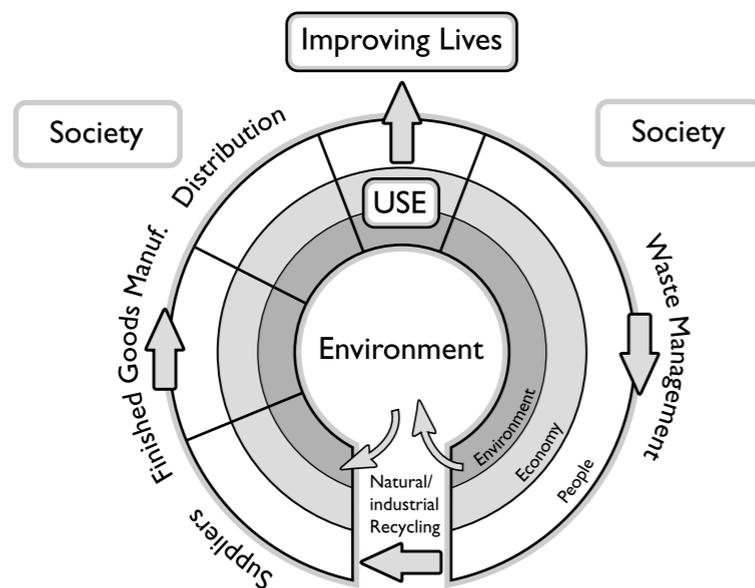
Figure 1 - Business contribution to sustainability.

The primary contribution of business to overall sustainability is to provide the products and services that improve people's lives. Individual businesses also contribute by the way they operate in providing these products and services: by considering the environmental, economic and social aspects of their own operations throughout the product or service life cycle. *After:* WBCSD, 1998.

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[6] 'Quality-of-life' is a personal concept derived from a social construct. It involves such factors as food, clothing, freedom, wealth, economic stability, health, safety, education and relationships in families and wider communities. Individuals should be free to choose how to balance these factors for themselves. However, from a common understanding (social construct), the meaning of quality-of-life has evolved over time. In the past, it was often mainly related to an idea of well-being and progress measured in economic terms (Gross Domestic Product and income per capita) and therefore in relation to the equation Q-o-L = high income.

2.2 From finished products to open product-service systems

Looking back on the history of the Western industrial model and society, the 1950s to the 1970s can be seen as essentially manufacturing and product-driven years, and the population's concern primarily to 'own' and 'possess' physical assets to create identity and status. As consumers grew more sophisticated, and markets saturated with goods, corporations became more marketing and brand-driven. In turn, consumers became more concerned with satisfying the less tangible aspects of life, such as emotions and aesthetics, and in engaging in less materialistic experiences (Pine, Gilmore, 1999). In this phase, the corporations' ability to define aesthetic and cultural icons and to 'manifest' emotions became the marker of consumers' identities. Today, the diversity of people and the complexity of their lifestyles, together with the emergence of new technologies, are moving advanced societies towards a new era, one which is less about *consumption* of material goods and more about *access* to services, authentic experiences, values and meanings. And as people become more concerned with personal growth and self-actualisation, their ability to *access* and *use* the tools, software and content of the new technologies, rather than 'own' them, is becoming increasingly important in defining their identity and their relation with products and services (Green, 2003/4).

Aware that the path towards a more sustainable society requires a 'de-materialization' of our production and consumption systems, new solutions can be researched within an emerging knowledge and service economy (Andersen et al., 2000; Johnson et al., 2003). Indeed, in many cases, what customers really need today is not a physical 'product' but rather the 'result' that a tangible asset provides: an answer to a specific demand. In other words, what we are seeing is a growing realization that people do not value physical goods – or ownership of them – for their own sake. On the contrary, the goods seem merely a means to an end, to satisfying a customer's needs (Leadbeater and Willis, 2001).

From this perspective, corporations that were traditionally product-oriented have started to look for new offer-systems "… *revolutionizing product design to reflect the new emphasis on services. Instead of thinking of products as fixed items with set features and a one-time sales value, companies now think of them as 'platforms' for all sorts of upgrades and value-added services*" (Rifkin, 2000). And, in doing this, they are finding new opportunities for generating sustainable value in business innovation and in the brand profiling processes. New dynamics for value creation, based on partnerships at the global and local scale, flexible and scalable technologies, and alternative ways of consumption (renting, leasing, pay-per-use) are setting the ground rules for the future development of a more 'human' capitalism. These dynamics enable a higher customisation and contextualisation of the offer, nurturing diversification and, therefore, marginalizing the possible negative effects of globalisation.

Today, especially in Western societies, it is beginning to place equal value on other 'soft' benefits such as work-life-balance, emotional well-being, empowerment, social cohesion and belonging.

Potentially, they enable the creation of **flexible, open and sustainable platforms** that we are going to call **'sustainable *product-service systems'*: "*profitable combinations of integrated and mutually dependent product and service components able to fulfil a user's demand, while containing the consumption of environmental resources and enhancing quality of life"* [7].

2.2.1 Differences and similarities

In order to fully understand the meaning and the intrinsic qualities of new emerging sustainable *product-service systems* (also called system-solutions or just solutions by the business), it is necessary to move one step back to the definition of 'service' and 'product', and to explain their differences and similarities.

'Service' in general, as the output of the tertiary sector, can be defined as a performance that one party undertakes for the utility, satisfaction and the support of another party's activities. It is essentially intangible and does not result in the ownership of anything (Kotler, 1997). The term **'product'** however, is used to indicate a material artefact whose purpose is to satisfy and support the activity of other people. It is tangible and it can be depicted in technical terms (Manzini, 1992).

Starting from these definitions, the main differences between 'service' and 'product' can be seen in:

- the **intangibility** of the service (service cannot be seen, felt, etc.) and the **tangibility** of the product
- the **variability** of the service (service is never the same) and the potential **standardization** of the product
- the **kind of relationship** between the supplier and the customer (direct interaction in the case of services, mediated interaction in the case of products)
- the **role of the time-factor** (in the case of services a simultaneous process of production and consumption occurs, while in the case of products the two phases are clearly distinguished).

Other characteristics of **service** and **product** can be derived from these four: the ownership of a service cannot be given to someone else; services cannot be transported; services cannot be stored; and, finally, they have a higher level of interaction between the supplier and the customer (Hoogerwerf, 1996). But, if these features have usually limited the field of business activities dealing explicitly with products or services (reflecting the different culture, economy, organization and design process of the enterprises), in reality their boundaries are not always so defined. On the one hand, no product can be supplied without at least one service component (its sale); on the other hand, services also need a minimum of support from products if they are to be performed.

Today especially, with the diffusion of information and communication technology, the borderline drawn between products and services is becoming more and more artificial. In practice, we are experiencing an increasing convergence of the two, a continuum of products and services generating solutions (*product-service systems*), in which the non-material component cannot be split from the system of services in which products assume value. Let's take an empirical example. Consider the hypothetical case of a person who needs to write and print a dissertation and who has to choose the methods and tools to be used. This person can opt for several solutions. On one hand, he / she can decide to buy the necessary equipment (computer, printer, etc.) to do the work by himself / herself or, on the other hand, he / she can choose to outsource the whole task to someone else. In addition to these two alternatives - buying a product or asking for a service - he / she can also choose other interim solutions in which services and products are mixed together in different scales. For instance, to rent or lease the equipment and to have access to the use of Internet services; to make common use of facilities for data electronic re-elaboration offered by a service centre (computer, printer, Internet connection, etc.). These two interim solutions represent practical cases of flexible and, potentially more sustainable, *product-service systems*. They also reflect a new product-service cultural orientation of the business and open up alternative methods of value creation.

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[7] 'Literature dealing with the concept of product-service systems (PSS) provides similar definitions. Stahel and Giarini (1991), for example, consider PSS as long term sustainable concepts to help in moving towards sustainability in a service society. Manzini (1997) defines PSS as a combination of products, services and communications that help companies to be competitive while participating in a social innovation process that underpins a more sustainable way of living. Goedkoop (1999) considers PSS as marketable systems of products and services capable of fulfilling a user's demands and presenting different degrees of economic, environmental and social value. Mont (2002) refers to PSS as a system of products, services, supporting networks and even infrastructures able to satisfy customer needs, and lowering the environmental impact of traditional business models. The essence of all these interpretations has been consolidated by UNEP in a definition of PSS developed during an experts' workshop held in 2002: "*The result of an innovation strategy, shifting the business focus from designing and selling physical products only, to selling a system of products and services which are jointly capable of fulfilling specific clients demands. … A result that offers a useful and promising concept in the direction of sustainability … it is only when a PSS actually assists in re-orienting current and unsustainable trends in production and consumption practices, that it can be referred to as a Sustainable PSS*" (UNEP, 2002).

Figure 2 - Different levels of convergence of products and services, viewed through a theoretical scheme of interpretation.
Source: Rocchi, 1997.

2.2.2 A path of classification

Sustainable *product-service systems* are growing in several sectors, for example, the automotive, building, chemical, white goods and electronics sectors, and the food industry. Studies and literature focusing on this phenomenon propose various paths of classification in relation to the type of services, and taking into account their environmental performance.[8] A simplified path of classification is often adopted when looking into the electronics, consumer electronics and information technology sectors, the areas considered in this study. In a broad sense, *product-service systems* are distinguished on the basis of the effects

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[8] Hockerts (1999) identifies three types of 'service' concepts: *product-oriented services*, which often address only one specific issue of environmental efficiency; *user-oriented services* which aim to increase the efficiency of the use of a given product; *need-oriented services*, whose function is the satisfaction of customer needs regardless of the product. Brezet (2001), however, makes a distinction between *services that relieve customers* of carrying out certain tasks and *services which empower customers* to complete certain tasks. UNEP (2002) categorises PSS in relation to: *services providing added value* to the product-life-cycle; *services providing final results*, and *services providing enabling platforms* for customers. Behrendt (2003) distinguishes between services that are supplementary to the products, and services that lead to a partial substitution of products: within this last category, a further distinction is made between *result-oriented* and *use-oriented services*.

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generated by their service components at product and system scale, namely: sustainable *product-service systems* with *product-oriented services*; sustainable *product-service systems* with *system-oriented services*.
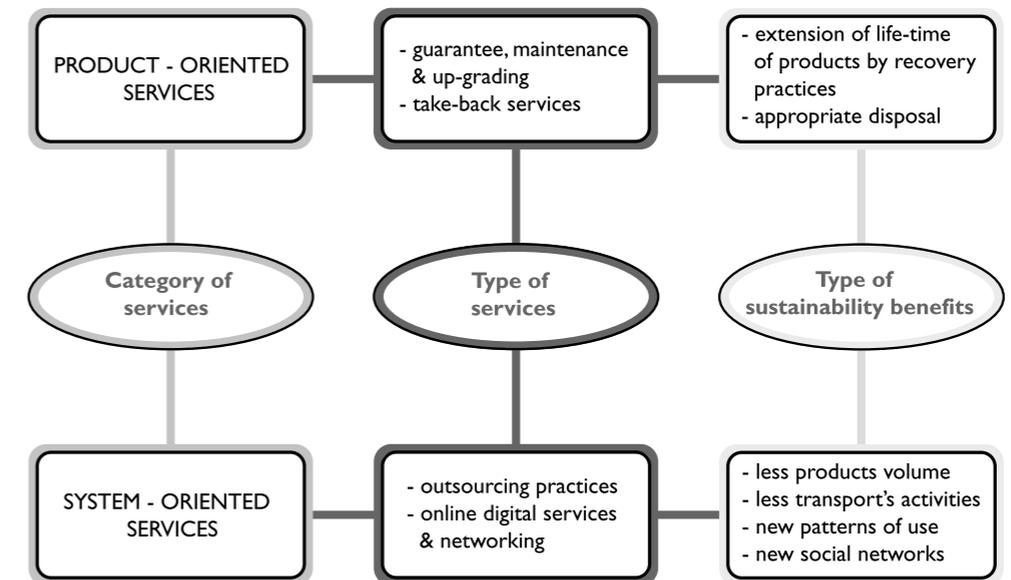
Figure 3 - Path of classification of services and possible relations between their function and environmental and social value.
Source: Rocchi, 2000.

Product-oriented services
These services can be viewed within a *product and material paradigm*. Indeed, it is 'add-on' services that are able to improve the environmental performance of a physical asset. They can either decrease the environmental impact of a single product-unit by extending its lifetime (in terms of functionality and durability), or assure an appropriate ecological disposal of an asset once it has reached the end of its useful life. In a narrow sense, these services can be identified by the following practices.

• **Guarantee and maintenance:** servicing / repair operations to keep a product working and to reduce its depreciation.
• **Up-grading:** the technological modernization of a product by changing / adding parts and components.
• **Take-back services:** activities that enable re-use of, or recycling options for, products and components returned to a company; an ecological disposal of those assets or components that, from a technological or economic point of view, cannot be recovered.

If such services are carried out in conjunction with product stewardship initiatives, they tend to generate interesting feedback on the hardware: producers are given an incentive to appropriately re-design their products to facilitate their re-use / recycling or disposal, and to transform take-back costs into economic opportunities.

System-oriented services
These services can be viewed within a *service and information paradigm*. Indeed, they are able to replace a product, or stimulate its different use, increasing the overall quality of the production and consumption systems. Depending on the circumstances, they can either generate environmental value, enabling a reduction of the amount of hardware delivered to the market, or stimulate social innovation by supporting new emerging lifestyles in line with a more sustainable society.

In a narrow sense, these services can be recognized as part of the following practices.

- **Outsourcing practices.** These are facility-management operations bound to a certain carrying medium: for example, providing photocopies vs. copying machines; providing electronic re-elaboration of data vs. electronic equipment. With these practices, the producer maintains the ownership of the product, while what is marketed is the service inherent to the product itself. As a consequence, it is in the producer's interest to intensify the use of the material components of the offer, and therefore reduce the amount of physical assets needed to satisfy a customer's needs.
- **Digital services and networking.** These are online services, such as tele-working and tele-banking, movies and games on demand. The sustainability value of these services can be viewed at different levels. At the environmental level: either in the reduction or elimination of the hardware component usually adopted in the achievement of a certain performance; or in the intrinsic potentialities of the information technology to reduce people's mobility needs (and therefore the consequent environmental impact of transportation activities). At the socio-cultural level: in the potential for facilitating the sharing of knowledge / physical assets, and generating new social networks and virtual communities at global and local scale.

The adoption of this approach implies new types of stakeholder relationships or partnerships, a new convergence of economic interests and a systemic optimisation of resources. The profit generated is linked to the turnover on the use of *product-service systems*, rather than the number of products sold. Indeed, a company can increase its revenue if it meets the same customer's demand with fewer products, and by optimising the lifetime of the physical technological park used in its offer.

Overall, the environmental and social relevance of these categories of services should be viewed not so much from the quantitative importance of results achievable today but in their capacity to put into practice, on a local scale, direct 'leaps' from one given system of products and services to another – on a bigger, more sustainable scale – in the future[9].

2.3 Drivers for change: the role of digital technology
Non-environmental drivers, rather than environmental drivers, often stimulate corporations to create new *product-service systems* that - if appropriately designed - can be more sustainable than current offers. Increased competitiveness and new market development (via offer differentiation / customisation), increased flexibility (via rapid response to the changing consumer market), customer intimacy (via longer term client relationships) are certainly a few of the factors motivating business innovation process in this direction (UNEP, 2002). However, it is mainly the broad and fast diffusion of **information and communication technology** (ICT) that enables the proliferation of business strategies based on *product-service systems*, redefining the markets of many industries, especially the electronics and consumer electronics industries.

From the offer's point of view, limits to competitive business forces relying only on incremental technical improvements in the product-differentiation process are emerging. Technological innovation is becoming a common cultural heritage to all enterprises, so that many offers tend to present physical assets with equivalent intrinsic technical quality. Moreover, in terms of consumption, the marketplace has become more sophisticated. Simple models of social demographic segmentation no longer seem to be able to provide corporations with a thorough interpretation of current consumption patterns. Customers' expectations are continuously increasing and clients are not just looking for solutions directed at the satisfaction of their single needs, but are more often interested in the simultaneous satisfaction of their *groups* of needs. Increasingly, therefore, either a further integration of product functions or a deeper customisation of the offer is required.

On the one hand, this means that technological diffusion generates tough competition among product-oriented corporations who are only focused on technological product / process innovation. On the other hand, the potential role that digital technology can play in stimulating new business opportunities - for those corporations willing to explore an innovative mix of products and services - should not be underestimated. For this reason, the following two trends should be considered.

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[9] It has to be said that not all PSS result in economic and / or social advantages. They could generate 'unwanted' side effects - called 'rebound effects' - that make the PSS not viable in the long term. For example, certain commercial schemes, in which products are returned to the factory, could incur high transport costs – and the consequent use of fuel and pollution emissions – over the lifetime of the products. Renting, leasing or a common use of products could also lead to careless customer behaviours. Nevertheless, the development of PSS presents interesting intrinsic potentialities for generated win-win solutions, which simultaneously promote profit, environmental and / or social benefits.

Materialization of services

Many functions that once were sold as services are currently being sold as products. Indeed, some devices can now be considered as an aggregation of certain non-material components: an aggregation able to replace the supply of traditional services and therefore able to generate new configurations of activities replacing old ones (Normann, Ramirez, 1995). For example, due to digital technology, it is currently possible to hear a song with high sound quality on a compact disk rather than going to attend a concert in a theatre. Or, to take another example, it is also possible to develop our own pictures at home, using digital cameras and printers, instead of going to a photographic shop to have conventional photographic negatives developed.

De-materialization of products

The above trend, inherited from the industrial society, comes together with another one: the implementation of alternative services to the purchase of products (Ibid.). Indeed, in the emerging knowledge and service economy, some products have been - progressively - partially replaced by services. As already previously mentioned, a few companies have started to provide results (performances) rather than products (Rifkin 2000). In the consumer electronics sector, this can be seen in pay-per-view and video-on-demand services that enable end-users to download programs, video-games, movies and electronic books, so decreasing the quantity of hardware of support placed on the market and the amount of related physical logistics operations.

These trends show potentialities for an offer of re-definition in line with more sustainable scenarios. New typologies of products or services, and their integration, can be proposed from an environmental perspective (one that embraces a possible dematerialization of our production and consumption systems[10]), as well as from an economic and socio-cultural perspective (improving the quality of the overall artificial habitat of reference and its networks). Information and communication technology have diversified the options for value creation based on an innovative *mix of products and services* and have opened up new horizons for business. In this landscape, new market opportunities can be pursued by a *re-configuration of business activities*. Corporations willing to accept new ways of working - by redefining traditional roles and relationships - can stimulate the creation of new revenue streams. By establishing appropriate partnerships, new software, digital connections, content, interface design and services can become a lucrative business, a business that minimizes environmental impact and maximizes the personal and social added value provided to local communities and the overall society.

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[10]It must be stated once again that the use of ICT does not necessarily generate sustainable solutions. (For example, ICT could be more resource and cost intensive than old solutions due to its rapid obsolescence.) However, it presents interesting opportunities for companies to produce eco-efficient *product-service systems*. For example: shifting the production of value from hardware to software; enabling a more eco-efficient flow of resources and information on a systemic level. These would lead, mainly due to economies of scale, to better possibilities for the efficient consumption of resources.

2.4 Steering factors for eco-efficient services

Environmental regulations and customer expectations can be recognized as the two major steering factors in improving the environmental performance of innovative *product-service systems*. The combination of these factors is stimulating companies to promote solutions with eco-efficient service components aimed either at extending the product-life-cycle (by maintenance, up-grading, taking-back and recovery services) or at replacing products with services (by outsourcing practices and new forms of digital access) able to support more sustainable forms of consumption.

2.4.1 Environmental regulation

Corporations producing durable goods are subjected to a proliferation of international environmental policies and standards that go beyond traditional concerns about manufacturing process wastes to cover issues such as product design and post-consumer product disposal. In the European context, in particular, the European Community Directive on the take-back of Waste Electrical and Electronic Equipment (WEEE) has been formulated on the principle of the **extended producer responsibility**.

Under the latest version of this directive, agreed on 13 February 2003, manufacturers or importers of electrical and electronic equipment[11], in addition to phasing out toxic chemicals[12], will have to set up schemes to collect old equipment from households as well as pay for its recycling. In other words, producers are made fully 'financially' responsible for the collection, recovery and disposal of the waste components of electric and electronic equipment. And, in relation to that, they will have to reach specific targets set out by the EC Directive[13]. The intention is to provide an incentive to design electrical and electronic equipment in a more environmentally efficient manner, one which takes waste management aspects fully into account.

For quite some time now, this legislative pressure has prompted some electronics firms to develop extensive voluntary recovery and re-use strategies. These are strategies that initially were focused on achieving a minimization of landfill and incineration costs, but that have since become profitable activities by decreasing the total amount of purchasing costs through the re-introduction of recovered parts in the re-manufacturing and maintenance processes.

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[11]Categories considered by the Directive are: large and small household appliances; IT and telecommunications equipment; consumer equipment; lighting equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments and automatic dispensers (http://europe.eu.int/scadplus/printversion/ en/lvb/121210.htm).

[12]The WEEE Directive is issued in relation to the Directive on the elimination or restriction of the use of certain Hazardous Substances (RoHS) – for example, lead, cadmium, mercury, hexavalent chromium, flame retardants, etc. - in the new electrical and electronic equipment released to the market after 1 July 2006 (http://164.36.253.20/sustainability/weee/index.htm).

[13]Recovery targets must be achieved by 31 December 2006 while, by 13 August 2005, producers must provide for the financing of the take-back and treatment of the equipment (http://europa.eu.int/eur-lex/ pri/en/oj/ dat/2003/l_037/l_03720030213en00240038.pdf).

Corporations such as Rank Xerox Co. and Hewlett Packard Co., for example, should be mentioned in this regard. They are the proof that under an *extended producer responsibility* programme it is possible to encourage business innovation and discover profitable opportunities. By implementing design-for-environment practices, product take-back schemes and expanding related services (maintenance, up-grading, etc.), they have improved the life-cycle environmental performance of their products, not only satisfying their customers but also saving money.

2.4.2 Customer expectations

Consumers' awareness of environmental issues and their concern for the environment have grown considerably during the past decade in Western societies (Pantzar, Raijas, Heiskanen, 1995; Cowe & Williams, 2001). In addition to an increasing demand for environmentally and ethically made products[14], both professional customers and end-users have started to demand **take-back and recovery practices**, mainly of durable goods. Indeed, the environmental impact of products is starting to be understood in relation to their entire life cycle and the environmental question is starting to be perceived in its complexity. It is becoming common public opinion that the environmental question is not only a matter of sporadic local exceptional events (ecological disasters) that affect limited areas, but one of continuous environmental impacts related to the production and consumption activities - upon which we are extremely dependent - that daily threaten the natural balance of our eco-system.

Due to coverage by the mass media, environmental pollution is becoming much more visible. In the eyes of the public, ozone depletion and greenhouse effects are now automatically associated with global warming and changes in climate, with acid rain and loss of biodiversity to the impoverishment of the natural habitats, with the accumulation of wastes in soil and with water contamination. All these aspects increase the awareness of people's connectivity to, and co-dependency on, the eco-system, and they stimulate at the same time a mindset more demanding in terms of the conservation of natural resources and research into non-material and more sustainable solutions (Green and Rocchi, 2000). In other words, environmental issues are being increasingly associated with an understanding of 'quality of life' that goes beyond the simple economic equation of personal well-being and a high income (Jacobs, 1999). And, according to experts, in the next ten years the environmental question will be one of the main issues - together with social in-equity and political instability - that we, as a global community, need to address.

In this context, consumers now see producers as the actors who, in practice, can contribute to wealth creation in a more socially and environmentally responsible manner. They think that producers can offer better solutions and can potentially extend the life-cycle of the physical goods by providing efficient maintenance, up-grades and recovery services. At the same time, pro-active companies that have accepted this challenge have also discovered new opportunities in this direction, opportunities that reinforce their brand image and gain them a higher position in the market. New competitive advantages seem to emerge with open, flexible and sustainable mixes of products and services.

2.5 Observations

From the review of the literature considered in this chapter, the following observations can be outlined and brought forward in the development of this study.

- Today, the saturation of the markets and the complexity of people's lifestyles, together with the diffusion of information and communication technologies, are moving advanced societies towards a new era, one which is less about *consumption* of material goods and more about *access* to services, authentic experiences, values and meanings.
- From this perspective, several traditionally product-oriented enterprises have started looking for new offers in which stand-alone and finished devices are increasingly paving the way for a new and richer combination of tangible and intangible assets: a combination equivalent to open, flexible and customisable *product-service systems* (added-value solutions).
- When these enterprises manage to combine a triple bottom line approach with an appropriate use of Information Communication Technology (ICT) and other advanced technologies, they can then stimulate new ways of doing business, and new business ideas, which are potentially more sustainable.
- In particular, a specific use of service components, in the definition of innovative business answers to societal demands, seems able to generate environmental value:
  - by extending the product lifetime (via maintenance, functional upgrading and recovery services)
  - by reducing or replacing the hardware delivered to the market (via the adoption of outsourcing practices, sharing consumption patterns and online services).

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[14] People are starting to prefer products and services that, at parity of price and functionality, are marketed by companies taking their environmental and social responsibility into account. Indeed, even if only a few people are willing to pay more to get access to sustainable solutions, there is a common public expectation of the business: companies are now expected to behave with regard to certain codes of conduct in performing their daily activities and making their offers (Mori, B&E, 1999; Environics International, 2002; The Cooperative Bank, 2003).

3 Learning experiences

If the previous chapter frames the topic of research at a macro socio-economic scale, this section focuses on empirical examples of *product-service systems*, to make the theoretical features of this subject more visible and immediately understandable. Examples were investigated in the electronics sector, with a special focus on the convergence of consumer electronics, information technology and telecommunication[15]: the choice of this sector relates to the field of application of the experimental part of this study, which is the business context of Royal Philips Electronics.

The chapter starts with an overview of experimental business experiences and their related commercial strategies, then continues with a detailed analysis of two cases described in terms of type of offerings, sustainability related value and business practices.

3.1 A few business examples

The examples collected here represent the result of business strategies developed within either a material and product paradigm (the generation of a product's environmental quality) or within a knowledge and service paradigm (the generation of a system's environmental and socio-technical quality). They describe *product-service systems* usually marketed by a shift from the sale of products to full leasing practices or by the use of integrated practices aimed at the provision of total solutions.

3.1.1 Leasing and rental practices

Financial leasing or rental (operational leasing) practices often propose a package of *product-oriented services* able to improve the functionality, usability and durability of the physical assets; and to relieve customers of certain duties, such as maintenance and up-grading, which are then assumed by the supplier. The potential environmental value intrinsic in such practices has been explored and exploited in various pieces of equipment.

PC and PRINTERS
- In the international context, **Compaq (HP Group)** and **IBM** are the most successful companies in the IT sector capable of providing a broad package of *multi-vendor services* to support the hardware delivered to its professional customers. With the aid of leasing and renting contracts, these corporations incorporate the costs of installation, extended warranties, maintenance, asset management, take-back services, and up-

15 The selected business experiences come from a general benchmarking gathered from the Internet, specialised magazines, and the proceedings of workshops and conferences related to the topic of PSS.

grading options into their offer-systems. From an economic point of view, these contracts provide customers with protection on their investments and flexible acquisition / financing strategies. From an environmental point of view, they generate an extension of the product life cycle: add-on and upgrade options enable technology refreshment while reducing the need for the total replacement of equipment.
(http://www.compaq.ca/english/compaqfinancial/advantage.htm; http://www.ibm.com/industries/financialservices/doc/jsp/casestudy/).

• **Hewlett Packard,** through HP Financial Services, has developed an initiative in its portfolio designed to provide a credit to those end-users who wish to gain access to new equipment that 'respects' the environment. With the introduction of the 'HP card' - a kind of credit card for an agreed amount - Hewlett Packard allows end-users to replace the old hardware with new equipment that can be paid for in monthly instalments. The monthly fee incorporates the cost of the following services: take-back operations; ecological disposal for those physical assets that, from an economic point of view, cannot be re-used or recycled; up-grading of the new equipment and assurance concerning the hardware. (Della Mura, 1997; http://www.hoovers.com/hp-financial-services).

COPYING MACHINES
• **Xerox** and **Oce** are the most well known examples of eco-efficient 'documents reproduction companies' on the European market. By changing their delivery procedures from selling to renting and leasing, they have been able to ensure sophisticated and regularly updated services (consulting, training, upgrading and maintenance services) for their copying machines. They have increased customer satisfaction and fast, regular take-back of end-of-life assets, to guarantee a certain level of profitability for their re-manufacturing and recycling processes (Elsen, 1997; Wilt, 1997; http://www.oce.com/default.htm).

MONITORS and VIDEOCONFERENCING KITS
• The Canadian **Electrohome**, together with Full Scream Co., has created a structure for renting monitor units that enables projections on large screen at such events as trade fairs, clubs, concerts, private parties, etc. With Inland Audio Visual Ltd. - a partner specializing in the supply of conference communications technology - Electrohome provides a complete range of full audio-visual services including installation, maintenance and staging services to the Canadian market. Similar offerings are also available in the European market. In Italy, for example, rental strategies are being promoted by a few companies that deliver similar products and related services directly to end users.
(Re, 1998; http://www.inland-av.com/).

3.1.2 Provision of total solutions
With the provision of total solutions, companies propose offers that are often able to partially replace physical assets with service performances. They achieve this by the use of outsourcing practices or by allowing new forms of access to product-functionality resulting

from the diffusion of ICT. These solutions make use of *system-oriented services* with an intrinsic potential environmental value related to the dematerialization of the offer and the demand and, sometimes, social value that enhances the sharing of knowledge / goods, and the building of new social networks. There are several promising programmes in this area.

PC and PRINTERS
• **Compaq (HP Group)** has focused its activities on innovative product-service systems that help companies to deal with data electronic re-elaboration needs relating to the entire life-cycle of their business activities. Personalised strategic outsourcing practices are replacing the traditional supply of hardware with the delivery of specific results (for example, systems management, Internet operations management, etc.). In practice, the customer leases the entire function to operate the IT-infrastructure, in effect paying for a performance rather than for a product. In this way Compaq is able to satisfy several companies with the same technological park, and is able to reduce the amount of hardware it places on the market (Van Leynseele, 1996; http://www.compaq.ca/english/service/services.htm).

• **IBM** is developing learning and networking services for groups of end-users by setting up pilot projects based on an agreement among IBM Global Services, public authorities, educational and cultural institutions. This is demonstrated, for example, by the 'reinventing education' programme running in USA and in Europe. Its purpose is to facilitate the learning process in schools by supplying services, equipment and a platform of software - in a programme called 'Wired for Learning' - to a virtual local community made up of teachers, students and parents. These product-services systems are properly designed for enhancing the value of current social resources (the sharing of available knowledge), strengthening relationships in the local communities and strengthening existing available physical structures and places such as schools, libraries, homes etc., while reducing people's mobility needs (http://www.ibm.com/ibm/ibmgives/grant/education/programs/reinventing/).

• **Hewlett Packard**, with its 'e-inclusion' program, is piloting several projects aimed at delivering the benefits of Internet-enabled information technologies and services to people around the world with no connectivity. Based on global-local business ventures, HP has created common points of public digital access - 'i-community' centres - that focus on five key areas and related digital services: e-health; online education; work online; e-markets; e-money. In environmental terms, this program supports and facilitates the sharing of devices, access services (rather than products), and a reduction of local people's mobility needs by leapfrogging some ICT-based services to new developing and emerging markets. In social terms, this strategy creates conditions for raising people's living standards. In economic terms, the business model put in place to deliver information access solutions is expected to provide a return on investments in a few years time. (http://www.hp.com/e-inclusion/en/index.html).

COPYING MACHINES
- **Xerox**, through Xerox Business Services (XBS), offers a broad portfolio of long and short term advanced outsourcing services: network-based solutions and activities (from copying, collating and faxing to mailroom practices) designed to handle either all the day-to-day work of managing documents, or particular 'one-off' events such as meetings and trade fairs. From an economic point of view, these services enable customers to reduce their capital outlay, while freeing up time and resources to apply for revenue-generating work. From an environmental point of view, they reduce the amount of hardware marketed and improve its functionality, since it offers the producer the chance to make the best use of its technological park facilities (http://www.xerox.com/).

ELECTRONIC GAMES & VIDEOS
- **Sega of America** is implementing the diffusion of digital services in its business practices as a strategic market choice. In fact, Sega's traditional businesses and channels of distribution are being increasingly replaced by new product-service systems that include, for example, a TV-karaoke service and a supply of online video games. The TV-karaoke service is an offering that empowers users to access a music data bank, and choose their favourite songs, via the use of a set-top-box, special software and a normal television set. The online video games belong to a generation of downloadable games specifically designed to enable users to play head-to-head online through their television sets via a modem. In both cases, the hardware component of the performance is minimized while users are relieved of the need to go to the shop every time they want to buy a CD (http://www.sega.com/corporate/corporatehist.php?item=corporate_history).

3.2 A closer look at two selected cases

Two specific cases have been selected to analyse the key basic ingredients of the product-service orientation of their business and design strategies. They are Xerox and Hewlett Packard (HP). They offer an overview of various *product-service systems* that progressively shift the focus from:

- a business-to-business approach (offers to professional clients) to a business-to-consumer approach (offers to end-users)
- an offer characterized by the predominant economic value of the hardware component to an offer generated around the economic value of service
- eco-efficient aspects (product-related) to broader environmental, socio-cultural aspects (system-related).

3.2.1 XEROX
Market strategies and solutions
Since the early 1990's, Xerox[16] has progressively moved from the design, manufacture and marketing of copying machines to the supply of *solutions* for hardware, software and document management services in the business-to-business market. The basis of its offers

are strategies such as *renting*, *leasing* and *outsourcing*, all of which have been implemented to promote *new product-service systems* able to ensure economic and environmental viability in the years to come. Service components have, in fact, progressively increased their importance in promoting both customer satisfaction and more environmentally friendly solutions. In particular, taking the environmental value into account, the following promising categories of services can be quoted in relation to Xerox's product-service systems (http://www.xerox.com).

- **System Consulting Services.** Professional consulting activities intended to design and implement applications and solutions that provide customer demands with maximum efficiency offers. These are consulting services made to *optimise the hardware and software park* of customers (by proposing the minimum equipment able to guarantee maximum performance).
- **Office Services.** Professional consulting activities, such as 'Critical Document Survey' and 'Document Strategy', are designed to help customers achieve higher productivity by suggesting ways of *improving the value-in-use* (functionality as well as energy saving) *of the equipment.*
- **MultiVendor Services.** Support activities that, in addition to system installation and a software help desk, provide customers with maintenance by on-site repair services, online services, upgrading and training practices. Furthermore, take-back services of disposable machines can be also be included in this group. These are services designed *to extend the durability of the hardware* (during and after its useful lifetime).
- **Integrated Document Management Services.** Outsourcing activities that relieve customers of the daily management of documents and data. These activities include filing, translation, researching, reproduction and distribution services. These are services that are able to *reduce the amount of marketed hardware* by centralizing activities at the supplier side while, at the same time, increasing the economic value of its performance via the provision of total solutions.

Recovery programmes and product stewardship
For years, Xerox took back leased machines from customers. However, it was only in the early 1990s – as thousands of old copiers piled up in warehouses – that the environmental and full economic value of these returns became evident. As a result of strong pressure from customers and employees to avoid simply disposing of the machines first, and take-back legislation inputs later, Xerox started to look for a solution that would offer a business opportunity in accordance with its environmental philosophy. Instead of treating leased-off products as waste, throwing away potentially valuable resources, Xerox worked out

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[16] Xerox Corporation is a \$15.7 billion technology and services enterprise that helps businesses to deploy smart document management strategies through an understanding of their document-related needs. It supplies publishing systems, copiers, printers, scanners, fax machines and document management software, as well as related products and services. It operates in 130 countries with more than 60,000 employees.

a systematic world-wide process for the recovery and re-manufacture of its equipment. (http://www.xerox.com/ehs/1997/sustain.htm). Indeed, by retaining the ownership of its products, Xerox received increasingly strong motivation to:

• develop a logistics system for returning the physical assets to the factories
• improve the re-manufacturing and re-cycling options of the physical assets
• re-design the physical assets in order to facilitate their maintenance and extend their life-cycle.

These motivations helped mature a progressive change in the way of doing business. Inspired by the conservation of resources, waste reduction and financial opportunities, *product recovery* has become a fundamental part of Xerox activities, with particular attention being paid to 'Designing for Reuse' strategies. In 1991, an 'Asset Recycle Management Programme' was implemented to manage an ever-increasing range of products returned to the company for re-processing. Through this programme, Xerox started to develop procedures for recycling and re-using equipment while simultaneously keeping old products to the same high quality standards as its new products[17].

The process enables returned equipment to be separated and either re-manufactured or stripped down for parts and material recovery. Repaired parts are returned to manufacturing for use in second generation equipment. Parts and assemblies too damaged for re-manufacturing are scrapped to recover the metal and plastic content. Currently, interrelated loop-closing systems have been also developed in collaboration with suppliers, as well as with third parties able to use materials that can no longer be recycled internally. Overall results achieved in 2002: equipment re-manufacture and the re-use and recycling of parts prevented more than 64,000 of tons of wastes from entering landfills, while generating several hundred million dollars in cost savings (Xerox, 2003). In addition, complementary programmes, such as 'Copy and Print Cartridge Return Programme' (started in 1991), a 'Toner Containers Return Programme' (started in 1995) and a 'Waste Toner Return Programme' (started in 1997), have also been developed. These enable customers re-box empty cartridges and toner containers in their original packaging and re-mail them to Xerox, who also pay the shipping costs. Cartridges and containers are then cleaned, inspected and refilled or recycled. Partnerships with Xerox customers have made these activities a success. In 2002, the 'Green World Alliance' prevented more than 8,000 tons of waste from entering the landfills worldwide (Wilt, 1997; Xerox 2003).

Following on the success of the Asset Recycle Management Programme, Xerox went one step further and developed a full-scale 'Designing for Reuse' initiative, as an attempt to

achieve *waste-free* products from *waste-free* factories. This initiative implements a *product stewardship* approach to minimize the waste going to landfills and to relieve pressure on the environment at every step of the product life-cycle[18]. By re-designing products (incorporating re-use considerations into the design process), Xerox encouraged a reduction in the use of resources, as well as an optimisation of re-manufacturing practice. Currently, strategies related to 'Designing for Reuse' in Xerox are resulting in a significantly longer (and more intensive) performance of components and materials. As examples, the following practices can be quoted in terms of design empirical implications: components standardization; modularity; snap in / out; less use of adhesives or use of compatible adhesive. All these practices can be recognized in the latest equipment generation: new copiers, printers and multifunctional products have been conceived simultaneously for customers' optimum productivity and for easy re-use and re-manufacture. To be more precise, equipment returned to Xerox can be re-manufactured today to as-new performance specifications, re-using 70 to 90 percent by weight of machine components, while meeting performance specifications for equipment with all new parts.

3.2.2 HEWLETT PACKARD
Services and value creation
In a society in which information is exchanged quickly and products are easily copied and marketed at a price that often does not take the costs of development into consideration, Hewlett Packard[19] (HP) has realized that if it wants to continue to be competitive, it must consider the added value of its services' as an important element of its business strategies. By developing and deploying '*new services with new partners*', HP is attempting to exploit new business opportunities and to broaden the environmental performance of its offer via more customized solutions.

In particular, it is the 'Managed Life Cycle Services' that must be quoted when discussing the relation between environmental value and services for this business: a combination of financial practices - mainly based on renting and financial leasing - with some specific activities that HP provides to business customers (http://www.isp.hp.com/6_00_index.html). This package includes three major clusters.

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[17] Initially, asset recycling was carried out in specific recovery centers. Later, the company re-tooled plants so that newly built and re-manufactured equipment became part of the same integrated line: the result is a more efficient transfer of resources and uniform quality standards, the 'Xerox Total Satisfaction Guarantee' (http://www.xerox.com/94ehs/design.html).

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[18] Xerox has developed a financial model that enables engineers to assess the trade-off between life cycle costs and various design parameters. Based on net present value model, it incorporates the life cycle of a part or component by generating a picture of the total asset management of that part. This includes raw materials, technology, manufacturing and re-manufacturing process, distribution and service, in addition to costs associated with the final disposal of the product or components. The final output enables engineers to conduct sensitivity analysis between product cost changes and total life cost (Vietor and Murray, 1994).

[19] Hewlett-Packard is a technology solutions provider to consumers, businesses and institutions globally. It delivers IT infrastructure, personal computing and access devices, global services and imaging and printing products. HP, with approximately 142,000 employees, operates in more than 170 countries throughout North and South America, Europe, Australia and Asia (http://www.hp.co).

- **Technology Refreshment initiatives.** These favour technology up-grades that avoid the total replacement and disposal of obsolete equipment. These initiatives enable HP to identify the real needs of its customers within leasing scenarios and to propose the implementation of appropriate equipment and software to meet those needs while still maintaining cost efficiencies.
- **Asset Management Services.** These help customers to manage their own assets. They include such *maintenance* and *repair operations* as self-maintenance instructions, mail-back / carry-in service, and on-site service and repair. The effectiveness of these services supports an extension of the useful lifetime of the equipment.
- **Take-back and disposal services of leased assets.** These support the *re-manufacturing process* or the *ecological disposal* of end-of-life products. Owing to its sizeable leasing operation, HP has created a re-marketing group. Its purpose is to determine any value that may be left in the recovered obsolete products and to stimulate recycling operations or re-use options.

A similar combination of financial and environmental services has also been developed for end-users. At the end of the 1990s, consumers buying an 'HP card' made available from HP Financial Services could access new technology, manage their own finance, up-grade their equipment, and ensure an ecologically safe disposal of their old products (Della Mura, 1997). From an economic point of view, the 'HP card' provided the applicant, after making a monthly payment, to access electronic consumer products and relevant accessories and service. The end-users could trade in their own current equipment and receive credit toward the purchase of new equipment. In addition to this, all computer-related products purchased with an 'HP card' were insured for 23 months against fire, theft or virus damage. And, if the user was between the ages of 18 and 60, the purchase was also insured against any unforeseen illness or unemployment that might have limited the customer's ability to make the regular monthly payments. (http://www.hp.com/hpcard/england/uk_trade-in_terms.html).

From an environmental point of view, the 'HP card' offered a useful tool for implementing the *take-back flow* of obsolete products that needed to be recycled or disposed of in an ecologically safe manner. By contacting the HP Service Centre, the end users could easily arrange an appointment for the collection of the old equipment directly from their home. Once the product was returned, HP credited the account of its client with an amount defined in the 'Trade-in Table' related to the time of the return. However, credits were only granted if the product collected was in good working condition. All traded-in products were then recycled or disposed of on the basis of legal rules in force at that time. (http://www.hp.com/hpcard/england/uk_trade-in_terms.html).

Today, this system has been replaced with the 'e-coupon', a pilot programme that gives end users up to 50 Euros (and sometimes 100 Euros) towards the purchase of a new HP product when they recycle computer hardware through HP Planet Partners[20].

Product stewardship and recovery programmes

In 1987, HP found it both difficult and expensive to obtain new service parts for some printers. In its search for solutions, the service organization found that disassembling used equipment, and the subsequent refurbishment of old components, was a cheap and reliable source of service parts. For some old technologies that were no longer in production, the recovery of components from used equipment was viewed as the only option to keeping equipment in service (Dillon, 1997). In addition, in the 1990s new regulations emerged, and customers increased their environmental concern about end-of-use products by demanding *take-back* and *recycling* schemes (http:www.hp.com/ ljsupplies/recycle.html). All these factors stimulated a flow of returned equipment, which was then fed in the years to come by the implementation of leasing and renting practices. As a consequence of an increased number of 'taken back' products, specific *recovery programmes* were developed, together with a broad spectrum of recovery services. They were thought of as a part of a *product stewardship* commitment started in 1992, designed to minimize any negative impact to the ecosystem that might occur at any point in the life of an HP product, from the moment of its design to the moment when it was no longer used. HP Planet Partners, operating in more than 30 countries, was able to recycle approximately 46,500 tonnes of used products in 2003. This has enabled the company to pursue a two-pronged policy.

- An improvement in customer service and the availability of second-hand spare parts appointed for sale. Refurbished components are indeed addressed to HP's service organization for internal use (for example, electronic assemblies, boards, and monitors, etc.) and to secondary markets as commodity items (for example, disc drives, integrated circuits, etc.).
- The generation of new revenue streams by re-marketing refurbished products. By selling re-manufactured equipment, HP is trying to fill existing customers' demands as well as target new niche markets. The company is in fact, by trying to avoid its products entering the 'grey' market, also trying to satisfy directly those customers who are not able to afford the latest technology[21].

In addition to the main recovery process of electronic equipment, HP also offers, in several countries, a no-cost recycling programme for the return of print and LaserJet print cartridges. Professional customers and end-users can return spent cartridges to Planet Partners recycling centres with the help of HP's postage-paid labels. Once returned, the cartridges and packaging materials are separated and recycled. Since 1991, using this method, more than 80,000 tonnes of HP LaserJet and inkjet print cartridges have been recycled worldwide. The value created with these recovery programmes should not be considered only in the downstream practices. Indeed, these programmes have stimulated

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[20] The HP Planet Partners take-back programme covers the return and the recycling not just of HP computer hardware but also of HP print cartridges.
[21] For such a purpose HP has created an online store in the US - the 'HP Shopping Village' - that also sells lower-price, guaranteed refurbished consumer products (www.shopping.hp.com).

the re-design of products in accordance with environmental guidelines, so that new physical assets are now easier to re-use or recycle. In particular, design criteria for disassembly and recycling have been implemented with this idea very much in mind. A growing percentage of equipment is now designed to be easier to dismantle and recycle. Many components simply snap apart, making it easier to separate metal from plastic. The number of different types of plastic and metal parts has been reduced and material identification codes have been put on plastic. Hewlett Packard has also improved the design of its toner cartridges to make them more environmentally friendly: they have been redesigned to handle more toner, so extending their useful lifetime.

I-communities

In the last couple of years, HP has started to use ICT products and services to find ways of closing economic and social divides around the world. By matching its global-citizenship program with its business strategy, and by building public-private partnerships, HP aims to promote solutions able to create opportunities for long term sustainable growth in new emerging markets, while also raising the standard of living of people at the bottom of the economic pyramid. With the 'e-inclusion' program, the company is piloting several projects to connect rural remote or sub-urban areas with no connectivity in Eastern and Central Europe, India, Africa and Central America to the rest of the world. To do this, it is using common points of digital access and Internet kiosks called 'i-community' centres. These centres provide on-line services that focus on health information and literacy programmes, information for farmers and local dealers, and assistance for people applying for government subsidies and micro-credits (http://www.hp.com/e-inclusion/en/index.html).

The business rationale underpinning these initiatives is that local communities pay for each use of the services (the 'shared services access model') while the business venture established by HP keeps the ownership of equipment and handles the maintenance and upgrading of the 'i-community' centres. In this way, even people with very low incomes will have the chance to be empowered at different levels. Provided with information, training and financial support, they can create or expand their own local business and become economically self-sustaining. HP sees the 'i-community' centres as instruments of local socio-economic development: by providing the benefits of networked-based solutions to all, regardless of location, age, language, income or level of education, these centres are able to revitalize marginalized or underdeveloped areas and communities. At the same time, they are also considered potential powerful instruments for unlocking the markets of the future; as soon as the demand appears, HP will be ready to extend its offer (Dun and Yamashita, 2003).

The success of these projects and their related strategies could have tremendous positive effects in environmental terms, either in the way in which new solutions are used, or in the way new solutions are powered (the centres often work with off-grid solar-powered / renewable energy systems). And even if the quantitative results attainable from

using an 'access to services' pattern of consumption are currently almost negligible — due to a small minority of involved end-users in pilot cases — such a strategy is absolutely in line with 'up-scalable' sustainable ways of living. It presents an interesting aspect of social innovation (cultural and behavioural discontinuity) able to generate solutions of factor 10 or 20 of eco-efficiency. In fact, by supplying digital services instead of physical assets, it maximizes the service output per minimum unit of material product and relieves the local economy and society from the environmental impact resulting from the logistical operations of moving people and goods.

3.3 Observations

Looking back at the offers and business practices described in this chapter, the following considerations should be kept in mind.

- Experiences of eco-efficient *product-service systems* started to emerge in the early 1990s through business to business value propositions prompted by customers' pressure, environmental legislation and cost-saving opportunities. However, only recently have the full economic, environmental and social advantages, potentially achievable by a smart combination of product and service components, become clear with:
  - a large diffusion of ICT that has enabled deep changes in production, distribution and consumption models
  - companies increasing their commitment to all dimensions of sustainable development.
- Enterprises that have decided to explore opportunities in this field - either business-to-business or business-to-consumer propositions - are experimenting with practices that sometimes privilege the product in the value creation process, and sometimes focus primarily on the overall final result (performance to customers).
- Product-service oriented business practices that make the emphases on the product do not go beyond environmental results, achieved by product recovery and product use optimisation. Instead, business practices, re-thinking the company's offers from the point of view of expected results, can also rely on environmental and social benefits potentially achievable on a much broader scale. Indeed, these practices relate to consumption models that, even if still restricted in scale, can be considered significant examples of the kind of social innovation required by a sustainable future.
- Key to the success of the *product-service systems* analysed above would seem to be a paradigm shift in the way value is created and commercialised:
  - the conventional closed, single company value creation process is being replaced by an open, partnership-based process of value creation
  - the one time 'make / buy' model is being replaced by commercial practices linking producers and customers over a certain period of time.
  Underpinning this shift, there is a new innovative business logic and design practices.

The peculiarities of this business logic of value creation, as well as its design implications, are discussed in detail in the following two chapters.

4 A new business logic

This chapter looks at the business literature dealing with the features and peculiarities of the new logic of value creation, which underpins the promotion of marketable solutions based on *product-service systems*.

It touches on such issues as strategic holistic 'thinking' and company cultural change, value network and partnerships building, organizational models, commercial patterns and their theoretical explanations. Without the kind of innovation here described, it would be possible for the business to continue to apply eco-efficient practices and eco-design criteria for process and product environmental improvements; however, it would not be possible to carry out those design-for-sustainability strategies necessary to create effective triple bottom line propositions.

4.1 Innovation and cultural change

With the current market undergoing a product-service orientation, a new business and design logic is emerging. Among its main features, the most notable is a **business culture**[22] **paradigm change**. Indeed, today, traditional production and marketing values such as process and product development, price reduction and 'time to market' tend to decrease their competitive force in an economic context that is becoming increasingly 'chaotic' and difficult to predict (Peters, 2003). The globalisation and the saturation of markets, the fragmentation and sophistication of consumption patterns, the impact of the information and communication technology, and the urgency of the environmental question are breaking down a 'business-as-usual' rationale based on a 'product thinking', and one time 'make / buy' logic. Today these factors stimulate a innovative logic of value creation supported by a new strategic 'functional thinking', and various systems of values.

If, in a conventional business culture, competition takes place within clearly established boundaries defined by hardware and service offers, then in the emerging business culture these boundaries are often crossed to enable operations in *product-service systems* that take corporations beyond their industry's traditional methods of supply and core competences. More complex and articulated answers are provided by the introduction of service components appropriately designed around product and ad hoc partnerships. Creating satisfaction for customers by focusing on the question of how best a company can meet people's needs

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[22] Business 'culture' can be defined in terms of the predominant values and ideas that characterise all the events, processes and structures in a company (for example, leadership style, personnel policy, and organisational structure).

has now become the priority, instead of concentrating business activities on the redesign of conventional products and on the volume of products sold to cover standard market demands. Linear, hierarchical 'thinking' about the economy is increasingly being replaced by 'system' thinking that acknowledges the need to generate different ways of doing business, ways of business with a reduced environmental impact, higher social value and brand equity (Leadbeater and Willis, 2001). Within this framework, innovative and flexible combinations of products and services can generate market opportunities with solutions able to better fit specific local needs in specific socio-cultural and physical contexts.

This contingent and adaptive thinking is not, however, easy to address: it requires a change in terms of internal business structure, management skills and mental models; in other words, it requires innovation or, to be more specific, an open innovation[23]. The acquisition of knowledge becomes crucial at many levels of the organization: it is often externally developed and internally adapted and integrated. 'Creativity' and 'entrepreneurialism' are becoming fundamental elements in an economy in which managers have to make decisions without the benefit of complete information. New visions and the exploitation of new ideas are necessary for the initiation of strategies that - to grab new opportunities for a sustainable growth - go beyond the closed, internal, concepts' creation processes, the conventional asset of the market, and the traditional relationships that link the actors of the system (McIntosh and Arora, 2001).
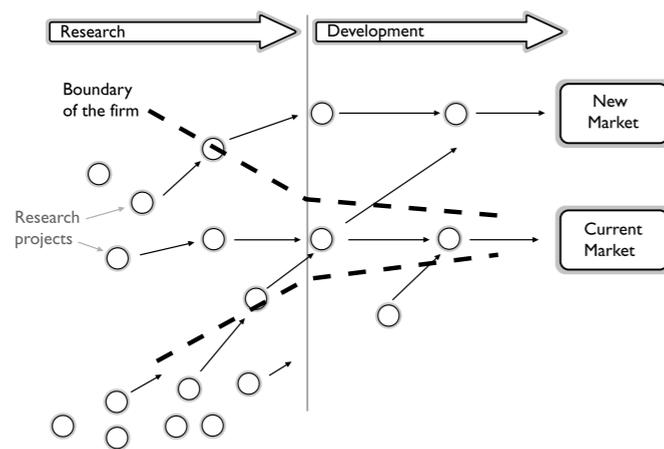
Figure 4 - The 'open innovation' diagram for managing knowledge creation.

Ideas for creating new value can come from inside or outside a company and can go to market from inside or outside a company as well. The challenge for an organization is to define internal mechanisms to claim a portion of that value. *After*: Chesbrough, 2003.

[23] The business analyst Henry Chesbrough (2003) writes about 'open innovation' in terms of an approach that combines internal research and activities with external ideas, and then deploys those ideas both within a company and also through other companies' businesses. The key for Chesbrough is the challenge to the company in understanding what should be internally supplied and how to integrate both internal and external pieces into systems and platforms. Indeed, for this author, being successful is more important in building a better business model than getting to the market first with a new offering.

4.2 Beyond value chain towards value network

In the classical 'make / buy' business model - value creation is a sequential and uni-directional process symbolized by Henry Ford's assembly line. According to such a model, "*every company occupies a position on a value chain. Upstream, suppliers provide inputs. The company then adds value to these inputs, before passing them downstream to the next actor in the chain, the customer*" (Normann, Ramirez, 1995).

In the current fast-changing competitive landscape, this traditional 'thinking' about value, grounded in the assumptions and views of an industrial economy, is outdated. Today, successful companies increasingly do not just *add* value, they *reinvent* it by recombining tangible and intangible assets into new solutions based on a logic of **co-creation of wealth** involving different actors. To put it in another way, companies increasingly act from a perspective of systemic social innovation that reconfigures roles and relationships within a *constellation* or *network* of actors[24] mobilizing the creation of economic value in new forms.
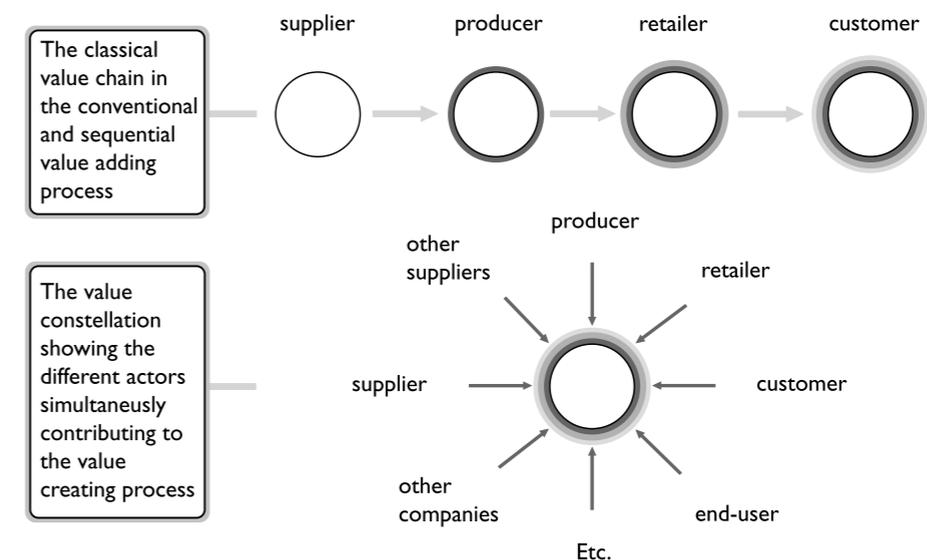
Figure 5 - Value chain and value constellation.

Confrontation between the classical value chain (in the conventional and sequential value-adding process make / buy) and the value constellation (in which different actors simultaneously contribute to the value creating process). *After*: Normann and Wikstrom, 1994.

[24] Looking at the literature about business value creation in the knowledge and service economy, terms such as *value constellation* (or *value star*) and *value network* (or *value web*) are replacing terms such as *value chain* - typically associated with the industrial economic models. Normann and Ramirez (1995) defined *value constellation* as a *"value-creating system itself, within which different economic actors – suppliers, business partners, allies, customers – work together to co-produce value"*. Some years later, Allee (2000) defined *value network* as a network able to generate *"economic value through complex dynamic exchanges between one or more enterprises, customers, suppliers, strategic partners and the community"*, and to engage in *"transactions around goods, services, revenues, knowledge and other intangible benefits"*.

As the business answers become more complex and varied, the relationships necessary to produce them also increase their complexity. The most attractive *product-service systems* involve end-users, professional customers, producers and suppliers, business partners, and sometimes also public bodies and non-governmental organizations, in such a way that their relations become less sequential and more reciprocal and synchronous. It is in these multiple interactions that the value of the offer is co-created. All the actors, representing various productive resources and types of knowledge, become co-designers of the production system itself. Suppliers, producers and business partners share all the benefits, as well as the costs, at virtually every step along the way (Normann, 1996). End-users become 'prosumers', co-producers or even innovators[25]: they are regarded as participants in the co-creation of value and are encouraged to adopt this role rather than remaining passive receivers[26]. Thus the borderline between supplier and client often becomes blurred. 'Partnerships' between actors become fundamental components of a new business model. Joint ventures and alliances permit a company to provide the market with customized *product-service systems* without the expense of developing new expertise and capabilities of its own. Moreover, they allow businesses to concentrate on their own core activities while also improving their strengths: tapping external competencies and skills instead of doing everything in-house leads to greater efficiency and flexibility, as well as improving competitiveness (Tidd, Bessant and Pavitt, 2001). And, as practical consequence, they help to:

• reduce the cost of, and the time for, technological development or market entry
• reduce the risk of development or market entry
• achieve scale economies in production.

This theoretical framework of interpretation can be recognized by looking back to the business experiences analysed earlier. For example, for Xerox and Hewlett Packard, creating and maintaining partnerships with customers, suppliers and recyclers is imperative to the success of the eco-efficient, *product-service systems* these companies promote. Currently, interrelated loop-closing systems have been developed to overcome the problems and challenges of product recovery channels, recycling and re-manufacturing. Co-operation with professional customers and the participation of end-users have been crucial for

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[25] The term 'prosumer' was coined by the futurist Alvin Toffler back in 1980 to describe a category of consumers that do more than just use a product or a service: they become co-promoters by being involved in the design and manufacture of products that meet their individual specifications. However, it is only with the ICT diffusion that 'prosumerism' has begun to emerge in practice, with a few companies starting to equip customers with tools to design and develop their own solutions, ranging from minor modifications to major innovations (Banaie, 2002). These customers have more recently been called 'co-producers' (Normann and Wikstrom, 1994) and 'innovators' (Thomke and Hippel, 2002).
[26] Corporations in the industrial society focused on *relieving* customers of certain activities and functions. In the knowledge and service economy, however, the tendency is increasingly to *enable* customers to do something to get more value out of the products and services that they access. Therefore, if value creation is to be measured in terms of what a company and a customer can produce together, the customer then becomes an important production resource that the company must handle accordingly by enhancing its own productivity, capacity and self-fulfilment (Normann and Wikstrom, 1994).

diverting a large volume of waste from landfills. Agreements with suppliers and recyclers have been fundamental in reprocessing components and recycling materials to reduce costs and preserve natural resources, while alliances with local stakeholders have increased the efficiency, reliability and customisation of the offer. Furthermore, particularly in the case of HP, new partnerships with non-governmental organizations (NGOs), universities and public bodies have enabled it to propose new, affordable, environmentally and socially valuable solutions for untapped markets of advanced and less advanced societies.

4.3 Corporate transformation
In this process of corporate transformation - in general terms - any company that seeks new markets by exploiting innovative and more sustainable *product-service systems* has three main options in its choice of organizational models (Tidd, Bessant and Pavitt, 2001). These options vary in relation to the degree of development of the new in-house competencies, or to the choice of acquiring knowledge through ad hoc partnerships and corporate ventures.

Development of a knowledge and competence team (I)
This is a specific business competence division, group or task force dedicated to creating capabilities for the offering of *product-service systems*, in terms of hardware, technological infrastructure, related services and know-how for implementation. In order to set up this option, the following basic conditions are required:

• the availability of a group of people capable of several - multidisciplinary - skills to promote and communicate the entire mix of products and services
• the organization of an 'application unit' for the development of, and experimentation into, new applications such as electronic devices, new materials and virtual interfaces
• the establishment of an independent accounting system to initiate the incubation phase for new applications and pilot projects before scaling up the solutions.

In the benchmarking described earlier, this option can be seen in the business model adopted by Xerox and the IBM Group. With 'Xerox Business Services' (the fastest growing business division of Xerox) the company is able to provide specific customized 'solutions' for a comprehensive range of document services. The IBM Group has also enhanced new service-oriented strategies: with its 'IBM Global Services' division, the company is expanding its market share into the so-called 'selected outsourcing offerings' to gain competitive value.

Acquisition or creation of a new subsidiary company (II)
With this option, the company continues to maintain a strict focus on its core business (related to product development), while also realizing the extra value of the service components needed to create new competitive offers, and to do this by relying on a new subsidiary company with its own independent mission, organization and necessary competencies.

For example, Sega Enterprise Ltd of Japan - an industry leader in electronic games - is expanding, with its subsidiary company, Sega of America, its market share in the interactive digital entertainment media business by supplying innovative software and digital services.

Processing an entire organizational change (III)
This option implies a deep change in the original mission, and in the structure and competencies, of a company. By assuming a vision that shifts strongly the business activity from product development and marketing to the provision of *product-service systems*, there is a need for the integration of new competencies at different levels of the organization.

This is illustrated by Hewlett Packard who, in continuing to be competitive in generating more personalized, sustainable *product-service systems* and loyal customer relationships, has decided to focus on services' value by initiating an entire corporate transformation. This has resulted in various repercussions throughout the company: new programmes, new strategies, the updating of the traditional roles and skills of the employees, all from the concept generation stage to the delivery phase of the new offering.
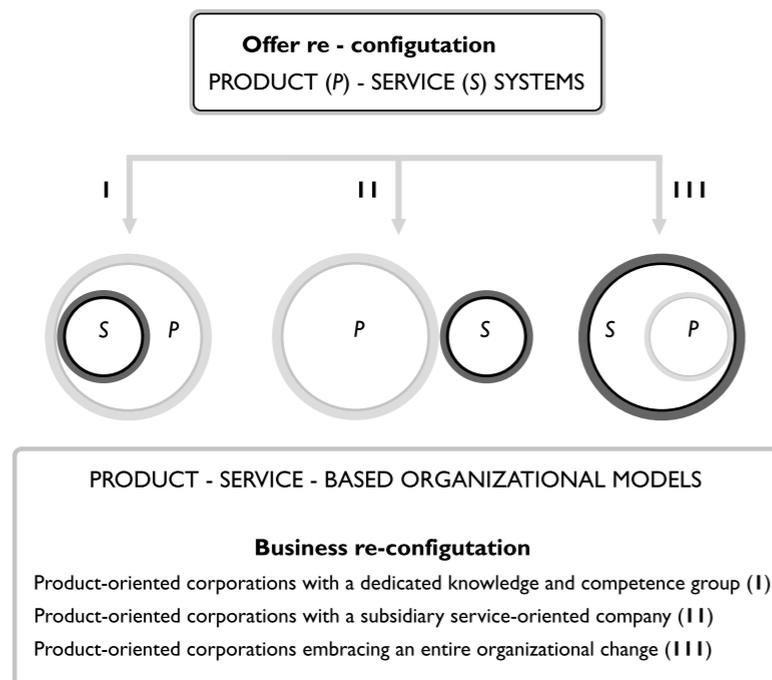

Figure 6 - Visualization of three emerging organizational models, in relation to a product-service orientation of the market.
Source: Rocchi, 2000.

4.4 Commercial patterns
In an economy in which markets are making way for networks, and ownership is steadily being replaced by access, commercial patterns different to the usual one-time relationship of 'make / buy' are taking place: "… *many durable goods will be held by suppliers and accessed by consumers in the form of short-term leases, rentals, membership and other services arrangements*" (Rifkin, 2000). The promotion of most successful sustainable *product-service systems* is often related to marketing and commercial patterns of **full leasing**, which can be considered the evolution of *financial* and *operating leasing* practices[27]. With a *full leasing contract*, the financial services at the base of traditional leasing practices are extended. Collateral services are introduced to improve the functionality, the usability and the durability of the asset - such as the assurance, the maintenance and the up-grading - and customers are relieved of certain duties assumed by the leasing firm (Censis, 1997). An alternative to full leasing is the **provision of total solutions** to specific customer's needs. In this commercial approach, product-oriented companies assume a very strong service orientation. By providing a 'result' to their clients, they drastically shift the economic value of their offer from the hardware component to the entire service performance. This means that customers pay for the expected result - in relation to the degree of satisfaction of a function - rather than in proportion to the economic value of the hardware adopted to perform the service.

Full leasing
From a business point of view, the adoption of this commercial pattern helps corporations to internalise the costs of supplying the services that generate supplementary qualities for their hardware and to increase their potential surplus. Companies can invest in providing the services the customer wants, while the customer is willing to pay a service premium relative to the perceived value of a more complete offer. To put it another way, companies can assemble resources to generate solutions customized to specific user profiles (customisation via specific or local services) and, at the same time, can stimulate the creation of loyalty with them by an extension of the relationships in the medium-long term. Moreover, full leasing contracts can speed up an increase in the market shares for products at high-tech content[28] by offering different kinds of credit to professional customers and, more recently, to end-users as well (Marks and Johnson, 2004).

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[27] *Financial leasing* can be defined as a contract that gives the customer the opportunity to use a product by paying a periodic fee. It also offers the customer the opportunity to buy the product at the end of the agreement. *Operating leasing*, by contrast, is a contract of location (renting) that does not offer time-constrictions and opportunities for buying the product; the product remains the property of the leasing firm. It is considered an effective tool for making available a product without investments and immobilisation of capital (Della Mura and Rodighiero, 1997).

[28] The adoption of leasing practice is not always appropriate. Current market experiences show that financial and *operating leasing* have been adopted for equipment that usually presents an economic value of at least 1000 / 1500 Euro. This is for two main reasons: because the commercial transaction requires necessary investments in a medium / long-term relationship among several actors; or because the significance of the transaction is also a function of the capital intensity of the equipment and, as a consequence, there is a greater economic interest in the recovery of a product with high-value components than a relatively low-value device.

And, last but not least, in conjunction with product stewardship programmes, they are also useful tools for ensuring continuous take-back flows of used products needed to develop profitable recovery options.

From a customer's point of view, the benefits are also relevant. In the electronics and consumer electronics sector, these contracts offer professional customers and end-users the chance to overcome the problem of the equipment's rapid obsolescence. They can upgrade the hardware and update the software at their convenience, as well as make use of technical assistance when required. In addition, they can benefit from the immediate availability of the equipment without having to afford the consistent capital investment of purchase and ownership.

In terms of financial mechanisms, full leasing contracts are generally implemented by finance players[29] that support the producer in the transaction. In practice, the finance company buys the hardware from the producer and leases it to professional customers, or end-users, for a contract period that allows for the redemption of the equipment and a degree of financial remuneration. The relationships among producer, finance company and customer are usually resolved in such a way that the producer issues the invoice directly to the finance company, which in its turn invoices the rental fee to the client.
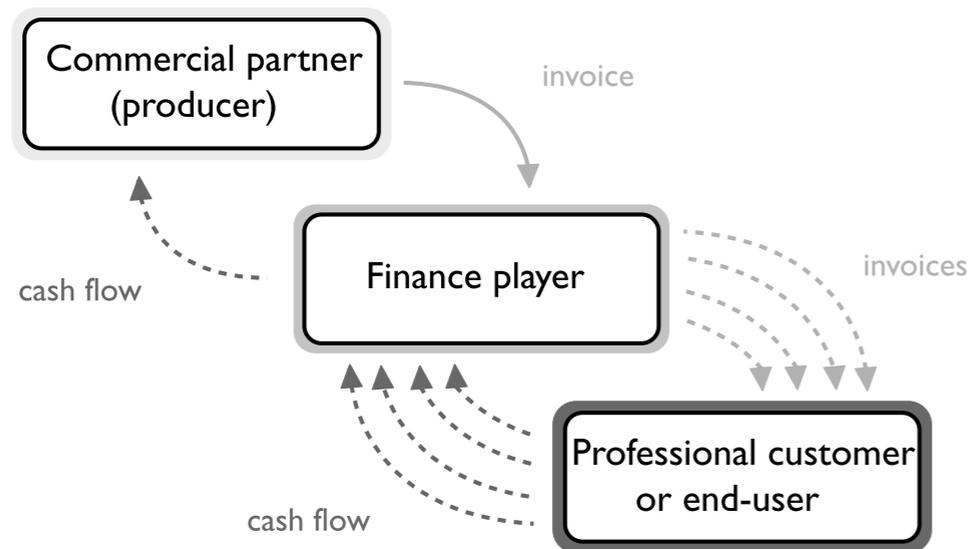
Figure 7 - Schematisation of credit to customer flow by a leasing transaction.
Source: Rocchi, 2000.

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[29] In many European countries, leasing transactions are bound by law to the presence of specialised finance actors.

Provision of total solutions
Outsourcing operations represent, particularly for data management and data electronic re-elaboration, an option already broadly used in this category of business propositions (for example, Xerox's integrated document management services and Compaq – HP's Internet operations management). With this option, companies make available their specialized management skills and resources to operate the entire IT-infrastructure, leaving customers free to concentrate on their core business activities.

In the same category, another group of practices is represented by the provision of digital services via pay-per-use payment, in which professional customers, or end-users, are given the opportunity to create their own value by the use of services that perform functions traditionally provided by products (for example, IBM's learning and networking services, Sega of America's online games on demand, and HP's i-communities centres).

4.4.1 Roles and actors
These marketing strategies and commercial patterns often imply a redefinition of an internal company's conventional roles, and in many cases, stimulate a strong interaction with new external actors. The implementation of full leasing practices, aimed at encouraging interrelated loop-closing systems and eco-efficient services, require the presence of specific professional figures, as described below.

- **Financial actors who support credit to customers.** These are relatively new in the business of electronics: they enable the access of expensive product-service systems to business-to-business customers and end-users through the supply of financial services (for example, Digital-DecLease, HP Financial Services, IBM Semea Financial Services).
- **Actors who provide maintenance and up-grading operations.** These actors, originally called 'third-party maintenance', have actually extended their traditional functions. In addition to installation, maintenance and up-grading, they have started to provide training programmes on the use of their equipment. In addition, some of them have assumed logistics functions for the take-back of 'dispose-off' equipment.
- **Actors who help in the re-manufacturing and re-marketing of end-of-lease products.** Qualified personnel are often specifically appointed to determine any value that may be left in obsolete products and to manage the complete logistical aspects of the recovery and re-marketing of products (for example, the re-marketing group of HP).

The provision of total solutions and digital services, aimed at replacing hardware components with service performances or stimulating a change in the product use and in patterns of consumption, also requires the following specific actors.

- **Strategic thinkers at corporate level.** Individuals able to formulate future visions on a long-term perspective - to anticipate socio-cultural changes - are a fundamental prerequisite of these strategies. They are at the root of many sustainable *product-service systems*.

- **Employees capable of adopting a new mindset.** Employees able to cover aspects that move beyond the linear logic of product development, production and marketing steps are required for the provision of solutions that receive continuous feedback from the market.
- **Design multidisciplinary teams.** Teams involving researchers, product, interaction and web designers, technology, marketing and product development experts are required to create sustainable *product-service systems*. By integrating the different skills and inputs necessary to shape better and more contextualised business answers, these teams assume a fundamental facilitation role in the company innovation process during the early stage of concept creation.

4.5 Observations

A few common elements can be recognized in the new logic of value creation emerging with the promotion of competitive and sustainable *product-service systems*.

- Creating satisfaction for customers, by focusing on the question of how best a company can meet people's needs, is becoming the priority, rather than concentrating business activities on the redesign of conventional products and on the volume of products sold to cover standard market demands. With this mindset, new business opportunities as well as new opportunities for the dematerialization of the economic systems arise.
- 'Creativity' and 'entrepreneurialism' are becoming fundamental elements in an economy in which managers must make decisions without having access to complete information. Indeed, today, successful companies increasingly do not just *add* value; they *reinvent* it by recombining tangible and intangible assets into new forms.
- The most attractive *product-service systems* involve end-users, professional customers, producers and suppliers, business partners, and sometimes also public bodies and non-governmental organizations, in such a way that their relations become less sequential and more reciprocal and synchronous. All the actors, representing various productive resources and types of knowledge, become co-designers of the production system itself: the value of the offer is co-created.
- In particular, the chance of generating sustainable solutions can increase when the process of value co-creation ensures the involvement of local actors and final users: by leveraging on the use of local available resources, the end results can better fit the needs and requirements emerging in specific socio-cultural and physical contexts.
- The most attractive *product-service systems* are often related to marketing and commercial patterns of leasing and renting practices, or to the provision of total solutions. In the case of renting and leasing practices, the adoption of this commercial pattern helps enterprises not only to internalise the costs of supplying the service that generate supplementary qualities for their hardware, but also to increase their potential surplus. In the case of total solutions for specific customer's needs, product-oriented companies drastically shift the economic value of their offer from the hardware to the entire service performance (customers pay in relation to the degree of satisfaction of a function).

5 Strategic design and innovation

This chapter provides an important part of this study: it summaries the current theoretical debate about the meaning and the role of design within business innovation processes. Indeed, the promotion of competitive and sustainable solutions not only implies a new dynamic of business value creation as argued in Chapter 4, and an appropriate execution of all the phases of the value chain / network, but it also requires new corresponding and appropriate design approaches.

Chapter 5 begins with an overview of conventional eco-design practices typical of incremental product changes, then continues with an illustration of new emerging design-for-sustainability strategies able to support a radical innovation in the company's offer. It ends with an analysis of two major specific design methods and related steps, which steer the ideation process from the creation eco-efficient to sustainability-based *product-service systems*.

5.1 Design paradigm and discontinuity

Design[30], as an intrinsic part of the business value creation process, has to face the complexity of today's markets directly. It has to question 'what' to shape, in terms of tangible and intangible aspects of a solution, and 'how' to do that, in terms of approaches, tools and kind of competencies involved.

Originally introduced to compensate for the absence of art in the forms of industrially produced products, design has long been "*the mediator between the natural, artificial and commercial worlds, concerning itself with the interdependencies of people, habitats, technologies and commerce, while simultaneously exploring its own meaning, purpose and future*" (Kyffin, 2003). Nevertheless, in people's minds, this discipline has been often related to two simplified common assumptions: it is a technical and engineering process that focuses on a product's function; it is a styling exercise needed only to choose colours and materials that make a product more appealing to the eyes of customers. Times have changed, however. In the last decade, companies have realized that design can help them create competitive

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[30] Many definitions of the word 'design' are characterised by a common message: "*design is the art of making plans*" (http://dictionary.cambridge.org). The emphasis in these definitions is not so much on the end result but rather on the process required to achieve the end result: the 'act' of making something. 'Design' can be therefore be considered as the art of creation: arranging elements in such a way as best to accomplish a particular purpose. It is the act of developing a project, of thinking about and organizing a plan to achieve a certain goal. Anything that starts from an idea, develops through a process and is finalised through a tangible articulation has been 'designed'. As such, 'design' is a very complex and broad activity that involves a research phase, strategic thinking and the capacity to articulate and implement.

propositions, and people have come to appreciate that a well-designed solution can simplify their everyday activities. Its recognition in terms of business strategic asset has been now broadly accepted by many Corporate Chief Executive Officers (Peters, 2003), and its importance becomes clearer if we study the following few considerations.

• Many current products present an ever-increasing number of functions and technologies. Digital products, in particular, are too often overloaded with technical specifications difficult to understand for end-users. Design, in this case, can become the key offering differentiator by virtue of its capacity to simplify and develop easy-to-use interfaces: that is, intuitive and distinguished solutions that adopt a familiar communication language directed at people who want to be 'empowered' and not 'overpowered' in the performance of their everyday activities.
• Aware of markets' requirements and also sensitive to emerging social and cultural manifestations of people's needs, design is able to translate technological potentialities into commercial value propositions. By nature, it has the capacity to:
  - convert neutral technologies into recognizable and attractive physical assets or services able to satisfy customer's needs by speaking a language that the target audience can understand
  - provide new social significance to, and derive personal and cultural meanings from, applications that could originally have been intended for different purposes.
• Design has the power to make tangible and appealing the intangible by searching the aesthetic-linguistic of the immaterial and by finding ways of externalising and communicating the functions, meanings and values of a service performance. This is an aspect that becomes crucial in the proposition of new *product-service systems,* where the intangible components start to assume the same importance as the tangible elements during the customers' decision-making process before a purchase.

It is particularly with regard to this last consideration that **the design paradigm must today respond to an economic model that supports the provision of converged and connected solutions, combining products, services and content to suit individual and collective needs in their specific socio-cultural contexts.** Here the challenge is to find the right balance between material and immaterial aspects, global standard technologies and local specific resources - mobilized inside and outside a company - in order to create unique added value solutions and customer experiences. The key for design is its role as the facilitator of a value creation process able to integrate the different competencies that cross a company's boundaries. Indeed, as stated more than once, competitive *product-service systems* can hardly be created by a single business department / unit or one company in isolation: they require knowledge sharing among different actors, as well as creativity and multidisciplinary skills from the beginning of the research. Within this framework, the design activity is no longer an isolated and independent process - steered by a visionary design director - for the generation of ideas, but rather a team effort nourished by researchers, designers, engineers, marketers and strategists, all of whom

collaborate within the creative sessions. The stakeholders are not only all involved but they are all also essential contributors to the creation process of the new solution.

The **level of design innovation** brought to this process may vary. It can be **'incremental':** providing some improvements that 'fit in' with existing users' expectations, and which do not require behavioural changes. It can be **'radical':** providing new solutions able to generate new patterns of behaviour (new ways of fulfilling a need through different activities or ways of interacting with products and services. Taylor, 2003). In many cases, during the creation of new *product-service systems* - in terms of new applications or existing applications used in a different ways - the design-driven innovation is 'radical'. This path, by requiring a certain degree of social innovation, is certainly more commercially risky, since it has to take the time necessary to establish new customer behaviours into account. However, once it is accepted, it opens strong business opportunities. Its implementation depends very much on the business attitude to the experience of a "*continuous discontinuity*"[31] (Marzano, 2003), of finding ways of constantly experimenting with the 'new' and of understanding individuals, social contexts, value systems, and how these all evolve through time. In such a rapidly changing and complex world, no designer, engineer or architect is able anymore to know the whole system as it grows in all its details. It is innovative and more sustainable *product-service systems* - in terms of open, co-created and evolving systems - that seem to be potential valuable answers to these new market requirements.

5.2 From eco-design to design-for-sustainability
Companies addressing the challenge of radical innovation and sustainability must also question the traditional **eco-design**[32] practices developed and implemented since the early 1990's. Nowadays, these practices have produced necessary and important results, but such results are not sufficient for a society that – if it is to be sustainable – needs to learn how to live better while decreasing the use of environmental resources by a factor 10 or 20 of eco-efficiency within 50 years[33]. Their limitations stay in the field of intervention, which is mainly the production side: eco-design, in its essence, is the integration of environmental criteria into the product development process (Brezet, 1998).

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[31] Because markets are made by people so, just like people and societies, they continuously evolve. As a consequence, in the words of authors such as Marzano, "*The more a company looks for continuity internally (procedures and static tools), the more it will grow unable to respond to the needs of a market whose sole rule is open discontinuity … the answer to such paradox lies in the development of a transformation process that allows companies to experience a continuous discontinuity*" (Marzano, 2003).
[32] Many definitions have been given for 'eco-design' or 'design-for-environment' (also called 'green design', 'environmental or ecological design', 'environmentally sound or friendly design', etc.). One of the most commonly accepted, comprehensive, explanations defines 'eco-design' as "*a design process that implies the application of environmental criteria focused to the prevention of wastes and the minimization of a product's environmental impact along its material life-cycle*" (Van Weenen, 1994). Today - no matter what definitions are used - the ultimate goal associated with such a term remains the same: designing products that take environmental matters into account, and minimizing their direct and indirect environmental impacts in relation to their life-cycle.
[33] Only those systems of production and consumption able to use 90% fewer environmental resources per unit of service provided than in current advanced industrial markets can be considered sustainable in the long run: in other words, relying on only 10% of the resources used today (Schmidt-Bleek, 2000).

And, as such, it promotes incremental, continuous (but limited) product improvements by the use of different environmental strategies that modify physical assets to answer conventional consumption patterns. Design strategies applied within this framework can be roughly classified as follows (Manzini and Rocchi, 1995).

- **Design for reduced consumption of resources.** The aim is to reduce the quantity of energy or materials normally used, while selecting recyclable or renewable resources.
- **Design for product-life-time extension.** The aim is to consider the durability of material, as well as the ease with which components can be replaced, in order to discourage too quick a replacement.
- **Design for recycling.** The aim is to use materials that can be recovered (recycled, regenerated, reutilised), avoiding those ones which are harmful to the environment.
- **Design for disassembling.** The aim is to enable, after disposal, an easy separation of components and materials to encourage rapid recycling and reutilisation, or correct ecological disposal.

The combination and the integration of these strategies have proved to be able to create relevant environmental improvements throughout the entire product-life-cycle[34]. However, the product eco-efficiency generated in this process has sometimes been annulled by a lack of real eco-effectiveness: a product can be energy-saving due to technical modifications but, if the user increases the frequency of its use or allocates the money saved from its cheaper performance to other 'unsustainable' ways of consumption, then the product's original environmental benefits can be all too easily neutralized. This phenomenon, known as the 'rebound effect', can be partially contained by including considerations of a customer's behaviour at an early stage of the design process. By changing a point of view, focusing on people's needs and their expected results, design can extend its boundaries of intervention and become an agent able to stimulate social innovation in the area of sustainability. The key question to keep in mind in this conceptual shift is: do people want a product or the result brought by such a product to fulfil their needs, values and aspirations? In other words, do people want a washing machine or just clean clothes? a refrigerator or convenient access to fresh food? a television set or immediate access to information and entertainment?

Seen from this perspective, the importance of the carrier of the result diminishes, while the means of achieving it becomes central. Following this route, design must deal with the production as well as the consumption of a product. It must operate in terms of function or system innovation (two of the four types of innovation levels characterizing the design path towards sustainability identified by Delft University of Technology - Faculty of Industrial

Design Engineering[35]). This path and its related innovation levels are well known inside and outside the European landscape. They have been described by Brezet (1997a) as follows.

- **Type 1: Product improvement.** This involves only partial changes and improvements to various aspects of a product; the product itself and the production techniques stay the same. Examples of this include changes in the type of coolant or substances used in a television set to improve its environmental performance in comparison to a predecessor model.
- **Type 2: Product redesign.** In this case, the typology of the existing product remains unchanged. However, its components are improved or replaced in order to facilitate disassembly, recycling, re-use procedures or energy use reduction. Examples include energy saving systems in a television set, and the introduction of recyclable plastic parts or modular easy-to-replace components.
- **Type 3: Function innovation.** This type of change is no longer confined to the existing product concept. Here, the way in which the function is fulfilled is different. The old television tube, for example, is replaced with other image carriers (LCD monitor instead of CRT-based monitor, or replacement of the television with a light projector). Through these innovations, environmental performance in fulfilling the function can be improved by as much as a factor of 10.
- **Type 4: System innovation.** Here, the entire socio-technical system (the product, the production chain, associated infrastructures and institutions) is replaced by a new system. One example of this is the use of information and communication technology to deliver information and images to the end-users through video-on-demand systems. This can affect the organization of the labour and physical transport and, potentially, achieve improvements by a factor 20.
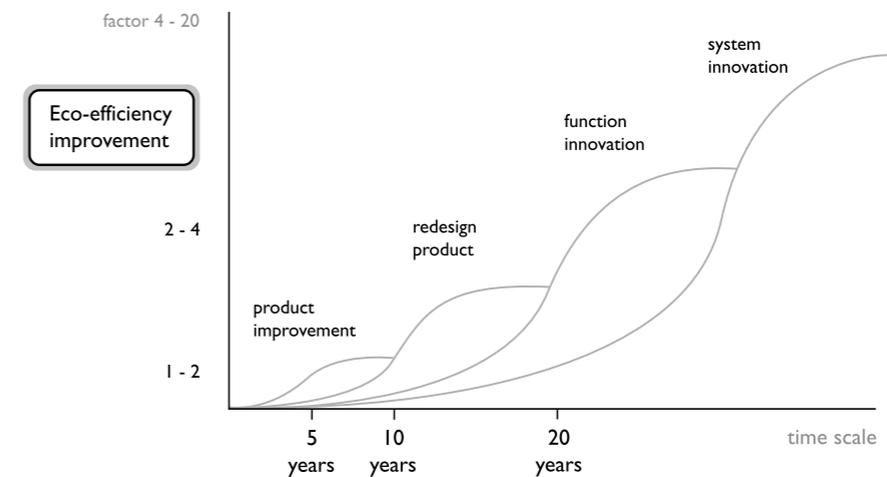
Figure 8 - Four levels of environmental innovation in the design path towards sustainability.
After: Brezet, 1997a.

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[34] Over the past decade, tools such as Life-Cycle-Analysis have tried to assess and map products' environmental impact throughout their whole life-time, including: extraction and processing of raw materials; product manufacture; product use; end-of-life options (e.g. re-use, remanufacture, recycling, treatment and disposal).

[35] Professors such as Brezet, Stevels and Vergragt have been dealing with studies and projects related to function and system innovations since 1997. To foster R&D development in this field, and its implementation in advanced European companies, TU Delft and TNO Industries have even created a special Institute called Kathalys Centre.

If type 1 and 2 of such innovations are still related to an eco-design paradigm by their proposal of incremental environmental product improvements, type 3 and 4 carry out the kind of radical changes required by a sustainable design or **design-for-sustainability** paradigm. They bring into the design process the discontinuity necessary to create solutions designed to rely on only 10% of the resources used in solutions currently available. The value of these paths, as well as their limits, can be summarized with a few observations. On the one hand, they open a new mindset and design perspective in which designers (tend to) become actors who act within a more complex network of stakeholders, and take on the role of facilitators in a participatory value creation process. With the use of design tools, designers generate ideas about possible *product-service systems*, visualizing and communicating them in multi-faceted lifestyles-scenarios presented in concise and visual forms that facilitate the discussion during the decision-making process. On the other hand, it can be also said that the line between function and system innovation is generally so weak that in many cases it is difficult to make a distinction between the two (examples of function innovation often imply a system modification). Moreover, the emphasis is mainly on environmental performance in terms of eco-efficient *product-service systems* (social aspects are not explicitly addressed). And little attention is reserved for the short-term opportunities for the implementation of radical changes: the emphasis is on the potential influence on the long-term scale of intervention.

Some experts in this field, therefore, take this design path as a starting point to going one step further. They argue that design can create valuable sustainable results today, even if a mass broad implementation will require more time (Manzini, 1997). They also begin to bring into focus the social dimension in the design process, with regard to ethical principles, equity and respect for the local socio-cultural context: "*Sustainable design begins to address the bigger picture by considering collectively some of the harder questions, such as need, equity, ethics, social impact and total resources efficiency and thus the role of design in achieving inter-generational equity. More specifically, sustainable design seeks to translate and embody global and regional socio-environmental concerns into products and services at the local level. This necessarily demands a system view of design and does not always focus on realising physical products*" (Lewis et al., 2001).

This definition explicitly states that the sustainability challenge cannot be addressed either by incremental innovation in the technology currently used via re-design operations, nor by targeting environmental issues only. A structurally different system of production and consumption is required, as well as eco-efficient solutions able to promote and bring to life a new idea of well being (Manzini and Jégou, 2003). It is about a radical innovation generating *product-service systems* able to enhance the quality of life of people in their particular environments, at a particular time. This is a new idea of well-being and, consequently, of quality of life, that does not live in an ideal world. On the contrary, it is already present in society, in an incubation phase. It is an idea more related to quality than quantity, to access to functions, experiences, value and meanings rather than to

the possession of more products. Indeed, especially in the Western markets, people are starting to define well-being as a concept that goes beyond 'wealth' to physical and mental health, self-fulfilment and relationships[36].

5.2.1 Main product implications

Function and system innovations can affect the attributes of the product utilized in the proposition of new *product-service systems* in different ways. In particular, in the electronics and consumer electronics sectors, the development of service components around product-functions tends to stimulate either a re-design of the physical asset, or the introduction of new families of electronic devices.

Product changes

Certain *product-service systems* imply the use of such services as maintenance, up-grading, and recovery, services able to promote an extension of the product life cycle. In this case, product improvements are needed to take full economic advantage of re-use and re-manufacturing operations. For such a purpose, eco-design strategies focusing on ease of repair, up-gradeability, fast disassembly, and reduction of the amount of parts required for an earlier comparable product are being increasingly applied during the product design process. As a practical example, Xerox, as far back as 1997, (http://www.xerox.com/ehs/1997/execsumm.htm) launched the 'Document Centre 265' equipment that incorporated such modifications as:

- standardization of components to facilitate the replacement of parts and the repair of equipment (part of *design for common use strategies*)
- several hundred fewer parts than previous equipment of the same category (part of *design for disassembling strategies*)
- 97% of the parts designed to be recyclable, 84% to be re-manufacturable (part of *design for recycling strategies*).

Recently, the company has further extended its ability to re-use parts and up-grade equipment by re-designing hardware around modular product architectures and a common set of components. A machine can therefore extends its functions, growing over time or, if returned to the manufacturer, can be rebuilt as the same model within the same product family, or used as a source of parts for next-generation models.

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[36] As recently as 2001, a survey about 'happiness', conducted by American psychology students, underlined that money and power do not bring more happiness to people' lives. The study found that people increasingly value a sense of closeness with others and self-esteem (James, 2003). In parallel to such surveys, new indicators of well-being are emerging, indicators that distance themselves from an idea of progress defined mainly in material terms and measured only as economic growth. For instance, the Genuine Progress Indicator (GPI) adjusts the Gross Domestic Product (GDP) for a wide range of social and environmental factors (Venetoulis and Cobb, 2004).

New families of electronic devices

In many cases, business offers generated around online and digital services require a hardware component constituted by new families of electronic devices, such as new material interfaces, that facilitate Internet access and the creation of networks.

One practical example that fits within this framework is the 'Sega Saturn Net Link'. It is a *product-service system* that enables online multiple gaming and full Internet functionality for e-mail and web surfing. Its hardware components are a 32-bit CD-based video game system with more than 200 games available, and a modem that turns the video game console into a TV-based Internet device (http://www.sega.com/central/press_releases/ug97/netlink_feature.html).

Despite such product's changes, the major implications for physical assets as part of *product-service systems* are their patterns of use. Once again, HP's 'i-community' program represents a meaningful example that underlines the kind of discontinuity required by sustainable innovation: devices in community centres are accessed by multiple users in a sharing usage model (http://www.hp.com/e-inclusion/en/index.html).

5.2.2 Comprehensive design principles

In light of the theoretical and practical considerations mentioned above, it becomes clear that design today needs to shift from a 'transforming nature' paradigm to one of 'transforming society' towards sustainability, by improving the quality of life of communities and relations between natural and artificial habitats. For authors such as Lewis (2001), this means that designers need to follow some new and more comprehensive basic principles. For instance, they need to:

- re-examine human needs, and set appropriate goals that prioritise ecological sustainability and social equity
- rethink the basic nature, method and goals of the design process itself
- integrate knowledge from other fields concerned with human and eco-system health
- promote technologies, systems of production, and construction methods that do not rely on natural capital, fossil fuels and harmful chemicals.

Similar indications have been given by Manzini and Jégou (2003) in a more recent publication on the subject. These indications are consistent with ethical principles related to people and society, as well as to relationships with nature, in terms of low energy and material intensity, and high regenerative potential (in order to revitalize local environmental and social resources). They have been articulated in a series of specific suggestions to guide design choices towards (potentially) more sustainable solutions. A summary of the suggestions is given below.

- **General principles to keep in mind before starting design activities**
  - *Think before doing.* Weigh up the objectives.
  - *Promote variety.* Protect and develop biological, socio-cultural and technical diversity.
  - *Use what already exists.* Reduce need for the new.

- **Quality of the context in which the solution will be used**
  - *Give space to nature.* Protect natural environments and promote symbiotic nature.
  - *Re-naturalize food.* Cultivate it naturally.
  - *Bring people and things together.* Reduce the amount of transport.
  - *Share tools and equipment.* Reduce the amount of physical products.

- **System intelligence for a sensitive management of resources and people**
  - *Empower people.* Increase participation.
  - *Develop networks.* Promote decentralized, flexible forms of organization.
  - *Use the sun, wind and biomass.* Reduce dependence on oil.
  - *Produce at zero waste.* Promote forms of industrial ecology.

Based on these principles and parameters, this study defines **design-for-sustainability as a result-oriented design process aimed at stimulating technological change and social innovation in the current systems of production and consumption, to decrease the use of environmental resources and enhance people's quality of life, both today and in the future.** It is a concept in which technological change and social innovation stand for a radical innovation process able to generate results different from those currently available. And the results carried out through new *product-service systems* are able to fit and assume a meaning in this process.

5.3 Emerging methods and activities

Design guidelines, tools and related methodological approaches concerning incremental environmental design innovation have been broadly documented by literature[37]. However, the same cannot be said for methodologies and tools concerning the kind of radical or discontinue innovation required by design-for-sustainability. At the moment, design methodologies in this field seem to be solid bases only for work-in-progress, work that is feeding an explorative research supported, in the majority of the cases, by public bodies.

In this regard, the first toolbox containing practical guidelines for the development of eco-efficient product-service systems was made publicly available by the Dutch government (VROM – Ministerie van Volkshuisvesting, Ruimtelijeke en Milieubeheer) in 2001, in the report entitled '*Designing eco-efficient services*'. Sponsored by the VROM, a team of researchers, part of the Design

[37] Eco-design manuals are currently available. Worth considering are the old but still quite comprehensive 'Green Products by Design: Choices for a Cleaner Environment' manual (OTA, 1992), the toolkit 'Managing Eco-Design: A Training Solution' (CfSD, 1996), and the well-known 'PROMISE' approach of UNEP (Brezet and van Hemel, 1997b), which has been successfully applied in companies in more than 25 countries (Europe, Asia, Latin America).

for Sustainability Program of Delft University of Technology, developed a process - articulated in phases - to be used as a framework for structuring and communicating the different activities that, in the end, should lead to a successful eco-efficient service (Brezet et al., 2001).

Almost in parallel, two other progressive research projects on sustainable product-service systems development started under the sponsorship of the European Union[38]. 'Highly Customerized Solutions and The Solutions Oriented Partnership Approach' (HiCS) is an action-research project focusing on the development of a methodological framework and related tools for the creation of context-specific solutions with a high degree of sustainability via a partnership-based model (http://www.hicsproject.org). This project recently ended with the release of two books: the first, focusing on theory, describes methods and tools used by the consortium of partners (Manzini, Collina and Evans, 2004). The second provides an overview of the *product-service systems* marketed by the industrial partners (Jégou and Joore, 2004). The other project in this field is 'Product Service Systems Methodology' - MEPSS. Its aim is to provide a practical toolkit for industry that will enable manufacturers to analyse newly-developed product-services with regard to design and implementation aspects; to micro / meso / macro-economic impacts; to social and environmental impacts, and to issues related to consumer acceptance and culture and ethics (http://www.pss-info.com/html/st_mepps.php). However, the results of this study offer more evaluation and assessment tools rather than new concept creation practices.

5.3.1 'Designing eco-efficient services' toolbox

This methodology aims to increase the possibility of successfully developing environmental services by effective methods and techniques. Its ambition is to offer a universally applicable and flexible toolbox that would enable eco-efficient *product-service systems* to be designed. Its starting point is the reconsideration and adaptation of the product development methodology elaborated by Roozenburg and Eekels (Brezet et al., 2001). The framework proposed is articulated in six major steps - including a list of activities and tools - that need to be enriched and validated during the experimentation via an iterative process. The six major steps recommended in the toolkit can be summarized as follows.

- **Step 1: EXPLORATION.** An organization gets an idea for a function or system level innovation and makes sustainability part of this change, defining the scope of intervention and possibly the target audience. External partners or internal coalitions among different departments are also identified. Tools suggested at this stage range from market qualitative research to SWOT analysis, benchmarking and 'backcasting' techniques.

- **Step 2: POLICY FORMULATION.** Goals and strategies are defined in a policy that gives directions (specific tasks) to subsequent phases and specifies the roles and responsibility of the various players. The vision, jointly formulated by the partners involved, determines the level of sustainability being aimed for. Life-Cycle-Analysis (LCA) scenarios, external and internal analysis, and a stakeholders' analysis are a few examples of the tools recommended for such a purpose.
- **Step 3: IDEA FINDING.** The aim is to translate rather vague and broad ideas into concrete environmental services ideas, by thinking in terms of functions and customer demand instead of products. Creative techniques are used at this stage to generate concepts, and filtering tools are adopted to narrow them down and make a selection from them.
- **Step 4: STRICT DEVELOPMENT (DESIGN).** Concepts are shaped and articulated by specifying product and service components that will form the solution to be implemented in the market. Tools such as LCA scenarios are recommended to help assess the expected environmental performance, (preferably using real prototypes).
- **Step 5: REALISATION.** This is the execution stage that results in the launch, onto the market, of the new *product-service systems*. Communication tools are also used to make explicit the environmental benefits provided by the new offer.
- **Step 6: EVALUATION.** An evaluation is necessary to guarantee a process of continuous improvements to the offer. In this stage, environmental and financial effects are measured to provide appropriate feedback via various available tools (for example, LCA analysis practices).

By working through all the steps and the tools proposed, the value of the contribution provided by this toolkit to the field of *product-service systems* development becomes very clear, as does its major limitation. While it definitely represents a pioneering piece of work that offers practical guidance to companies embracing a service re-orientation of their offers - and taking environmental questions into account - it excludes from the sustainability challenge some equally important social issues. In addition, other comments about the sequence of the steps proposed need to be addressed. For instance, it is not always the case that a single company or business group originates an idea of a new value proposition first and then identifies the right partners for its implementation; it is also possible that companies or business units with a shared vision can come together to explore simultaneously new business opportunities[39] based on innovative sustainable *product-service systems*. As a consequence, the idea generation becomes a richer and more dynamic process that produces a broad range of new concepts: the results of a dialogue and of the activities needed to find convergences towards common mutual goals

[38] The EU's Fifth Framework Programme (Competitive and Sustainable Growth) has been co-financing the two main research projects in this field since 2001. 'Highly Customerized Solutions - The Solutions Oriented Partnership Approach (HiCS)' co-ordinated by Politecnico di Milano, started in April 2001 and ended in March 2004 (http://www.hicsproject.org). 'Product Service Systems Methodology' - MEPSS, co-ordinated by Pricewater house Cooper started in November 2001 and ended in October 2004 (http://www.pss-info.com/html/st_mepss.php).

[39] The 'Clustering' concept elaborated by the World Business Council for Sustainable Development ment (WBCSD) is based on this assumption. It is used to aggregate companies with similar visions and common goals that can come together to explore new profitable and sustainable solutions by aggregating their complementary skills and competencies. The outcome of this process is not known in advance but it is the result of a series of brain storming sessions (WBCSD, 2004).

in a more democratic process. In addition, the partners involved might change during the evolution of the project; therefore, the policy formulation and the project plan do not necessarily need to be fixed at a very early stage of the process. Finally, it should also be said that no reference has been made to the composition of the team during the different steps of the process, or to the timescale required to perform the tasks.
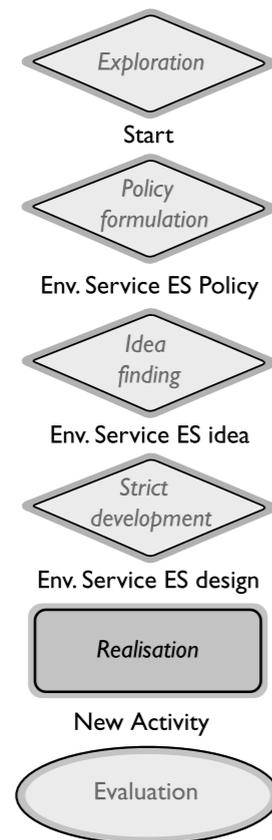

Figure - 9 The design of eco-efficient services process.
Individual steps in the development of eco-efficient *product-service systems*. *After*: Brezet et al., 2001.

5.3.2 The 'HiCS' concept generation method

This method focuses on the generation of *product-service systems* customized for specific people in their specific 'contexts-of-use' (physical and socio-cultural spaces in which an action takes place and assumes a meaning). It summarizes some design guidelines to be considered during the dynamic process of solution development within the framework of a new, partnership-oriented business model. As such, the process for developing HiCS concepts has to be seen as part of the other two methodological streams: the **partnership development** and the **'context-of-use' understanding**. All three streams co-evolve

together and influence each other in an iterative process: real life information about users in their everyday 'contexts-of-use' feeds concept creation; new ideas about the resolution of 'contexts-of-use' related problems can be better realized by creating synergies among partners with different skills and capabilities.

The process of HiCS concept generation differs from normal design processes in the following ways. It is about designing:

- *product-service systems* instead of a single product or service
- in a partnership instead of relying on a single company
- for multiple groups of users instead of specific consumer segmentations
- for triple bottom line ambitions instead of eco-efficient aspects only
- a common organizational and/or technological platform able to provide the basis for several specific solutions.

It is characterized by divergence and convergence steps in the flow of idea generation and selection, all of which follow seven phases (Joore et al., 2003): generating tentative solutions; defining the solutions direction; design solutions based on platform vision; defining the platform; designing specific solutions; defining the HiCS; formalizing the final solution.

- **Phase 1: Generating tentative solutions.** At the very beginning of the project, a tentative solution workshop is set up to bring together organizations with similar interests in developing HiCS solutions (workshop A). At this stage, the briefing focuses on the mapping of potential market areas, identifying promising 'contexts-of-use' and understanding partners' strategic intent in the project philosophy.
- **Phase 2: Defining the solution direction.** Primary rough ideas are filtered by three major criteria: 'contexts-of-use' fit; partners' interests match; sustainability requirements. A tentative qualitative assessment is then addressed through the use of system organization maps, to distinguish system boundaries for each solution: main and secondary stakeholders, core performance and secondary functionalities, etc. The solution ideas are clustered by common features and used to create a platform vision for the initial partners' promoters.
- **Phase 3: Designing solutions based on platform vision.** A second workshop (workshop B) is then organized. A clear design briefing must be provided and should include a description of the clustered ideas, the platform vision and the specification of roles and responsibilities among the partners involved. At this stage, conceptual ideas grounded on the same platform start to take shape (common technological and/or organizational elements agreed by the partners).
- **Phase 4: Defining the platform.** With the aid of a design plan, all the players involved in the solution need to be mapped, the 'contexts-of-use' addressed, the issues to be solved made clear, and the added value claimed with the new propositions (including sustainability benefits) communicated. Particular attention should be paid to the entry of new partners, to the consideration of new 'contexts-of-use' and to the testing of the concepts for their

improvements. Tools available at this stage include 'contexts-of-use' mapping, stakeholder benefits matrix, storyboards, economic benefit charts and ISSI method (Integration of Sustainability in Systems Innovation).

- **Phase 5: Designing specific solutions.** The solutions are now detailed in their product, service and organizational components. With the aid of a new workshop (workshop C) and follow up sessions, a distinction is made between the core platform elements and the specific elements needed to contextualise the solutions on a local scale.
- **Phase 6: Defining the HiCS.** All the solutions and solution components must be assessed from the economic, the environmental and the social point of view. HiCS assessment tools (sustainability web schemes) have been developed to evaluate and improve the performance of the solutions before entering the phase of the final implementation.
- **Phase 7: Formalizing the final solution.** At this stage, products are engineered and prototyped, services are organized, the business plans developed and feedback from the sustainability assessments and the pilot test also processed.
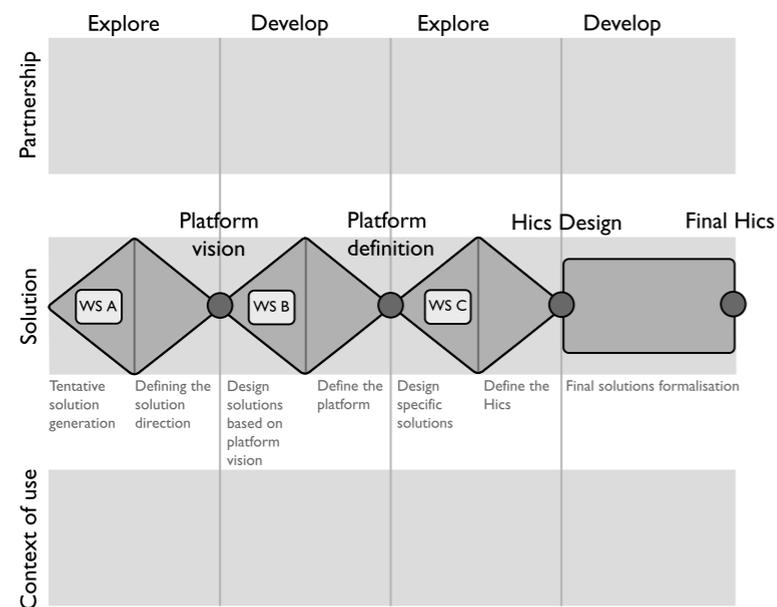

Figure 10 - The HiCS solution stream.

Divergences and convergences can be identified in the method of concept generation of HiCS. These steps can be visualized with the aid of a few diamonds: the first part of each diamond represents the diverging step, where many new ideas are generated; the second part represents the converging step, where these ideas are evaluated and selected. *After*: EC HiCS project, Joore et al., 2003.

A few comments should be made - as were also made about the 'designing of eco-efficient services' toolkit - about HiCS' value and possible room for improvement. The 'HiCS' concepts generation process is a very valuable and innovative research work: its holistic approach and its specific tools have successfully guided the generation and implementation of interesting

industrial *product-service systems* customized to local 'contexts-of-use'. Nevertheless, it does have some weaknesses. The process proposed encountered various problems in embedding the triple bottom line aspects at the beginning of the design process. Indeed, the development of the entire methodological framework for the integration of the three streams (partnership building, concept creation and 'context-of-use' understanding) took quite some energy and time, which negatively affected the sustainability ambitions of the project. Furthermore, no specific indications about the time scale for phases or team composition are explicitly mentioned in the process description, which leads in turn to problems during the replication phase.

5.4 Observations

The following key lessons about the content addressed in this chapter need to be summarized and brought forward into Part Two, which deals with the experimentation phase of this study:

- Today, design is increasingly being recognized as an intrinsic part of the business value creation process. Therefore, it is no longer an isolated and independent activity for ideas generation, but rather a process facilitating a team effort nourished by researchers, designers, engineers, marketers and strategists, all of whom cooperate to generate new business value propositions.
- As such, design can help to stimulate innovation in various forms. It can be 'incremental': providing some solutions' improvements that 'fit in' with existing users' expectations, and which do not require behavioural changes. It can be 'radical': providing solutions able to generate new patterns of behaviour.
- Innovative and more sustainable *product-service systems* require radical innovation rather than incremental innovation. They require a shift from eco-design practices (generating incremental, continuous - but limited - product environmental improvements) to design-for-sustainability practices (generating solutions able to improve the quality of life of communities, and the relations between the natural and artificial habitat).
- *Product-service systems* design methodologies emerging from the literature give clear indications about how to pursue radical innovation results; however they contain some weaknesses in relation to triple bottom line ambitions. They often focus their attention on eco-efficiency targets, excluding some equally important social issues from the sustainability challenge, or they encounter problems in embedding triple bottom line aspects at the beginning of the design process.
- Nevertheless, in various studies, both environmental and social design guidelines have already been indicated as important elements to be considered upstream in the design process:
  - enhance biological, socio-cultural and technical diversity
  - re-use what already exists and share what is already available
  - make the best use of locally available natural and human resources
  - empower local actors
  - make use of renewable energy sources
  - reduce the amount of transport
  - promote decentralized, flexible forms of organization
  - promote forms of industrial ecologies.

PART TWO
Grounding sustainability in creativity: experimentation

6 The Philips context: from eco-efficiency to the triple bottom line

Chapter 6 introduces the specific business context of experimentation for the development of the design approach that is the subject of this study, and defines the research agenda of issues to be covered to fill in the gaps emerging from the literature.

It explains Philips' current business and design practices, and introduces new ambitions for the creation of sustainable value propositions underpinned by a triple bottom line approach.

6.1 Introduction

The first part of this study argued that changes in market conditions are stimulating some companies[40] to identify new methods of value creation, and to produce 'open' *product-service systems* that are more sustainable than traditionally finished, stand-alone products with high material and energy usage. Theoretical references and empirical examples have been used to demonstrate that certain combinations of products and services can open new business opportunities in terms of wealth creation / brand reputation and, at the same time, limit their environmental impact and / or enhance their social benefits.

This section focuses on understanding the path that Royal Philips Electronics can undertake to generate innovative and more sustainable *product-service systems*. **The ultimate goal is the development of a broadly applicable, flexible and practical methodological design approach to envisioning** *product-service systems* **able to create value for the business as well as environmental and social benefits for society.** To build such an approach - able to feed 'innovation' projects[41] - some general questions were addressed during the experimentation process.

- How does Philips tackle the challenge of sustainable development?
- What is Philips' current position in relation to product-service oriented business logics emerging in today's market?
- What would a sustainability-based combination of products and services look like for Philips in the perspective of its focus areas 'Healthcare, Lifestyles and Technology'?

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[40] By way of a reminder: the investigation focused on the digital networking and information communication technology arenas, with particular attention paid to electronics and consumer electronics sectors in the Western markets.

[41] The methodological design approach proposed in this study is not directed at facilitating incremental innovation design practices (within daily ways-of-working) but at carrying out design interventions able to stimulate discontinue changes and system innovation (within strategic design activities).

To assist such an approach, the thesis' author has developed a design 'tool-kit' within the design service unit of Philips (Philips Design) via two concept creation workshops organized, respectively, in May 1999 (workshop A), and in November 2002 (workshop B). Both design workshops took sustainability's aspects into account from the early stage of concept creation: they shifted the design challenge from 'how' to design and develop a solution in a more environmentally friendly manner, to the radical issue of 'what' makes sense for the business, the society and the environment. Both workshops generated new design scenarios (visualizations of solutions and their interaction with the users) by finding a practical way of working out the following hypotheses[42].

• Stand-alone and finished products and services are increasingly paving the way for a new and more complex mix of tangible and intangible assets that generate 'open', flexible and customisable *product-service systems* (added-value solutions).
• The combination of a triple bottom line approach with an appropriate use of ICT and other ad hoc technologies can - potentially - generate new ways of doing business, and new business ideas, in line with more sustainable lifestyles.
• Competitive and sustainable solutions are the outcome of a complex value co-creation process that involves different stakeholders - including local actors and end-users - with various competencies and expertise.
• Design can assume a strategic role in the business innovation process by bridging technological innovation with social innovation. It can facilitate the mix and match of multiple knowledge and inputs needed to create added-value solutions able to satisfy - in a sustainable manner - the needs and wants of an exponentially increasing population.

In applying these common denominators, a slightly different route for concept generation and articulation took place in the two workshops. Differences emerged concerning the ways of embedding sustainability principles and criteria during the process, concerning partnership building, user involvement, and concerning the role assumed by Philips businesses in the value network that formed the basis of the new propositions of *product-service systems*. As a final outcome, the design methodological approach and its tool-kit, illustrated in chapter 9, can be considered the result of:

• a capitalization on a few important lessons provided by theory and practice concerning business value co-creation and *product-service systems* design research methods
• an attempt to cover emerging gaps in the literature by an iterative process of adjustments built upon these two experimental workshops.

Lessons learned to bring forward included the importance of focusing on the question of how best a company can meet people's needs, rather than concentrating on the redesign

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[42] The hypotheses of this study were verified in the first part of this document, which provided an insight into the theory of product-service systems (its business / design logic) and its practicalities.

of conventional products, and on the volume of products sold to cover standard market demands. Moreover, the importance of considering the stakeholders involved in a value creation process as co-designers of the solutions proposed; in order to leverage on various capabilities and types of knowledge to provide answers able to better fit the needs, and requirements, emerging in specific socio-cultural and physical contexts. The meaning of design, as an intrinsic part of the business value creation process, in its task of orchestrating a team effort nourished by various expertise. And last but not least, the importance of considering design-for-sustainability strategies, which - differently from product-related eco-design criteria - include both environmental and social guidelines, either at functional or system level.

Emerging gaps, in a process of value co-creation grounded on the design of competitive and sustainable *product-service systems*, constituted the basis for setting a **precise research agenda of issues** defined as follows.

• What kind of expertise is required per design stage: When and how should these areas of expertise be brought together.
• How should inspirational and informative knowledge be circulated and transferred among the team and at what moment in time.
• How can all the stakeholders involved in the concept creation be assured that they will be afforded the same opportunity to best contribute their knowledge. In particular, what is the most appropriate stage for involving the customers/users.
• How can customers/user's needs be positioned at the centre of the creative process, while taking technology into account as an enabling factor to ensure the most effective answers.
• How can a common triple bottom line mindset be created among participants, bearing in mind there could be a different level of understanding of sustainability-related challenges and opportunities.
• How can design-for-sustainability criteria and filters be integrated into the steering framework of the creative process.
• How can concepts that involve a mix of tangible and intangible components be communicated best to the decision makers, in order to indicate the most promising options for implementation.

The experimentations in the Philips context were essential to layout practical steps that designers, and workshop facilitators, can easily and flexibly apply during creative sessions aiming to support business innovation projects.

6.2 Current practices and new ambitions
Philips has, for a long time, tackled the sustainability challenge in terms of *eco-efficiency*. For instance, production processes have been subjected to specific environmental targets since the 1980s and, in the last few years, almost all manufacturing sites have been ISO

14001 certified. And, since the 1990s, product environmental performances have been comprehensively related to '*five green focal*' company areas (eco-design principles): the reduction or elimination of hazardous substances; weight reduction; packaging optimisation; minimization of energy consumption; recycling and disposal (Royal Philips Electronics, 2000). More specifically, process and product targets have been set up over time via the company's 'EcoVision' programmes[43].

Today, steps have been taken to move beyond *eco-efficiency*: **the company recognizes** ''*the need to perform a triple bottom line approach, integrating economic prosperity, environmental quality and social equity*'' (Kleisterlee, 2003). Building sustainable development - the path to sustainability - into the business processes is considered the ultimate opportunity for true innovation, open dialog and cooperation with stakeholders both inside and outside the company. It is considered a way of doing business to bring meaningful, life-enhancing technology to the market at the right time with the goal of improving the personal well-being of people today and in the future. The focus is on economic, environmental and social responsibility as illustrated by the following few statements (Royal Philips Electronics, 2004).

- Economic responsibility: the company is committed to achieving sustainable economic growth and to becoming a market-driven company that creates higher value for all its stakeholders by focusing on the areas of *healthcare, lifestyle* and *technology*.
- Environmental responsibility: with its ambition to be a world leader in eco-efficiency within the electronics industry[44], the company is working to minimize the impacts of its products, processes and services; it also sees environmental performance as an opportunity for innovation.
- Social responsibility: by revitalizing the company's heritage of social commitment, Philips is starting to view the potential for all its technology to bring a better quality of life to its employees and to society at large, in particular by contributing to projects focusing on *health* and *education*.

Seen in this light, **sustainability is increasingly perceived as an opportunity for innovation and wealth generation, while at the same time living up to the company's brand promise of improving people's lives**. As a consequence, Philips has started to move beyond incremental products / processes and environmental ambitions to embrace new paths for solutions development by including functional and system innovation. Accordingly, new *product-service systems* are being considered to create added value solutions for both advanced and less advanced markets.

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[43] EcoVisions programmes are defined every three years to update process and product targets. The latest EcoVision programme covers the period 2002-2005.
[44] In 2003, and in 2004, Philips was selected as the number 1 company in its industry category in the Dow Jones Sustainability Index.

Figure 11 - 32PW8717 TV and BGY284.

Two examples of Philips' green flagship products (products with a better environmental performance than their predecessors or competitors in one or more of '*five green focal areas*'). Compared to the average of its three closest commercial competitors, the Philips 32PW8717 TV weighs 8% less, is 33% more energy efficient and uses 15% less packaging. The BGY284 is an ultra-small GSM power amplifier module. Compared to its predecessor (the BGY282) the BGY284 weights 67% less, uses 25% less energy and eliminates the hazardous substance lead. *Sources*: Royal Philips Electronics, 2003; Royal Philips Electronics, 2004.

6.2.1 Beyond process and product performance

In 2003, Philips launched a special programme to explore new business opportunities and new markets by considering sustainability as a key-driver. This programme, called 'An exciting business challenge', aims to develop a business case for projects that will benefit people with low incomes while contributing to the company's internal long-term growth (Royal Philips Electronics, 2004). The targets are the advanced as well as the less advanced societies, including both emerging and still developing markets. Even taking into account differences in size, developing and emerging markets are present in all regions of the world, from Europe and the United States to Latin America and Asia Pacific. Indeed, gaps between 'satisfied' and 'unsatisfied' needs do not necessarily reflect geographical distinctions, since economic disparity and variations in life expectations are also found in advanced Western societies.

Under the general umbrella of the Philips' meta-themes 'health' and 'education', specific topics for implementation projects have been defined in relation to the core competencies of the Product Divisions[45]: knowledge distribution and sharing; health and well-being; clean energy and lighting; fresh water and air purification; food preservation and processing.

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[45] Royal Philips Electronics contains five Product Divisions: Lighting, Medical Systems, Semiconductors, Domestic Appliances and Consumer Electronics.

In order to articulate the Philips sustainability business case, it has been recognized that the implementation of promising solutions within these specific topics requires the use of a holistic approach, one that combines triple bottom line targets with new business models that often require:

• collaborations between Product Divisions and external global and local partners, including NGOs and universities
• a different and creative use of available - or new - technologies, combined with consideration for the local contexts of application in terms of physical and socio-cultural requirements
• new patterns of consumption in terms of solution access by sharing, renting, pay-per-use, etc., rather than ownership.

By examining the features of this programme, the ways in which the company is looking ahead to stimulate sustainable innovation - business organizational changes and the appropriate value propositions necessary to unlock unexploited markets - become clear.

6.2.2 Enrichment of the High Design Process

Within Philips Design, 'sustainability' is perceived as a dynamic process of change, one that can stimulate the business to be innovative in thinking of solutions able to meet people's needs with regard to environmental and social values, for both current and future generations. The belief is that design can play a crucial role in this dynamic process of change by contributing to the shaping of a more sustainable future. "*Design can integrate ecological requirements in the business creation process and go far beyond it. Acting as a bridge between people, technology and business, design can facilitate the systemic integration of economical, social and environmental parameters in the framework of new and more sustainable patterns of production, marketing and use*" (Philips Design, 2000). As an engine for sustainable innovation, design operates at two levels: it supports the business in carrying out either incremental or radical innovation via the application of specific knowledge, practices and tools.

With regard to incremental innovation and the generation of new products, design is an established part of the business product creation process: design activities are linked to business processes, plans and milestones (Taylor, 1999). At this level, the generation of sustainability value is related to the creation of products with increased eco-efficiency (mainly savings in energy and materials), and improved life-cycle costs (costs reduction for the business and economic affordability for customers). Here, design practices respect the five Philips '*green focal areas*' and the specific guidelines set by internally developed eco-design manuals[46].

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[46] The first eco-design manual specifically developed to guide designers in making Philips products with lower environmental impacts was introduced in 1995: 'Guidelines for ecological design – Green pages' (Philips Corporate Design, 1995). An updated version was re-printed in 1997: 'Philips EcoDesign guidelines - Point of no return' (Philips Environmental & Energy Office, 1997).

Concerning radical innovation and the creation of new solutions in terms of *product-service systems*, design is playing a more strategic but also more complex role. At this level, design activities aim to enhance the 'sustainability performance' of current socio-economic systems by suggesting solutions that require the reconfiguration of ways of production and consumption. In other words, design generates solutions that can encourage the adoption new business models (for example, new alliances, new ways of creating revenue streams different from traditional channels), as well as stimulating social innovation (for example, new social behaviours based on accessibility versus ownership, sharing versus individual use, upgradeability and reparability versus replacement), while still answering people's needs and feeding economic development. From this perspective, sustainable solutions do not necessarily imply the generation of new high-tech devices, but they can propose a different use (or re-use) of the available ones. With these interventions, design activities cannot rely on a fixed and static formula. In contrast to incremental innovation, there is still an ongoing discussion with regard to radical innovation, concerning 'how' and 'when' design can contribute to the business innovation process. Nevertheless, the approach already in place within Philips Design is quite consistent. Design activities here adopt a holistic approach that combines knowledge about:

• **new and emerging longer-term personal and social values** (for example, ethics, balance, responsibility, care, belonging), in line with more sustainable lifestyles
• **potentially more environmentally friendly technologies** (for example, upgradeable and updateable digital platforms, solar and human power technologies)
• **new business and marketing strategies** (for example, leasing, renting, pay-per-use practices and different forms of access to digital services).

This approach is part of a more structured process for concept creation and is called the 'High Design Process'. In the 'High Design Process', designers operate in a multidisciplinary team of sociologists, psychologists, anthropologists, environmental scientists, trends analysts, and technology / business experts. The team works together at everything from envisioning scenarios to the modelling phases. The emphasis in sustainability-related projects is on the search for solutions able to offer *intangible benefits* and *functionality* over *products*, which means that the design process is no longer reduced only to the definition of physical artefacts (a new product or family of products). Extending its boundaries, design lays a strong emphasis on service design activities, and on the introduction of new, multi-functional user interfaces to replace single, mono-functional, devices. This implies a change from a traditional way of creating value through physical products to the experimentation of new methods and tools that deal with the shape of relationships in a spatial, temporal and socio-cultural context.

The ambition is to define flexible practices that envision new value propositions able to enhance personal, social and environmental well-being, increasingly contributing to the triple bottom line, and indicating to the business new directions towards a 'preferable' future.
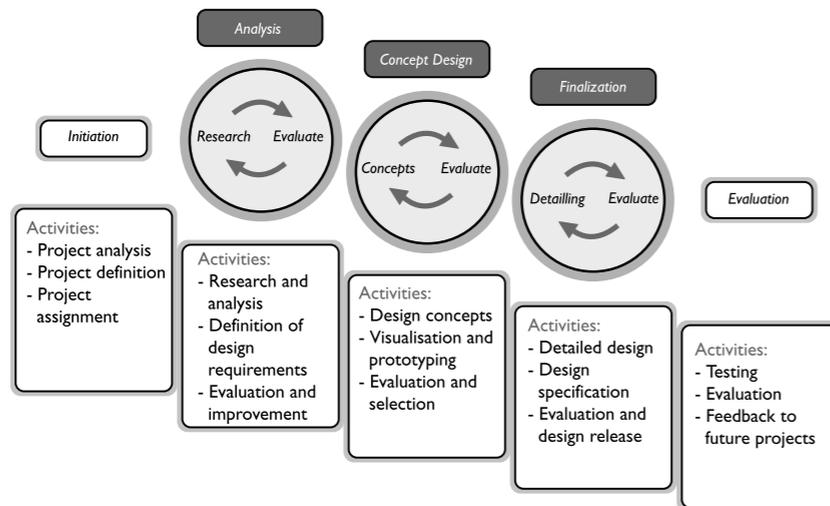
Figure 12 - The High Design Process.
Description of the phases of the High Design Process in use in Philips Design. *After*: Philips Design, 1998.

6.3 Some thoughts about the contribution of this study

This study has been carried out with the deliberate intent of developing a methodological design approach, and appropriate tools, able to enrich the High Design Process of Philips Design in the execution of 'radical' innovation projects.

The ambition was to support Philips Design in moving beyond eco-design - as a "*product-oriented design process aimed to minimize the environmental impact of the product along its material life-cycle™*" (Rocchi, 2003), towards design-for-sustainability as a "*solution-oriented design process aimed to stimulate technological change and social innovation, in order to contain the use of environmental resources and enhances people quality of life, today and in the future™*" (Ibid).

The value claimed with the experimental part of this study concerns the definition of a path for:

• the creation of a sustainability mindset, and the introduction of triple bottom line design guidelines since the beginning of the creative process, so as to influence the nature of value propositions that are going to be developed in strategic design projects
• the inclusion of real-life user information in different phases of the concept creation, to envision 'effective' *product-service systems* (*product-service systems* able to satisfy what people really need and want) rather than just 'eco-efficient' products
• the encouragement of cross-fertilization activities among different Philips Business Units and/or Product Divisions, and external partners, to co-create competitive solutions able to better answer specific local requirements.

7 Workshop A: people with reduced mobility and personal well-being

Chapter 7 offers a generic description of the design process adopted - specifically the scenarios envisioned - with the first creative workshop carried out in Philips around the theme of *product-service systems* in the arena of digital home networking.

It addresses issues such as partnership building, business construction of new value propositions, sustainability benefits evaluation, and the definition of a possible way of communicating design scenarios.

7.1 Setting the scene: scope and outcome

By following the research agenda of issues defined in the introduction of the previous chapter, in order to explore a practical path to design competitive and sustainable product-service systems, in May 1999, a two day concept generation workshop was organized at Philips Design. Chosen as topics for which new concepts relevant to Philips' business should be generated were:

• *healthcare and virtual medical assistance*
• *information and lifelong learning.*

These topics were selected chiefly because they are part of the key Philips positioning areas used to address sustainability-related projects. Indeed, by their nature (for ethical and social reasons), they are important components of personal well-being[47] conditions, and more broadly, valuable parameters considered to define the quality of life in advanced societies. Furthermore, from a business perspective, expenditures on health monitoring / prevention practices, and learning via Internet are rising trends that are opening new market opportunities in the field of self-monitoring applications and personal digital devices for information gathering.

The objective of this workshop was to generate economically, socially and environmentally valuable ideas and concepts. The starting point was that Philips could achieve this objective by leveraging on new join-ventures and alliances with service providers, content providers and application developers who would, together, be able to deliver more sustainable and personalized solutions to end-users. The construction of partnerships was therefore

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[47] With the terminology 'personal well-being' is meant a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (RIVM, 1995).

considered a key condition necessary to the supply of *customized* and *localized product-service systems*, by combining fixed and variable networked devices, connections and services. Within this framework, the generation of competitive value was related to two main aspects: the possibility of a better way of reaching the market via the use of a flexible product-service package able to target specific users' needs and wants; and the possibility of claiming the delivery of socially valuable solutions with increased eco-efficiency. This last aspect was linked to the exploitation of some potentialities of digital technology and ICT in terms of:

• the miniaturization of components, reducing product volume and minimizing the use of materials
• the replacement of product performances with digital service performances
• the stimulation of social relationships at local scale by the use of virtual networks
• the valorisation of the use of local available infrastructures and human resources
• the enhancement of patterns of use versus patterns of consumption.

People with reduced mobility were considered as a possible target. This category included all kinds of people having either temporary or permanent physical difficulties in moving, such as certain elderly people, pregnant women, people in wheel-chairs, convalescents, and chronically ill patients (for example, diabetic and cardiovascular patients). Concepts and thoughts were outlined to empower users in their daily activities specifically related to the topics selected for this exploration: *healthcare and virtual medical assistance*; *information and lifelong learning*.

The results included new ideas for *product-service systems* described in terms of their product and services components, new actors for implementations, and potential economic, environmental and social benefits.

7.1.1 Structure of the creative process

Workshop participants included product, interaction and web designers, trends analysts, environmental scientists, business representatives from a specific Philips Product Division (Consumer Electronics), Philips Research representatives and experts in the field of sustainability from two European universities (Helsinki School of Economics and Politecnico di Milano). To create a better common understanding of the scope of the workshop among the thirteen participants (see Appendix 1), some background information on the topics of exploration, as well as a workshop briefing, was sent to them before the event. Basic preparation was, therefore, required from their side.

The background document provided content concerning the current product-service market orientation, its economic and environmental / social drivers, and some business examples. The briefing document introduced the objective of the workshop, its focus areas, model of exploration and expected results. The event itself was organized to combine knowledge transfer sessions taking place through plenary presentations and discussion, with working groups' sessions for ideas generation, articulation and visualization (see Appendix 1).

The **first part** of the workshop tried to bring the participants to the same level of understanding of:

• the meaning of *product-service systems* (product and service features, differences, similarities, emerging market trends)
• the importance of including aspects of sustainability in the development of new value propositions (drivers, triple bottom line approach, business and societal benefits in the short and long-term perspective)
• *healthcare and virtual medical assistance* and *information and lifelong learning* (relevance to the business, the market and people, and technological angle of exploration).

Universities' representatives, Philips Design researchers and technology experts from the business provided knowledge at this early stage.

During the **second part** of the event, the focus was on understanding the target groups. Participants were split into two groups of six - to deal with, respectively, *healthcare and virtual medical assistance* or *information and lifelong learning* - to start the discussion around specific end-users profiles and their individual explicit and hidden needs. Trigger information about the end-users was communicated with posters, which described profiles built upon internal knowledge extracted from previous Philips Design researches into the two topics of investigation. The users, and the manifestations of their individual needs, were represented in hypothetical scenarios of everyday life: specific physical spaces and socio-cultural conditions (contexts). Each group, in smaller teams that mixed participants with different competencies, brainstormed this information to work out possible individual requirements for each user-profile[48], and to identify areas of intervention to be used during the concept creation phase. Information collected at this stage was used to outline the weaknesses of current available business answers and consequent new emerging market opportunities areas.

The **last part** of the workshop was reserved entirely for the exploration of new concepts of *product-service systems*, their articulation and rough visualization. Starting from the outcome of the previous session, the teams were asked to think about new solutions and necessary actors for their implementation, by outlining the:

• product and service components, and how they should be mixed to answer people's requirements
• roles and responsibilities of the hypothetical actors involved in the value network

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[48] Concerning *healthcare and virtual medical assistance*, end-user profiles taken into account included, for example, a pregnant woman at home, an elderly person living in an isolated area, and a heart patient living alone. Concerning *information and lifelong learning*, end-user profiles considered situations such as a person in a wheel-chair and his / her need for shopping, a full time worker studying at home in the evening, and an immigrant woman with three children learning another language at home.

- economic, environmental and social benefits that the new value propositions could potentially bring.

A template was distributed to describe in words and graphics all the components of the new emerging concepts. The concepts were then reviewed and discussed in the plenary session to select the most promising ones for their further shaping. Designers worked them out through storyboards to be able to explain the service performance and the end-users benefits.

At the end of the workshop, the results were shared with the entire group to collect feedback for further improvements. In terms of outcome, the most promising concepts were mainly related to the creation of new virtual social communities / self-help groups, and to the implementation of health monitoring practices, and the constant exchange of information between users and specific healthcare actors. All the initial sketches and the most promising concepts were collected in a booklet for internal distribution and evaluation.

7.2 Concepts assessment and selection

The twenty-eight concepts produced have been subjected to a qualitative assessment validated by interviews with internal experts. The assessment has been based on the criteria of technological and economic feasibility, potential customisation, and parameters of sustainability (see Appendix 1).

Concerning the **technological feasibility** of the concepts, considerations have been formulated in terms of the availability of technology in the short-medium time scale, the complexity of implementation and the availability of in-house competence. The **economic feasibility** has been related to the criteria of market attractiveness (the perceived value in terms of degree to which the concepts offer clear benefits to the end-user in comparison to already existing products / solutions) and business opportunities (Philips' competitive advantage and commercial fit). The **potential customisation** of the concepts was related to their ability to satisfy specific individual needs and requirements. The **sustainability's parameters** were related mainly to an evaluation using a system perspective, one that considered: environmental aspects (optimisation of the use of existing infrastructure / resources at community level, and reduction of transportation activities) and social aspects (valorisation of local human resources, generation of new social networks / knowledge, and improvement of well-being conditions).

As a result of the filtering process, three final concepts were selected for the development of more structured design scenarios and their underpinning business logics. These concepts have been titled *video-phone circle*, *mirror of well-being* and *well being-detector.*
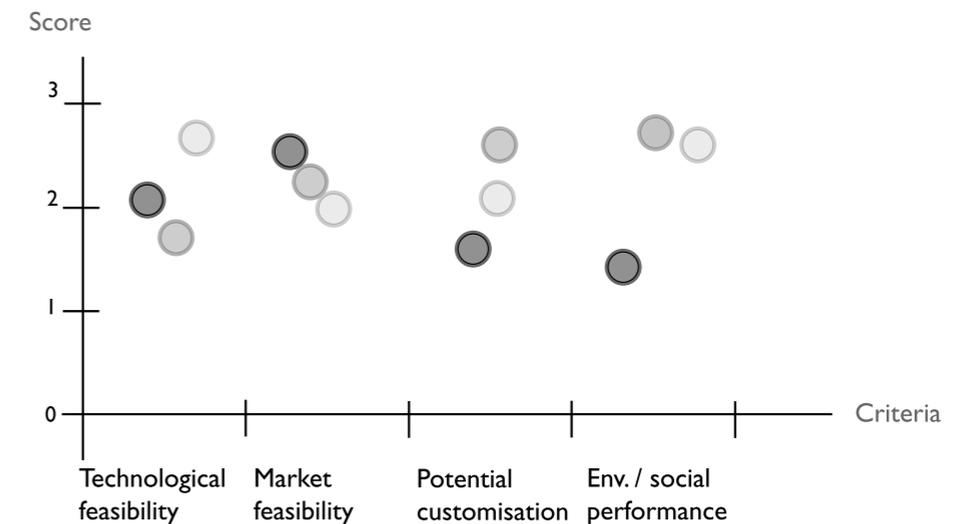

Figure 13 - Visualization of the outcome of the filtering process adopted to select the most promising concepts (workshop A).

The filtering process ranked the concepts in terms of technological and economic feasibility, potential customisation and aspects of sustainability. The scoring was done on a scale of 1-3 (low opportunity = 1, high opportunity = 3). The results represent an average calculated among the partial results achieved within the specific ranked criteria (see Appendix 1).

7.3 Framing the business case

To illustrate the potential added-value of the *product-service systems* generated in the workshop to a broader business community (either within or outside Philips), some further work was carried out by designers around the most promising concepts. The three priority concepts that emerged from the assessment (in relation to the topics of *healthcare and virtual medical assistance*) were articulated in more precise business value propositions. The aspects that were stretched and expanded in this re-elaboration included the specification of:

- concept features (solution elements), in terms of hardware and services, both standardized and customized to specific end-user's requirements
- the business rationale underpinning the solutions, explained through links among actors, their potential roles, benefits and hypothetical financial flows
- the environmental and social values of the solutions in relation to their overall performance at system scale (macro socio-cultural and physical context of application).

By touching upon all these aspects, a complete description was produced for the *video-phone circle*, *mirror of well-being* and *well being-detector* concepts. Their overview was then delivered to the business for possible follow-ups with the identified potential partners.

7.3.1. *Video-phone circle*

This concept proposes the creation of a social assistance network by an on-line video-phone connection that enables people with reduced mobility (for example, pregnant women) to come into contact with each other to benefit from reciprocal help. The core of this digital *product-service system* is the facilitation of a daily monitoring of the people that join the virtual community, and the provision of assistance via an on-line medical consultancy. The network could be activated deliberately at a certain time of the day, connecting each participant through a videoconference kit attached to the television set. A general overview of the group and a vocal interaction would be enabled and, if someone was found to be missing, it would be possible to leave a message. Participants could talk about their health problems, address questions, give suggestions, comfort each other (by multiple visual interactions) and consult the doctor or the para-medical staff on specific issues.

Solution elements
• Product components
  - Display screen (TV), specific remote control, set-top-box ('intelligent' box that enables the network to function) or Internet card added to analogue TV.
  - Videoconference kit: video camera; speaker.

• Service components
  - Technical services: software for virtual / on-screen interfaces (starting from the Philips platform software); infrastructure services, such as Internet connection and telephone line (telephone line is preferred to cable or ISDN solutions because it is relatively cheap and broadly diffused); installation, training, maintenance, up-grading of services (starting from the Philips smart connect service platform).
  - Social services: medical assistance; community assistance.
  - Financial services: monthly rental payment.

Storyboard 1 - *Video-phone circle* design scenario.

The user's interaction with the solution in a specific situation, at a particular time. *Source*: Philips Design (© Royal Philips Electronics), 1999.

Video-phone Circle

Social assistance network created by on-line video-phone connection that allow people in condition of reduced mobility (e.g. elderly people, pregnant women, etc.) to support each other. The digital product-services mix at the basis of this concept facilitates a daily monitoring of people that join the virtual community, assisting them by an on-line medical consultant.

The network could be activated deliberately at a certain time of the day, connecting you and other participants through a video-conference kit applied to the television set. A general overview of the group and a vocal interaction is allowed. If someone is missing, it is possible to leave a message. You can talk about your health problems, address questions, give suggestions, receive comfort (by a multiple visual interaction) and consult the doctor or the para-medical staff on specific issues.

5. The day after, qualified personnel of Telecom arrive for the installation

6. The technician provides for a quick training course on the use of the devices.


1. Patty is pregnant and she goes to the hospital for a check up.
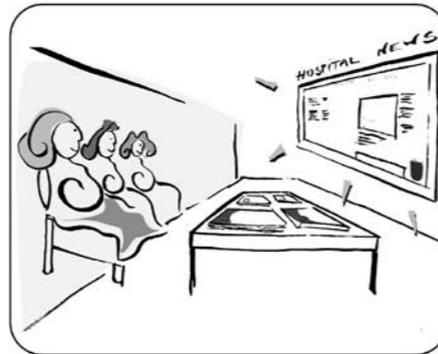
2. Awaiting for the doctor, she discovers a new video conferencing service for pregnant women.

7. The same day, at 5 o'clock she is connected to the self-help group of support

8. And she asks the doctor why is she always so hungry?!
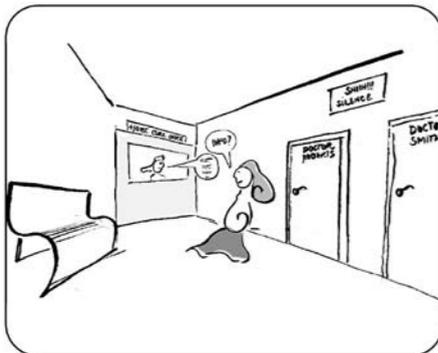
3. She goes to the home care office to ask for some more information
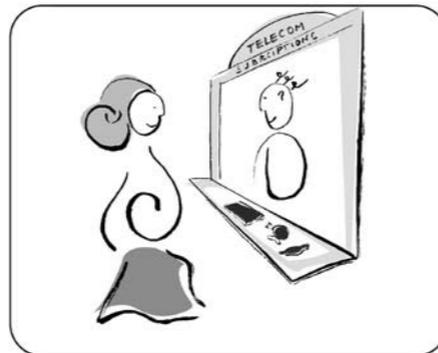
4. On the way back home she stops at the Telecom to ask for the subscription
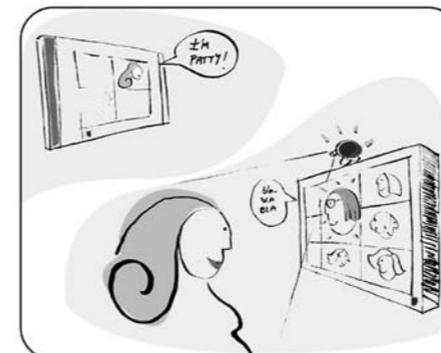
9. The doctor answers her and refers her to the group of women in the same phase of pregnancy
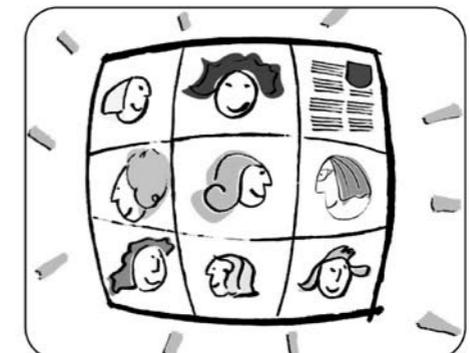
10. The online chat ....

Business rationale

In order to produce, market and communicate the *video-phone circle*, a partnership of participants is required. Agreements must be clearly set up to define the roles and responsibilities of the actors involved in the promotion of this *product-service system*.

Hypothetically, Philips can be considered the tools provider[49] for the end-users and the doctor or para-medical staff. For distribution tasks, the Telephone Company could play a key role, even more so than traditional consumer electronics retailers. Indeed, this actor has relevant experience in the market of telecommunication products and the necessary qualified personnel to deal with the installation, maintenance and up-grading operations. Furthermore, it usually has the availability of a commercial framework that allows for the renting of its products, to facilitate their access even if only for a temporary use. Eventual content providers - interested in providing advertising in the network - could cover the cost of the Internet subscription necessary to make the *product-service system* work. This could, for example, include local baby-staff hiring shops, which could use such a channel to promote their activities (not always known) to pregnant women. Pharmaceutical companies could advertise specific new medicines or therapies, and special groups of support could offer baby-sitting services.

Concerning the communication strategy, private or public medical insurance companies could assume a promotional role, together with the doctors: they could easily inform their customers of the benefits provided by this initiative.

- Philips' business opportunities
  - Implementation of actual market shares of videoconference kits and set-top-boxes (profit generated by tools).
  - New market opportunities related to the introduction of interactive material and non-material interfaces and new families' software (Philips as a browser) to satisfy latent social demands (competitiveness by exclusive services).
  - Increasing brand's reputation and equity generated by screen presence: Philips as promoter of social values.
  - Intellectual property rights.
  - Creation of customer loyalty and opportunity for data mining generation to anticipate users needs (potential database on end-users for a better understanding of patterns of consumption).

- Philips business units potentially involved (Consumer Electronics Product Division)
  - INC - Interconnectivity and Communication unit.
  - Video communication systems unit.
  - Home Networking Group, TV unit.

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[49] The company is able to provide conference kits, set-top-boxes, appropriate remote controls and software for virtual / on-screen interfaces.

- Benefits for end-users
  - Monitoring their state of health and sustaining their psychological well-being with the aid of a self-help group (maintain / create relationships with friends, people with similar health conditions).
  - Receive daily virtual medical assistance if required.
  - Sharing / up-dating of knowledge concerning healthcare (prevention practices, information on appropriate therapies and treatments, etc).

- Benefits for other actors
  - Infrastructure providers: Internet provider earns revenue on subscription for the service; telephone company earns revenue for the use of the telephone line and revenue for the distribution channel.
  - Support actors: private medical insurance company and/or social public sector benefit from a decrease of medical expenses by encouraging prevention practices.
  - Content providers: pharmaceutical companies, publishers, baby-staff hiring shops, etc. potentially gain an increase in their activities by new channels of promotion and distribution (e-commerce); medical / para-medical staff gain loyalty with their patients by offering richer services, while experiencing more flexible time management and an opportunity to build an electronic patients' database.

Sustainability related value

- Socio-cultural value
  - Reinforcement of social links by the creation of virtual communities.
  - Valorisation of existing social resources / knowledge.
  - Increase of mental and physical well-being conditions.

- Environmental value
  - Potential reduction of people's mobility needs and of the environmental impact related to their transportation activities.
  - Optimal use of existing physical resources / infrastructures.
  - Sharing of product components by renting practices (optimisation of product use).

Further concept articulation

An extension of the partnership at the basis of the *video-phone circle* concept could be applied to develop complementary services. Shown below are a couple of examples.

- *Easy shopping.* Using the same technological platform, a digital network could be created among the end-users - a supermarket and a train-taxi organization - to facilitate daily shopping for food. Such a concept would ensure that people with reduced mobility are assisted either with a pooling transport service organized by the supermarket, or by a home delivery service. A virtual interface would enable the user to see the food available, to be informed about special offers of the week, to make orders and, if desired, arrange a trip.

• *Easy moving.* Using the same technological platform, a digital network could be created among the end-user, private and public transport organizations and volunteer associations of citizens, to facilitate trips at different levels. Such a concept would ensure that people with reduced mobility would be supported in their moving by receiving information on the best routes to follow (avoiding architectonic barriers, difficult connections, crowded transport lines, etc.) and eventually receive physical assistance during the trip. A virtual interface would enable the end-user to interact with the network to obtain the needed information, to book and buy the ticket, and to make contacts with the volunteer support groups.
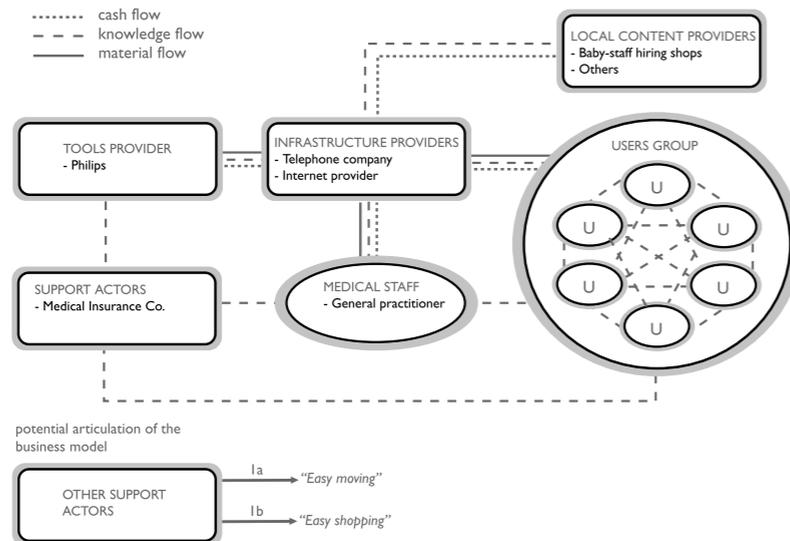

Figure 14 - *Video-phone circle* business rationale - actors and their relations.

Visualization of the links among the main solution's promoters, in terms of knowledge / information, material components and money flows.

7.3.2 *Mirror of well-being*

This concept proposes a 'mirror' enhancing self-check of people's health. It is a display screen equipped with specific electronic devices (for example, weighing scale, heart beat, and blood pressure / breath analysers) to enable a daily monitoring of the user's health. It works on the basis of different levels of information personalized in relation to the user-specific profile. When the 'intelligent' system is switched on, it reminds the user of the doctors' recommendations: the physical exercises that he / she should do every morning, the particular diet or therapy that he / she should follow and the right amount of medicine that he / she should take. In the next stage, the system monitors the state of the user's health, records and compares the data with his / her characteristics and sends back either reassuring messages or warning signals. At a third level, it transmits the detected information directly to the database of the personal doctor and contacts him if necessary, or, as an alternative, enables the patient to download the data in his / her personal smart card.

Storyboard 2 - *Mirror of well-being* design scenario.

The user's interaction with the solution in a specific situation, at a particular time. *Source*: Philips Design (© Royal Philips Electronics), 1999.

1. The medical insurance co. sends its customers a brochure on the new health monitoring kit marketed by Philips

2 John receives the brochure and a premium as an incentive to subscribe for the kit

3. He goes to the pharmacy to sign the contract
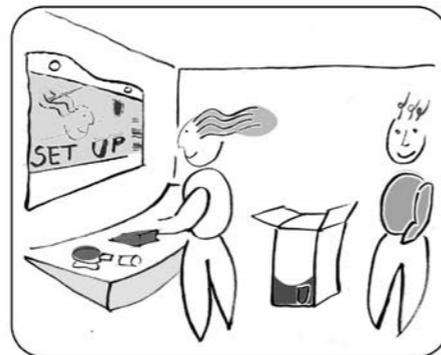
4 Two days later, third party maintenance come to install and set the devices in relation to his health profile as provided by the G.P. data bank

5. He can start his daily check, which is the first level of performance

6. The second step of performance is the self monitoring of health conditions. In this example, John checks his level of glucose in the blood

7. Two weeks later, as John is checking his blood pressure, the system sends him an alarm signal

8. At the same time John's G.P. receives a warning message
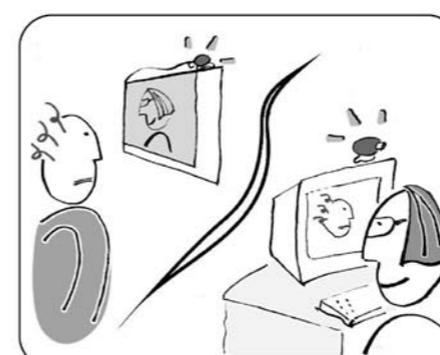
9. After an online chat, the doctor prescribes another therapy to John

10. One year later John decides to up-grade his kit with a new tool: the breath analyser

Solution elements
• Product components
  - Display screen and set-top-box ('intelligent' box to process and record the data and allow networking).
  - Heart beat, blood pressure / breath analysers, weighing scale, etc.
  - Videoconference kit: video camera, speaker.
  - Database technology for the doctor.
  Possible variations include
  - Smart card (to download personal data).
  - Input / output devices.

• Service components
  - Technical services: digital services such as software for virtual / on-screen interfaces; infrastructure services such as Internet connection, telephone line (telephone line is preferred here to cable or ISDN solutions because it is relatively cheap and broadly diffused); installation, customisation, training, maintenance, and possible up-grading services (starting from Philips smart connect service platform).
  - Social services: medical assistance.
  - Financial services: monthly payment by renting / leasing fees.

Business rationale
Like the *video-phone circle*, a partnership of participants is required to produce, market and communicate this concept. Agreements must be set up clearly to define the roles and responsibilities of the manufacturer, the infrastructure providers, the doctor, the end-user and the support partners.

Within the field of such a *product-service system*, Philips can be considered the major provider of tools[50] to end-users. Home care shops or pharmacies, or alternative shop-in-shops, could cover tasks of distribution, since these channels have the necessary credibility to market health care devices rather than Philips' traditional consumer electronics retailers. In this role, they could be supported by particular 'third party maintenance' actors who, on request, are able to provide for the installation, maintenance and up-grading of digital devices, facilitate customisation (by recording an end-user's profile information), and quickly train the customers. Leasing and renting strategies could be adopted, either to make the solution more economically affordable, or to facilitate its access for temporary use.

Private or public medical insurance companies could communicate the initiative, together with the doctors that could take part in the partnership. The medical insurance companies

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[50] The company provides display screens, health monitoring devices, set-top-boxes, conference kits, input / output devices, smart cards and software.

could also assume an active role in the market implementation of this *product-service system*, by offering a premium for its subscription to their customers (the amount of the premium could be used to cover the cost of the Internet fee).

• Philips' business opportunities
  - Implementation of actual market shares of conference kits and set-top-boxes (profit generated by products).
  - New market opportunities related to the introduction of new electronic devices, interactive material and non-material interfaces and families' software (Philips as a browser) to satisfy latent social demands (competitiveness by exclusive services and products).
  - Increase of the brand's reputation: Philips as promoter of well-being conditions and better quality of life.
  - Intellectual property rights.
  - Creation of customer loyalty and opportunity for data mining generation to anticipate end-user's needs (database on end-users for a better understanding of patterns of consumption).

• Philips business units potentially involved
  - Philips Domestic Appliances Product Division: personal healthcare unit.
  - Consumer Electronics Product Division: TV unit.

• Benefits for end-users
  - Daily monitoring of his / her health directly at home (no need to travel for regular check-ups).
  - Virtual medical assistance, if necessary.
  - Avoidance of hospital stays.
  - Receive help during personalized diet and therapy (for example, take exact quantities of food and medicines required by the body).

• Benefits for other actors
  - Infrastructure providers: Internet provider earns revenue on subscriptions to the service; telephone company earns revenue on the use of the telephone line.
  - Private or public medical insurance company potentially decreases medical expenses by the stimulation of prevention practices (prevent admission of the patients to hospital) and of home care therapies (reducing the time that patients stay in hospital).
  - Home care shops, shop-in-shops or pharmacies earn revenue on the distribution channel.
  - TPM (third party maintenance) generates revenue through installation and customisation services.
  - Medical / para-medical staff can gain patients' loyalty by offering richer services, while experiencing more flexible time management and an opportunity to build an electronic patients' database.

Sustainability related value
- Socio-cultural value
  - Increase of mental and physical well-being conditions.
- Environmental value
  - Potential reduction of people's mobility needs and of the environmental impact related to their transportation activities.
  - Optimal use of existing physical resources / infrastructures.
  - Minimum consumption of medicines and optimal consumption of food (the right amount in relation to the specific user's profile).
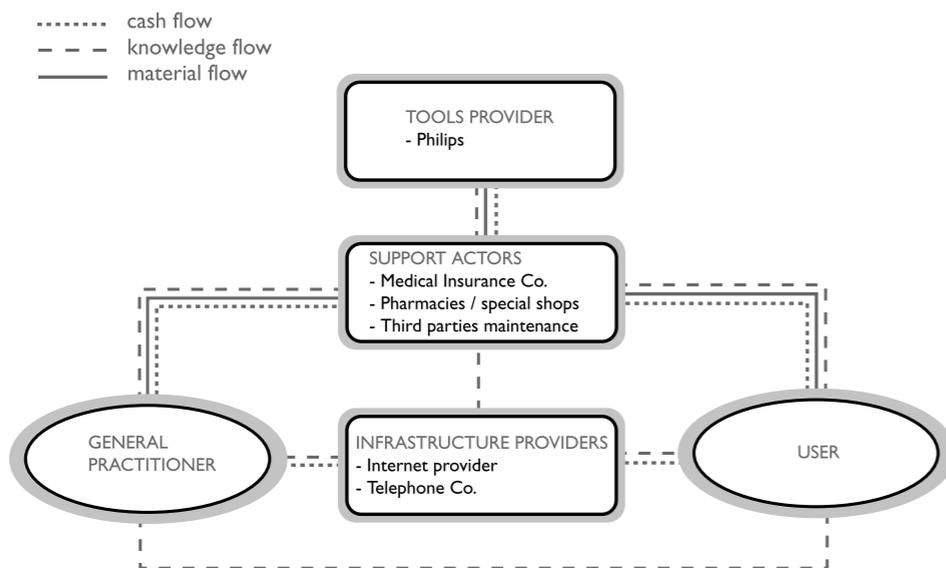
Figure 15 - *Mirror of well-being* business rationale - actors and their relations.

Visualization of the links among the main solution's promoters, in terms of knowledge / information, material components and money flows.

7.3.3. *Well-being detector*

This concept is a safety on-line network created by a 'health-detector' connected to the user's family / neighbours and to the local emergency medical centre. It proposes a mix of products and services comprising a central system and a wearable device able to detect whether the user has had a heart attack or lost consciousness and, in such a case, to send warning signals.

The network is activated automatically. If the system detects a dangerous change in the user's heartbeat (for example, coronary or heart failure), it sends a signal to him / her. If there is no reaction, it transmits a request for help (telephone call) to the selected contacts: as an option the medical emergency centre could also be able to locate the user outside the home, thanks to the use of a global positioning system (GPS) or GSM technology.

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Storyboard 3 - *Well-being detector* design scenario.

The user's interaction with the solution in a specific situation, at a particular time. *Source*: Philips Design (© Royal Philips Electronics), 1999.

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1. Going to the hospital Patty discovers a new device to monitor constantly her heart beat

2 She goes immediately to the home care shop to subscribe to this offer-system

3. She rents the device and asks for its installation

4 Trusted third parties maintenance come to set up a central system recording the telephone numbers of her neighbours and the local hospital to contact in case of an emergency

5. The hospital encloses the address of Patty in its database
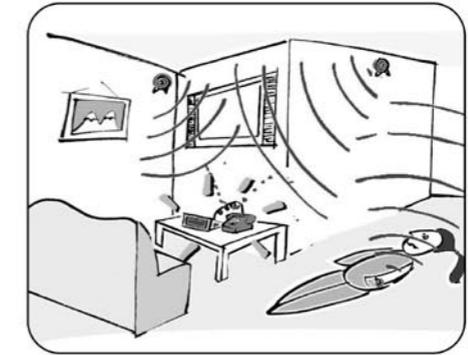
6. Six months later the system detects that there is something wrong and asks for feedback from Patty. Patty does not respond....

7. The central system attempts to contact Patty's neighbour without success. She does not respond either.....
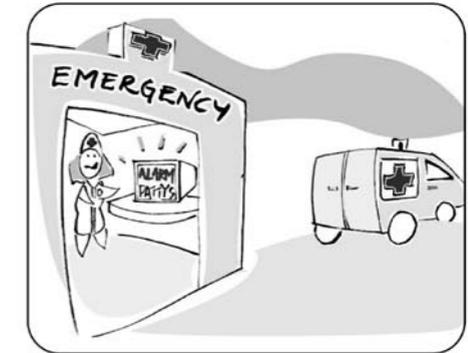
8. The local emergency medical centre is therefore contacted

9. Immediately an ambulance is sent to Patty's home

10. Luckely to Patty, the ambulance is just in time and the hospital is able to save Patty's life.

Solution elements
- Product components
  - Set-top-box and sensors (the central system is equipped with an 'intelligent' box and sensors to receive, process and record the data).
  - Wearable devices for sensing and transmitting warnings, and other related user interfaces.
  - Wearable connection components (for example, radio frequency) to download the data. Possible variations include
  - GPS / GSM technology and tag to locate the user when she / he is not at home.

- Service components
  - Technical services: software; infrastructure services such as telephone line; installation, customisation, maintenance.
  - Social services: emergency medical assistance; family / neighbours assistance.
  - Financial services: monthly rental payment.

Business rationale
The partnership of participants required for the promotion of the *well-being detector* involves Philips, pharmacies or home care shops, TPM (third party maintenance) operators, friends or neighbours and local emergency medical centres to provide assistance.

For this concept, Philips can be considered the main provider of tools[51] to end-users. Pharmacies or home care shops could be in charge for the distribution of the solution, since they have the credibility in marketing health care devices and are often willing to apply rental practices to cover people's temporary health monitoring needs. Third party maintenance actors could assume specific installation and customisation tasks. Besides covering fundamental operative assistance functions, hospitals and assistance medical centres could provide for communication tasks (supported also by friends or neighbours of the direct beneficiary of the solution).

- Philips' business opportunities
  - New market opportunities related to the introduction of new electronic devices and new families of software to satisfy a social latent demand.
  - Increase of the brand's reputation: Philips as promoter of personal well-being.
  - Intellectual property rights.

- Philips business units potentially involved
  - Philips Domestic Appliances Product Division: personal healthcare unit.
  - Philips Research.
  - Wearable devices group.

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[51] The company supplies set-top-boxes, sensors, software, wearable devices for monitoring and warning.

- Benefits for end-users
  - Feeling safe.
  - 24 hour daily virtual medical monitoring.

- Benefits for other actors
  - Infrastructure providers: telephone company earns revenue on the use of its telephone line.
  - Support actors: pharmacies or home care shops earn revenue on the distribution channel; TPM (third party maintenance) earns revenue on the installation and maintenance services; family / neighbours feel that they are part of an assistance network; local emergency medical centres can improve their service efficiency.

Sustainability related value
- Socio-cultural value
  - Reinforcement of social links.
  - Valorisation of existing social resources.
  - Increase of mental well-being conditions.

- Environmental value
  - Potential reduction of people's mobility needs and of the environmental impact related to their transportation activities.
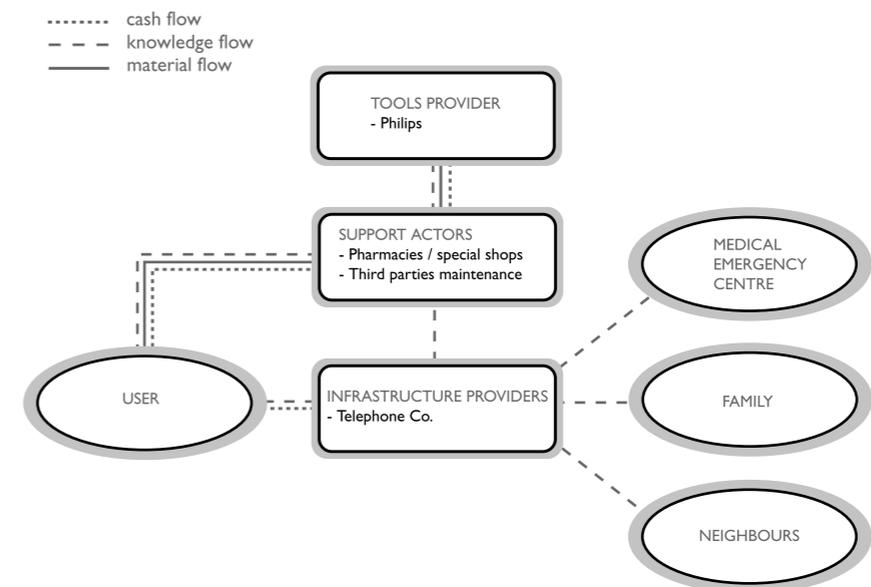

Figure 16 - *Well-being detector* business rationale - actors and their relations.

Visualization of the links among the main solution's promoters, in terms of knowledge / information, material components and money flows.

7.4 Concept architecture: open systems

The new business value propositions hypothesized in the three design scenarios described above can be viewed as open (*product-service*) *systems*. They are essentially based on a flexible combination of digital devices and interfaces with software components, online services and services of different nature able to add an exclusive value to the offer. To be more precise, they can be deconstructed into:

- a basic offer, as a standard package of fundamental hardware and services creating networking conditions (for example, set-top-boxes, Internet connections and primary software for communication)
- a flexible offer, as a package of additional devices, interfaces and services, which customize the basic offer to suit particular users' requirements.

In many cases, the basic offer provides for standard technologies produced by industrial global stakeholders, while the flexible offer requires a contribution from local actors. The *product-service system* resulting from this match can grow over time according to changes in users' requirements, by a variation in the flexible part of the system.
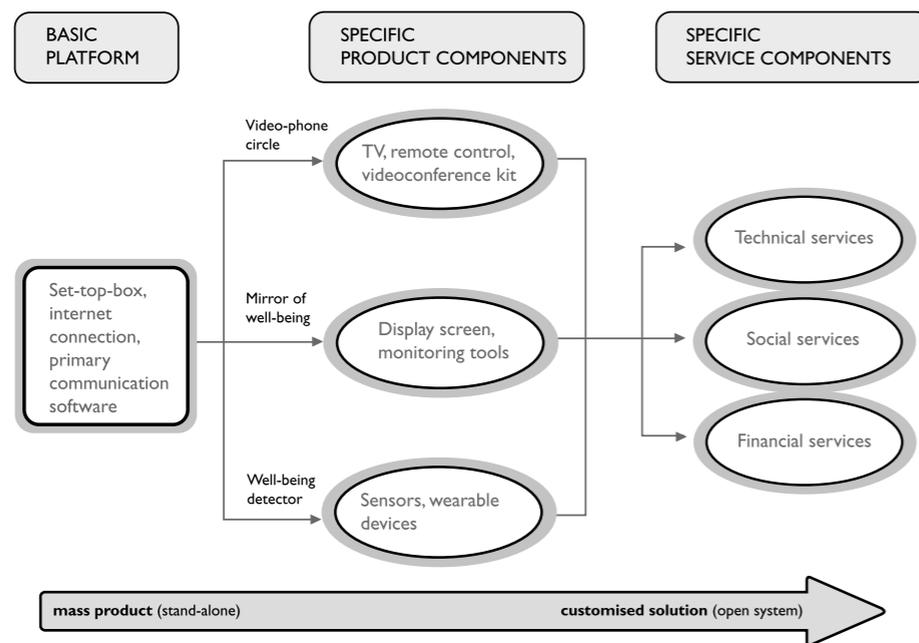
Figure 17 - Concept architecture.

Deconstruction of the *video-phone circle*, *mirror of well-being* and *well-being detector* concepts. The concepts are here divided into basic and flexible platforms. The basic platform is fixed for all the concepts, while the flexible platform varies in relation to specific users' needs and requirements over time and space.

7.5 Evaluating the process: some lessons

A few weaknesses can be pointed out when looking back at the process carried out in this workshop. The first, and the most visible one, relates to the difficulty encountered in creating a common mindset around 'sustainability' among the workshop participants in the short time available. The two hour dialog on the subject that took place during the first part of the event was a necessary, but not sufficient, condition to bringing participants to the same level of understanding: discrepancies between primary concerns on environmental issues and the triple bottom line challenge limited the speed of work on several occasions. In addition, appropriate sustainability-related tools for the evaluation of environmental and social potentialities of the concept under development - and therefore to steer subsequent design choices - were missed at different steps of the process.

Another point deserving attention concerns the multidisciplinary team. Mixing and matching designers, researchers, technology experts and business people from the very beginning of the creative process was certainly of great value when looking at the richness of the concepts that emerged. Nevertheless, involving them in an equal 'power-game' at each step of the process was of critical impact in terms of workshop facilitation. The creative flow was often interrupted by intensive discussions that, in many cases, should have been addressed at a later stage of the process (for example, in the concept assessment phase). A pre-defined leader for each session, and a better allocation of time according to expertise, would most probably have benefited the overall workshop.

Room for improvements relates also to the way of bringing information about users' needs into the discussion. Representations of users' needs via the illustration of hypothetical user's profiles were valuable tools for triggering participants' minds and stimulating interesting dialogs about user reactions and behaviours when faced with certain issues. However, the information delivered was quite generic in comparison to the specificity of the contexts identified for the generation of new solutions. Therefore, workshop participants experienced some trouble in diving into real life issues concerning particular target groups.

Finally, it should also be said that the scenarios elaborated after the workshop became powerful instruments in starting the conversation with internal business participants (from various Philips Product Divisions and / or Business Groups), and potential external partners needed to bring the new value propositions to the market. However, since these participants were not involved in the early stage of the value creation process (concepts creation workshop), this led to the lack of a common solid vision, and difficulties were encountered in moving forward the phase of new solutions development.

8 Workshop B: people with reduced access to healthy food

This chapter describes generically the design process adopted, and specifically the scenarios envisioned, with the second creative workshop carried out in Philips around the theme of *product-service systems* in the arena of digital networking, both in the domestic and public domain. The process described here intends to capitalize on the lessons learned during the previous event of 1999.

As did Chapter 7, so also does Chapter 8 address content issues such as partnership building, business construction of new value propositions, sustainability benefits evaluation, and the definition of a possible way of communicating design scenarios.

8.1 Setting the scene: scope and outcome

In November 2002, another concept generation workshop was organized at Philips Design. Considering the lessons extracted from the previous experience (not enough time and knowledge reserved to create a sustainability mindset among participants, slow concepts creation flow due to a chaotic and simultaneous involvement of all participants; use of abstract information on users' needs), and by bringing forward the research agenda of issues defined in the introduction of chapter 6, this second workshop tried to:

- provide a better integration of triple bottom line aspects into the overall approach, including the systematic use of design-for-sustainability criteria and filters along the process
- improve the co-design activities of the creative process, by bringing in the 'voice' of the potential partners in a more consistent, organized and structured manner
- enhance the creative flow, by defining better roles and responsibilities of the participants and their tasks
- involve directly the end-users in the shaping of the design concepts.

The specific workshop objective was to create ideas for new business value propositions in relation to the topic of *food shopping / delivery, preparation and consumption*, and *people with reduced access to healthy food*. This topic was selected for a couple of reasons. From a business perspective, people's expenditures on access to healthy food were found to be increasing in the European markets (opening new opportunities in this area). The specific focus on fragile categories of society (*people at reduced access to healthy food*) made it a relevant social topic in terms of improvements to many people's quality of life conditions. And last but not least, because the subject was already under investigation by a parallel project running in-house in

the field of *product-service systems*: Highly Customerized Solutions[52] (HiCS EC project).

In the attempt to generate meaningful concepts of *products-service systems* by taking personal, social and environmental values into account, three fundamental ingredients were considered in the process:

- a sustainability framework including triple bottom line general principles, design-orientation criteria and filters
- real-life user needs and wishes in relation to the everyday issues of access to food, manifested in specific physical spaces and socio-cultural conditions (contexts)
- competencies and knowledge of various industrial actors participating in the setting of the design briefing and in the brainstorming sessions.

The workshop, due to its complexity, required the involvement of a broad range of expertise - business participants, technology experts, product and interaction designers, user researchers, environmental scientists[53] - and a multidisciplinary approach at the base of any strategic design innovation project. The business and technology experts were taken from companies located in four different European countries[54]:

- Philips Lighting, with the New Business Development Unit and Philips Solar (a business unit in the market of solar energy systems)
- Philips Research, with an expert in Lighting Research on topics like 'cooking with light' and 'preservation of food with light'
- Whirlpool, a leading manufacturer and marketer of white home appliances
- Duni, a large company traditionally specializing in providing packaging for the food business, and currently working at providing complete solutions for their new and existing customers (including end-users)

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[52] By way of background information, this workshop was a simultaneous and complementary activity to the 'Highly Customerized Solutions' (HiCS) E.C. action-research project already mentioned in the first part of this study. The 'HiCS' project was inspired by the many issues raised during the Philips Design workshop on *product-service systems* held in 1999: how to build a partnership for new solutions development; how to research people's needs in specific contexts of their everyday life; how to define a common industrialised fix platform among the partners promoters; how to design industrialised but at the same time more sustainable solutions. 'HiCS', considering all these issues, has developed a partnerships-based business methodology for the creation of industrialized and context-specific solutions, missing by a certain extent design-for-sustainability design tools, and real users' participation. Philips Design, with this specific workshop, focused its particular attention on the design process by investigating a practical way of incorporating sustainability parameters and involving real users into the concept creation session.

[53] In contrast to the workshop that took place in 1999, on this occasion environmental scientists / sustainability experts were not represented by academics but only by professionals working in design and research centers (Philips Design and TNO).

[54] The majority of the participants were officially part of the 'HiCS' project consortium: Duni, TNO, Whirlpool, Trittico and Philips Design. (Partners of the consortium not physically present, such as Biologica - biological food chain retailer, and ACU – food NGO, were represented by the other HiCS participants). Philips Lighting and Philips Research joined the workshop for two reasons: to explore the potential contribution of lighting technologies related to food preservation, disinfection, warming / cooking (and their eventual combination with solar energy systems), in the overall new business value propositions of the HiCS consortium; to learn new ways (sustainability-driven) of creating value.

- TNO, a Dutch organization for applied scientific research working on the application of innovative technology in industry
- Trittico; a small and fast growing company offering complete and practical solutions within the area of the delivery of ready to (h)eat food.

Within this framework, the creation of competitive and sustainable value was linked to the belief that - to reach people's food-related needs and wants in a sustainable way - it is necessary to establish partnerships of global and local participants able to design, produce and deliver flexible and customisable solutions over time. By leveraging on the use of digital and smart technologies and ICT applications, the ambition was to envision solutions encouraging:

- digital access (to functions) and sharing usage patterns
- best use of local available infrastructures and human resources / knowledge
- efficient use of food available in the local areas
- ethical consumption.

People with reduced access to healthy food (due to context limitations and not so much to physical limitations) were considered as a possible target. This category included all kinds of people experiencing difficulties in accessing healthy, biological or ethnic food, including students living in shared housing, immigrants in foreign countries, people touring and camping, workers in remote areas, elderly people in care centres and in isolated homes, etc. Concepts were proposed and outlined to empower these categories of users in their daily activities, specifically as they related to the topic selected for this exploration: *food shopping / delivery, preparation and consumption*.

Results (from a total of 27 concepts) included new ideas of *product-service systems* described in their product and services components, actors for implementations, and potential economic, environmental and social value.

8.1.1 Structure of the creative process

The design process adopted for this workshop can be distinguished in three major phases: a pre-workshop phase designed to produce a common mindset among participants, and the creation of the content briefing; three days of working sessions for concept ideation and shaping; a follow-up phase for concepts articulation and communication.

During the **pre-workshop** phase, some preparatory work was required by the participants in order to exchange background information necessary to facilitate content alignment during the event. A preliminary document (pre-briefing) - was intended to define boundaries for concept exploration: this implied the collection and distribution of information and knowledge from and toward the partners. The emphasis here was on the specification of relevant market trends and target groups (quantitative data) to focus

the brainstorming sessions, and on an outline of the sustainability guiding principles faced today by the business. A second document - (briefing) prescribed: further preparation activities to be carried out by the business / technology experts and the researchers to package the knowledge intended to be shared during the workshop in as effective and communicable a manner as possible; further pre-reading material, especially concerning sustainability business drivers.

The **three-day workshop** for the creation of new concepts involved twenty participants at slightly different steps of the process (see Appendix II): seventeen researchers, designers and business / technology experts; three end-users. At this stage, the event was organized as a combination of knowledge transfer sessions taking place in plenary presentations and discussions, together with working groups' sessions for ideas generation and shaping (see Appendix II). The primary task of this phase was the creation of a consensus on the kind of sustainable *product-service systems* that should be generated during the brainstorming activities. Here, participants from companies were asked to give a presentation about their core business, their more visionary strategic intents, and their understanding of 'solutions' within the workshop philosophy (open *product-service systems* vs. finished and stand-alone products). The second fundamental task was the application of user's real life information extracted from a rich field research, to generate concepts and envision scenarios[55]: it started with an 'out-of-the-box' thinking exercise and continued during the description of the business rationale at the base of some emerging ideas. The third key task concerned the involvement of the users in the final part of the event, to record their definition of the features of pre-selected concepts.

The **follow-up phase for concepts articulation and communication** implied the consolidation of the outcomes of the creative sessions and their circulation among the industrial partners. At this stage, the record of the information covered different levels: compilation of a report recording all the ideas and sketches generated during the workshop; compilation of the general minutes of the workshop, including its evaluation; compilation of a report framing some business cases worked out from the most promising concepts. All the material was then distributed to the business for further evaluation, eventual concepts' enrichment or modification and - in the case of the 'HiCS' project consortium - for partnership reinforcement and actions for implementation.

8.2 Concepts assessment and selection
A total of twenty-seven ideas for possible *product-service systems* were generated. These ideas were **qualitatively assessed** by participants, in particular by the business and

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[55] Knowledge of people's needs and their problems concerning access to food in particular contexts (physical spaces and socio-cultural conditions where such needs are expressed) came from an extended field research carried out by Philips Design, and other partners, during a specific research module of the 'HiCS' EC project. Contexts related investigations took place in four European countries: The Netherlands, Italy, United Kingdom and Spain.

technology experts, in a plenary during half-way of the event. The evaluation process was based on criteria of business value, user satisfaction and sustainability performance. Concerning the **business value**, ideas combining considerations of technological feasibility in the short-medium period, and market opportunities related to competitive advantages offered in comparison with already available products / solutions were evaluated. **User satisfaction** performances were mainly related to the potential ability of the new propositions of answering individual needs and specific requirements. The **sustainability's value** was related to environmental and social aspects taking into account, respectively: potential for optimising the use of existing infrastructure / resources at community level, and reduction of transportation activities; valorisation of local human resources, stimulation of social cohesion, and improvement of personal well-being conditions.

After this first ranking process, a **second screening** was made only by the researchers and the designers. This restricted team reviewed all the concepts previously judged, and extracted - from each of them - their more interesting features: when possible, such features were then matched with those concepts already scored at the top. To be more precise, at this stage, a very critical analysis of **user satisfaction**, and of **environmental and social value**, was conducted with the use of maps and design matrixes. A 'contexts' map was adopted to identify which concepts were able to satisfy more than one issue across different contexts, and therefore which ones presented a greater market value from a qualitative point of view. A design-for-sustainability matrix was used to check and stretch the potential environmental and social values of the new emerging *product-service systems* by considering such aspects as: longevity (aesthetic and functional up-grading, modularity and scalability, durability, recovery); dematerialization (miniaturization, integration and multi-functionality, virtualisation, biodegradability); clean / efficient energy (solar / wind power, human power, hydrogen power, eco-efficient use); cultural diversity (available resources, appropriate technologies, traditional practices, individual and community empowerment); sharing (space, assets, time, knowledge).

As a result of this second filtering process, a richer ranking scale was produced and two of the most promising concepts were selected for the development of more structured design scenarios and their underpinning business rationales. These concepts were named *nutritional nuggets* and *fresh-food-2-go*.

8.3 Framing the business case
At the end of the three-day workshop, some further work was carried out by designers around two of the most promising concepts. As was also done for the experience conducted in 1999, the selected concepts (*nutritional nuggets* and *fresh-food-2-go*) were articulated in more concrete business value propositions. The aspects that were stretched and expanded in this re-elaboration included:

• the specification of concept features (solution elements), in terms of hardware and services, both standardized (mass produced) and context-specific (customized to

specific end-user's requirements in specific physical and socio-cultural contexts), and their environmental and social value
• the specification of the business rationale underpinning the emerging solutions, explained through links among partner promoters and other complementary partners, their potential roles and benefits.

8.3.1 *Nutritional nuggets*

This concept proposes the creation of an information system about food quality / background, and food availability in the local area. The information is made available through digital kiosks located in local supermarkets, and over the web. It is run by a partnership of participants led by a national or regional supermarket, involving NGOs advocating end-users' interests and various local food retailers. Its aim is to provide users with access to information about the quality / origin of food, where to find fresh, local or specialist / ethnic food, and even how to use it. With *nutritional nuggets*:

• information kiosks are made available in public spaces (supermarket)
• the kiosks offer information about all products in the supermarket but also about specialist ingredients available in the neighbourhood
• some of the background information about food comes from independent third party (NGOs)
• all the information is made available in multiple languages.

Scenario featuring a real end-user

Delphine is a French woman currently living in the Netherlands with her Dutch husband and two children. She is interested in knowing where her food comes from. However, she has to struggle to find the ingredients she was used to in France as well as to understand the new ingredients available in this country. Since she is concerned about healthy food, she wants to make sure that she feeds the best quality, biological foods to her family. Her problems with food can be summarized as:

• finding unusual ingredients
• understanding the origin and quality of food
• facing language barriers for non-residents.

Delphine is delighted by the new *nutritional nuggets* system available in the local supermarket since it provides customized information meeting her interests. *Nutritional nuggets* uses her own language, helps her to find unusual ingredients in the local area and gives immediate feedback on the background of products, as well as recipe suggestions.

Storyboard 4 - *Nutritional nuggets* design scenario.
The user's interaction with the solution in a daily life context. *Source*: Philips Design (© Royal Philips Electronics), 2003.

1. Shopping in her supermarket together with her son, Delphine finds a product but can't read its information in Dutch.

2. Delphine scans the product and chooses the French language to find out more information.

3. Delphine uses her loyalty card to access more detailed information about the background of the product.

4. At the meat counter, Delphine is searching for a turkey for Sunday dinner but can't find one.

5. Delphine searches on Nutritional Nuggets for the closest specialist poultry supplier.

6. Later in the local butcher, Delphine finds the turkey she was looking for!

Solution elements

- Industrialized components
  - Kiosk components.
  - Interfaces.
  - Installation and maintenance services.
  - Concept IP.
  - Agreements.
  - Standard information.

- Context-specific aspects
  - Local shops.
  - Easy access to 'customized' knowledge.
  - Local information.

- Sustainable value
  - Local trade (including mobility needs for the local area).
  - Valorisation of locally available resources.
  - Knowledge sharing.
  - Ethical shopping.

Business rationale

In order to produce, market and communicate *nutritional nuggets*, a partnership of participants is required. Agreements must be clearly set up to define the roles and responsibilities of those involved in the promotion of this *product-service system*.

Hypothetically, Philips can be considered as one of the actors providing the enabling technologies[56] for *nutritional nuggets*. The company can contribute its expertise in the design and manufacture of the public information kiosks, and also integrate connections with software suppliers to create the user interface and 'back-end' data storage solutions. Other partners, including content providers, are the supermarkets, global food companies, NGOs, local interest groups and local retailers. They process information and make it available to customers in the supermarket, or at home[57]. Each of them assumes a specific role. A supermarket-chain installs information kiosks for customers who want to learn more about the background of products and specialist food availability in the local area (information is filtered by the supermarket and selected NGOs). This actor makes agreements with a variety of high-quality, food specialty retailers (non-competitors) in the local area, to share information about complementary products and local customers' habits. NGOs advocating end-user interests co-ordinate information from multiple global food companies and local interest groups to provide such 'independent' and 'transparent' background information to the kiosks, as nutritional information, food production processes, etc. In all this, users are enabled to access multiple levels of information about the products of their interest (from standard to customized information).

- Philips' business opportunities
  - Implementation of actual market shares of displays and memory sticks (profit generated by tools).
  - New market opportunities related to the introduction of interactive material and non-material interfaces and new families' software.
  - Intellectual property rights.

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[56] The company is able to provide displays, networking platforms, smart interfaces and memory sticks.
[57] Local specialists or ethnic shops and supermarkets co-operate in a network able to provide complementary products so that they can retain commerce in the local area.

• Philips Product Divisions potentially involved
  - Consumer Electronics (Display and connectivity).
  - Semiconductors.

• Benefits for end-user
  - To the user, *nutritional nuggets* offers understanding about the background and quality of food, information about where to find particular ingredients in the local area and suggestions on what / how to cook.

• Benefits for the main actors
  - For the supermarket, *nutritional nuggets* offers customer loyalty through quality of experience and transparent information, insight into what customers value and better presence in the local community.
  - For specific retailers, *nutritional nuggets* offers a channel to help increase their regular customers.
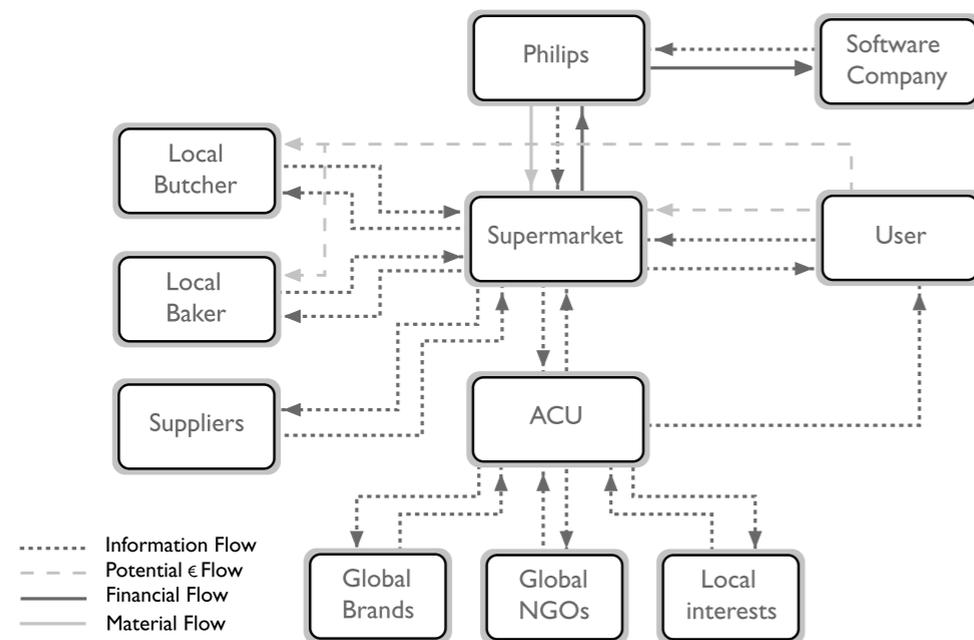
Figure 18 - *Nutritional nuggets* business rationale - actors and their relations.

Visualization of the links among the main solution's promoters, in terms of knowledge / information, material components and money flows. Philips and ACU (food-related NGO) are fixed participants, part of the consortium agreement established for the exploratory workshop. The other actors included in the picture can vary in relation to the different local areas selected to carry out the implementation activities.

8.3.2 *Fresh-food-2-go*

Fresh-food-2-go proposes an automatic fresh-food vending machine located in a busy public location (for example, railway station). It is run by a partnership of actors led by a biological food-chain retailer and involves a food preparation and distribution specialist, as well as selected local food retailers (for example, baker, butcher and fishmonger). This *product-service system* aims to provide 24 hour access to fresh and cheaper food at a convenient location, and a reduction of food waste. It basically offers:

• a self-service shop (vending machine) in strategic location (for example, railway station)
• cheaper fresh and biological food than traditional shops (near expiry date foods)
• optional ingredients collected together for a meal
• opportunities for new recipes
• opportunity to give food a 'second chance' (reduction of food wastage by retailers).

Scenario featuring a real end-user

Harm is a student at Nijmegen college (in the Netherlands). He lives in a shared student house 20 minutes by bus from college. Due to his heavy workload and extra-curricular activity he doesn't often go food shopping and he doesn't really know what to buy anyway to have a balanced feeding. His problems with food can be summarized as:

• lack of time - especially during shopping hours
• location - shops are not in the best, local place
• quality - fresh / biological food (due to his lifestyles he eats fast-food too often)
• cost - fresh / biological food is more expensive.

Harm is delighted with the new *fresh-food-2-go* vending machine in the train station where he catches his bus. It offers fresh, 'near expiry date' (and therefore cheaper) food 24 hours a day: either individual ingredients or a pre-packaged combination to make a meal (a recipe can be included). *Fresh-food-2-go* is on his way home and fast to use. Furthermore, he can buy just what he needs for the evening. Harm is eating better than ever and is experimenting with new recipes.

Solution elements

• Industrialized components
  - Vending machine components.
  - Lighting preservation technologies.
  - Solar energy components.
  - Installation and maintenance services.
  - Concept IP.
  - Infrastructure.
  - Quality check.
  - Quality certification.

- Logistical organization.
- Biodegradable packaging.
- Database of info.

• Context-specific aspects
  - Daily food.
  - Combination of ingredients.
  - Strategic location.
  - Daily needs.
  - Customized recipes for available food.

• Sustainable value
  - Energy saving.
  - Renewable energy (solar cells).
  - Food waste reduction (from the retailer's side).
  - Promotion of locally produced or seasonal food.
  - Optimisation of logistical flows by the use of ICT.
  - Re-usable secondary packaging.
  - Biodegradable primary packaging.
  - Just enough food (from the consumption side).
  - Virtual information flow.

Storyboard 5 - *Fresh-food-2-go* design scenario.

The user's interaction with the solution in a daily life context. *Source*: Philips Design (© Royal Philips Electronics), 2003.

Fresh-Food-2-Go

Harm is a student at Nijmegen college. He lives in a shared student house 20 minutes by bus from college. Due to his heavy workload and extra-curricular activity he doesn't often go food shopping and he doesn't really know what to buy anyway.

Harm is delighted with the new 'Fresh-Food-2-Go' vending machine in the train station where he catches his bus. It offers fresh, 'near expiry date' food 24 hours a day: either individual ingredients or a pre-packaged combination to make a meal (a recipe can be included).

Fresh-Food-2-Go is on his way home and fast to use and it is even cheaper than the supermarket! Furthermore, he can buy just what he needs for the evening.

Harm is eating better then ever and is experimenting with new recipes.

1. Every day Carl, a local food distributor, collects fresh 'near expiry date' food from selected multiple, local retailers.

2. Carl brings the food to his company for quality certification. The ingredients are combined intelligently to provide the potential for a complete meal.

3. The proposed recipes are sent directly to the Fresh-Food-2-Go vending machine at the railway station, that is restocked before the evening rush hour.

4. Harm is on his way home, late as usual and hungry. He knows there is no food in the fridge...

5. Instead of buying fast food, Harm is inspired by the fresh lasagne promised at Fresh-Food-2-Go. He buys this bag and receives a recipe to help him make the meal.

6. Later, harm is enjoying the lasagne he made, while his housemates are getting excited about this new offer...

Business rationale

In order to produce, market and communicate *fresh-food-2-go*, a partnership of participants is required. Agreements must be clearly set up to define the roles and responsibilities of the actors involved in the promotion of this *product-service system*.

The partnership brings together fresh food that is approaching its expiry date from local retailers. It gives food a 'second chance' at a market while offering the user the opportunity to opt for a healthy meal, by offering individual ingredients or a package of ingredients for

a complete meal in a very convenient manner. Hypothetically, Philips can be considered as one of the participants providing the enabling technologies[58] for *fresh-food-2-go* self-service shop. The company can create the user interface, and work together with an experienced producer of white goods (for example, Whirlpool) to design a vending machine that makes the best use of an eco-efficient technology for food preservation (lighting technology), eventually powered by solar panel systems.

The biological food-chain retailer (for example, Biologica) is at the centre of the business model - it provides the retail brand and credibility to offer quality fresh foods (fresh vegetables and fruit close to expiry date, eggs and milk), and create the agreements with other local retailers (bakery, butcher, fishmonger) to complete the daily fresh food supply[59]. The specialist food distributor (for example, Trittico) checks the food and guarantees the quality branded by the biological food-chain retailer and other minor shops. By having the necessary expertise in industrial-scale food preparation and logistics, this actor: collects the food locally; packages it intelligently so each package can be used to make a meal, and provides a recipe for that combination of ingredients; stocks the vending machine daily. Its supplier (for example, Duni), provides specialized primary and secondary packaging for the food collection and distribution processes.

To complete the picture, the Railway Company provides a space for the vending machine and guarantees a certain level of security. A dietary software company provides software that enables digital access to information on dietary advice and recipe. Other complementary partners provide for the maintenance of the vending machine. In all this, users can buy food for 'this evening' or 'this lunchtime' at their convenience.

- Philips' business opportunities
  - Implementation of actual market shares of displays (profit generated by tools).
  - New market opportunities related to the introduction of interactive material and non-material interfaces and new families' software.
  - Market exploitation of food preservation lighting technology (for example, UV light) and solar systems.
  - Intellectual propriety rights.

- Philips Product Divisions potentially involved
  - Consumer Electronics (Display and connectivity).
  - Lighting (New business development and Philips Solar).

- Benefits for the end-user
  - To the user, *fresh-food-2-go* offers the chance to easily buy healthy ingredients on the move, outside shop hours, for a cheap price and with helpful suggestions on what to cook.

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[58] The company is able to provide for: displays; networking platforms; smart interfaces; food-related lighting preservation technology (for example, UV light); small scale solar systems (inverters, displays and solar cells).
[59] The daily offer varies depending on what is available from the shops.

• Benefits for the main actors
  - To the biological food-chain retailer and other local complementary food shops, *fresh-food-2-go* offers a second chance for their unsold goods to reach the buying public through a prominent distribution channel actives 24 hours a day.
  - To the specialist food distributor, *fresh-food-2-go* offers the possibility of expanding its traditional business.
  - To other global industrial actors such as the white goods producer and the food packaging producer, *fresh-food-2-go* offers the possibility of expanding their 'business to business' activities.
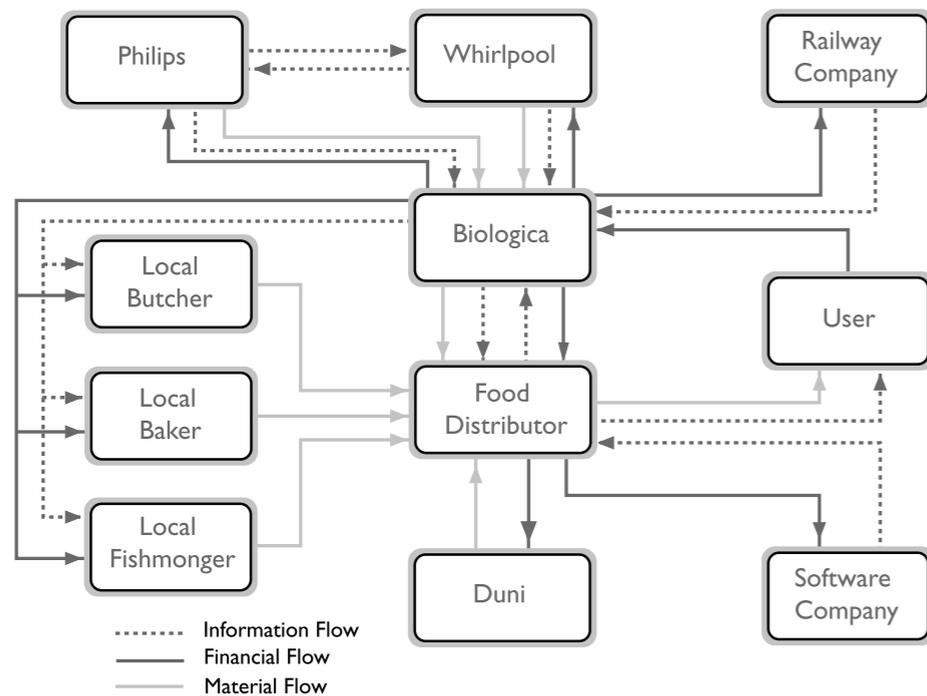

Figure 19 - *Fresh-food-2-go* business rationale - actors and their relations.

Visualization of the links among the main solution's promoters, in terms of knowledge / information, material components and money flows. Philips, Whirlpool and Duni are fixed industrial participants, part of the consortium agreement established for the explorative workshop. The other actors included in the picture can vary in relation to the different local areas selected to carry out the implementation activities.

8.4 Concept architecture: open systems

The new business value propositions hypothesized in the two design scenarios described above can be viewed as open (*product-service*) *systems* adaptable to specific local conditions and users' requirements. When we examine their composition, it can be seen that they are essentially based on a **flexible combination of standard hardware, service practices**

and digital interfaces with local components of different nature able to add an exclusive value to the offer. To be more precise, they can be deconstructed into:

• an industrialized part of the offer, as a package of fixed standard components (for example, networking technologies, primary software for communication, installation and maintenance procedures, etc.)
• a context-specific part of the offer, as a package of variable local components (for example, local knowledge, particular food locally available, etc.).

The package of fixed standard components is applicable to multiple contexts facing similar issues, and is usually provided by the partners' promoter. The package of variable components usually requires a contribution from local partners. The *product-service system* resulting from the match of these two parts of the offer can grow over time according to changes in the users' requirements and contexts' conditions.
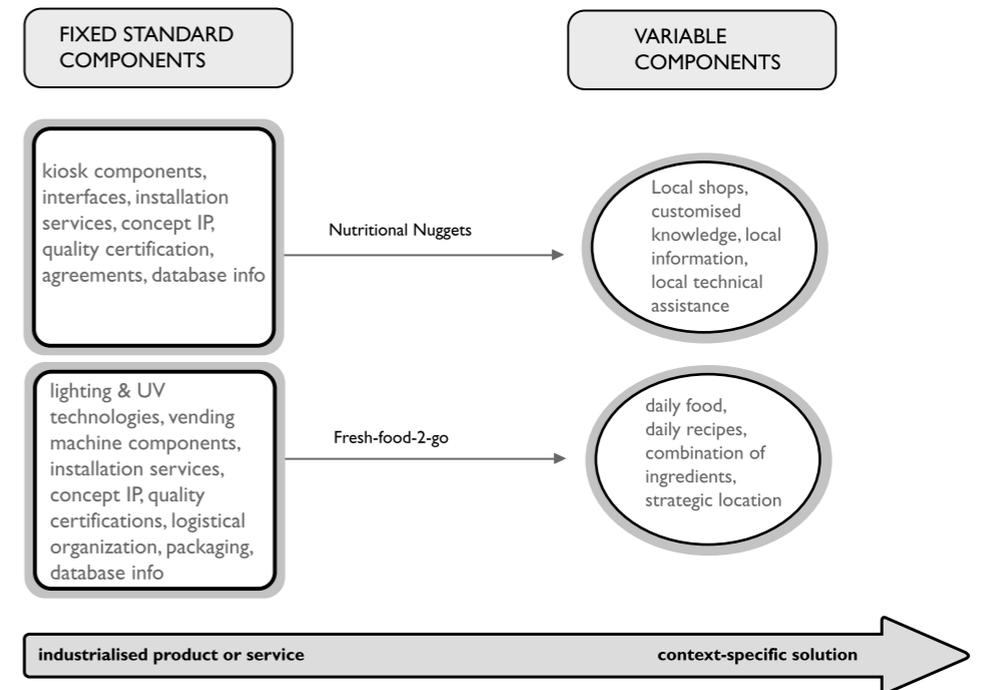
Figure 20 - Concept architecture.

Deconstruction of the *nutritional nuggets* and *fresh-food-2-go* concepts. The concepts are here distinguished in two parts of the offer. An industrialized fix part, which contains standard products and service components, and a context-specific part made by components that vary in relation to specific users' needs and requirements over time and context conditions.

8.5 Evaluating the process: some lessons

The overall design approach adopted during the entire creative process worked quite well. In particular, making a comparison with the framework adopted to carry out the workshop of 1999, the approach used in this second workshop achieved relevant improvements, which can be summarized in terms of:

- shifting the mindset of industrial participants from just an economically-driven business value creation attitude to a sustainability-driven business attitude underpinned by triple bottom line principles
- bringing real life users' information into play, from explicit unsatisfied requirements to hidden needs
- creating a fast dynamic creative flow, from first ideas generation exercises to activities for the articulation and visualization of more concrete business value propositions
- better specification of roles according to expertise and leadership allocation for working groups, from business assignments (for example, market directions and concepts evaluation), to research tasks (multiple knowledge transfer) and design activities (concept envisioning in its broad meaning).

However, besides these very positive results, two major weaknesses must be mentioned. First of all, it was too ambitious to think of bringing the 'users' several times into the creative process, either because of the time required from their side, or due to the difficulties encountered in making them full 'co-creators' during the envisioning of the final solutions. Although they were able to give very valuable inputs for concept modifications and improvements[60] at a certain stage of the process, when re-involved at a later stage, they could not fulfil the expectations of the designers: it was difficult for them to provide further input to the solutions simply by making using of design scenarios instead of dealing with concrete applications (one focus group with them was probably sufficient to collect all the relevant suggestions used during the concepts' creation). Secondly, no mechanisms were thoughts to assuring a continuation of the triple bottom line framework during follow up activities, leaving the implementation of social and environmental considerations concerning solution development tasks up to the sensibilities of the business decision makers (or to the single companies' rules and practices).

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[60] Users can be considered 'experts' in solving their everyday issues related to food.

9 The methodological co-design approach and its tools

Chapter 9 explains in detail the co-design approach elaborated and experimented with during this action-research study. It provides twelve practical steps for envisioning new sustainability-based *product-service systems*, and an insight into the tasks, tools and timelines used in each of these steps.

9.1 The process in twelve practical steps

The design process described here can be considered the result of an iterative research approach moving from the theory available on how to create sustainable *product-service systems* to new experimentation-practices, and from these practices to a new theoretical contribution. In other words, it capitalizes on the knowledge generated on the subject by the literature, other research studies, and on the two experiments conducted by Philips Design to define **a flexible, cost-effective, practical and ease-of-use methodological approach to envisioning new sustainability-based business value propositions.**

As a recap, lessons provided by theory and practice of business value co-creation, and product-service systems design research methods, included the importance of focusing on the question of how best a company can meet people's needs, rather than concentrating on the redesign of conventional products. Moreover, the importance of considering the stakeholders involved in a value creation process as co-designers of the solutions proposed; in order to leverage on various capabilities and types of knowledge to provide answers able to better fit the needs, and requirements, emerging in specific socio-cultural and physical contexts. The meaning of design, as an intrinsic part of the business value creation process, in its task of orchestrating a team effort nourished by various expertise. And last but not least, the importance of considering design-for-sustainability strategies, which - differently from product-related eco-design criteria - address both environmental and social guidelines, either at functional or system level.

Emerging gaps, in a process of value co-creation grounded on the design of competitive and sustainable *product-service systems,* constituted the basis for setting a precise research agenda of issues covered in the two experimental workshops previously described. The items to be investigated were defined as follows.

- What kind of expertise is required per design stage: When and how should these areas of expertise be brought together.

• How should inspirational and informative knowledge be circulated and transferred among the team and at what moment in time.
• How can all the stakeholders involved in the concept creation be assured that they will be afforded the same opportunity to best contribute their knowledge. In particular, what is the most appropriate stage for involving the customers/users.
• How can customers/user's needs be positioned at the centre of the creative process, while taking technology into account as an enabling factor to ensure the most effective answers.
• How can a common triple bottom line mindset be created among participants, bearing in mind there could be a different level of understanding of sustainability-related challenges and opportunities.
• How can design-for-sustainability criteria and filters be integrated into the steering framework of the creative process.
• How can concepts that involve a mix of tangible and intangible components be communicated best to the decision makers, in order to indicate the most promising options for implementation.

The experimentations in the Philips context were essential to provide the necessary answers to the pending issues articulated above, and therefore to layout practical steps easily applicable during creative sessions in support to business innovation projects.

As already previously mentioned, there are three fundamental building blocks in the construction of this holistic design methodological approach, and its tool-kit:

• a triple bottom line steering framework in terms of sustainability-related principles and criteria considered at the very beginning of the concept ideation phase
• a dynamic of value co-creation for the definition of new global-local propositions involving various actors with different competencies and expertise; in particular, the end-users
• a view of *product-service systems* as combinations of product and service components that can modify their functions and eventually, over time, grow.

By considering these building blocks, the process elaborated is not prescriptive but open to appropriate adaptations in response to different projects' requirements and the tasks to be achieved. And it can be basically deconstructed in a pre-workshop, workshop and post-workshop phase. Each phase requires specific expertise and knowledge about markets, technology, society and environmental / social concerns. Sometimes this expertise can be brought into the creative process via the physical presence of various business representatives, sustainability experts and users; at other times it can be included via the use of knowledge representation tools.

The overall process can be explained in twelve practical steps that are not necessarily sequential. The steps have been defined in terms of expertise involved, tasks, activities, steering tools and timeline.

• **Step 1 - Establish a two-way dialogue.** The aim is develop and circulate among workshop participants a pre-briefing document that defines the boundary of the explorative and creative sessions. This implies the collection and distribution of information and knowledge from and toward the partners.
• **Step 2 - Preparation of homework.** The aim is to develop a design brief that structures the content to be used in the creative session, and contains objectives and instructions for each partner. This involves some specific preparation activities.
• **Step 3 - Outline a common vision.** The aim is to bring the partners together to align their know-how and merge their strategic intents in a mutually accepted goal and direction. This is the start of the workshop activities.
• **Step 4 - Understand users' needs.** The aim is to share knowledge of users' needs and requirements, and identify related key issues and opportunities for improvement. This includes the explanation of specific contexts investigated in field-researches to gain an insight into people's real-life needs.
• **Step 5 - Explore 'out-of-the-box' ideas.** The aim is to explore new, visionary ideas. This involves individual thinking and group brainstorming for the generation of ideas of *product-service systems* outside current business and technology limitations.
• **Step 6 - Create business value propositions.** The aim is to co-create realistic business offers. This includes individual thinking and teamwork to envision ideas of sustainable *product-service systems* that are marketable in the short / medium-term.
• **Step 7 - Primary concepts evaluation.** The aim is to identify the most promising business value propositions. This involves an initial evaluation of the concepts from a business, end-user and sustainability perspective.
• **Step 8 - Concepts mapping.** The aim is to specify further the potentialities of all the most promising business value propositions. This involves a critical review of the concepts by the design and research team.
• **Step 9 - Concepts and scenarios shaping.** The aim is to articulate and visualize the most attractive emerging concepts of *product-service systems*. This includes some initial design activities by a team of researchers and designers to create a communicable story around the new value propositions and their contexts of application.
• **Step 10 - Get feedbacks from the users.** The aim is to adjust and enrich the concepts with input from their potential users. This includes the direct involvement of the users in the last stage of the design workshop.
• **Step 11 - Concepts articulation.** The aim is to work out the selected value propositions and their scenarios. This is a continuation of the design activities - by a team of researchers and designers -in order to translate the rough concepts into more comprehensive *product-service systems*.

• **Step 12 - Report back to the partners.** The aim is to create communication material to fully document the outcomes of the creative process. This implies the compilation of reports in digital (and printable) formats that are able to support the partner promoters in the phases of solutions review, evaluation and development.

The process and its tools have been tailored to the specific benefit of designers and workshop facilitators to support them in performing tasks related to design strategic projects.
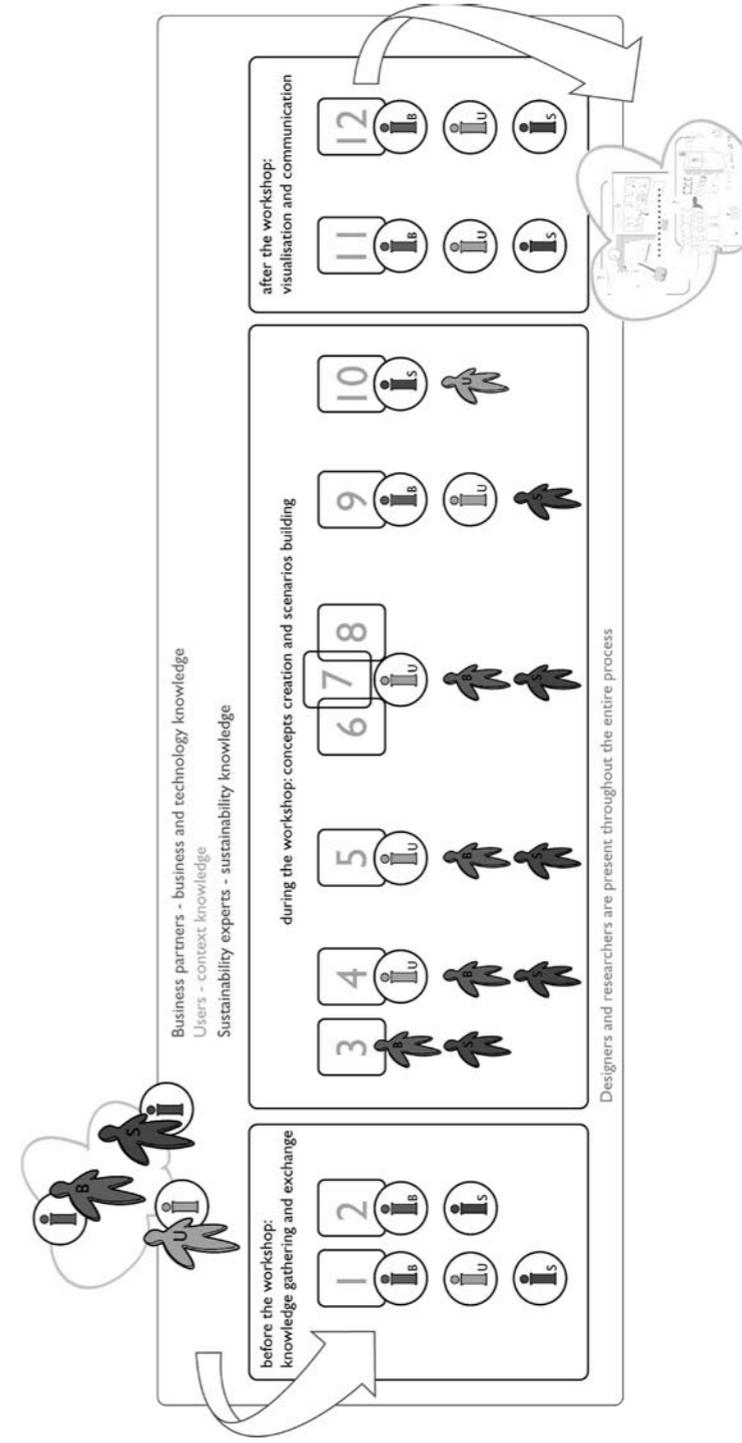
Figure 21 - Co-designing sustainable value: visualization of knowledge and expertise involved.

This scheme provides an overview of the kind of competence and expertise used in the twelve steps adopted to describe the methodological approach elaborated in this action-research study. The scheme indicates when the physical presence of the experts (businesses, sustainability experts and users) is required and when it is sufficient to use knowledge representation tools. Designers and researchers, however, are involved throughout the creative process.
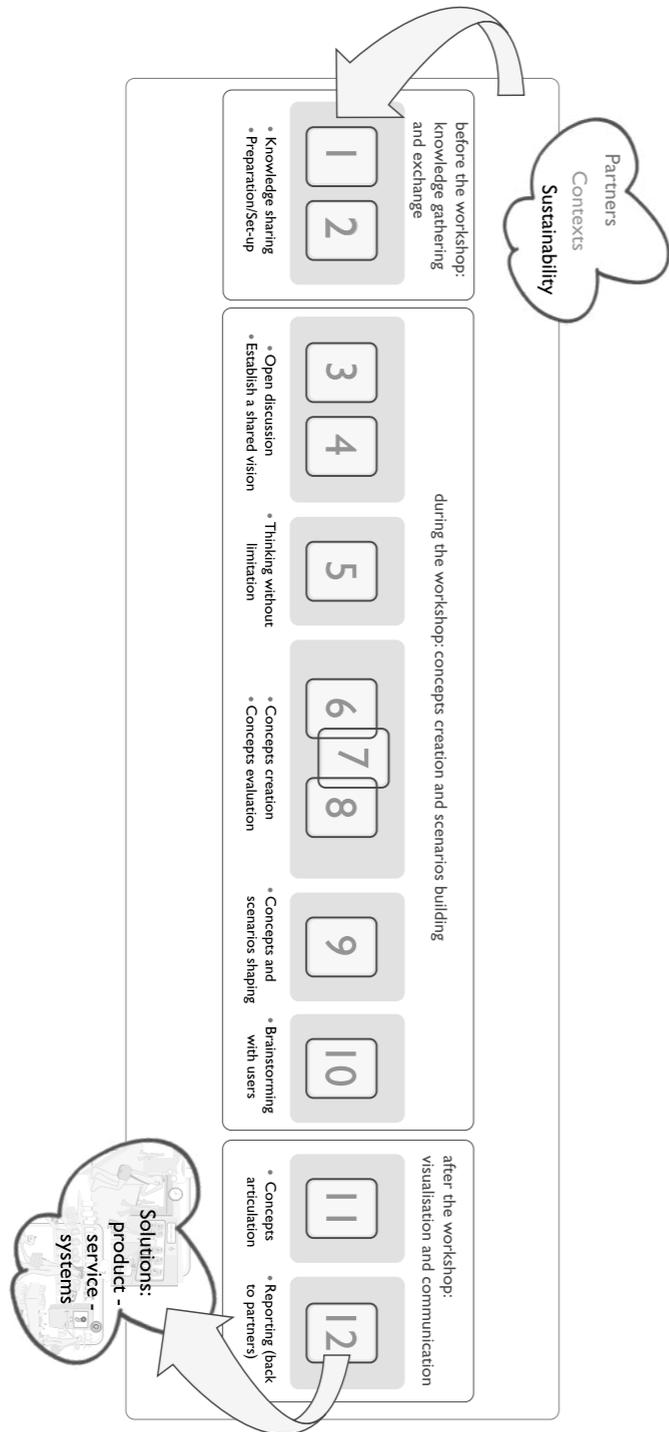
Figure 22 - Co-designing sustainable value: visualization of twelve practical steps. This scheme links twelve design steps for the co-creation of economic, social and environmental value with a few specific activities to be performed all along the process.

9.2 Before the workshop

Once the business has defined a possible focus area of intervention and established a basic network of potential partners for the co-exploration of new marketable solutions (sustainability-based), it becomes crucial for designers and researchers to set up the workshop activities in an appropriate manner. This implies providing guidance to the creative process and assuring the availability of all content necessary to come up with concrete answers to the societal and individual needs being investigated. At this stage, a clear workshop structure and related tools need to be sorted out. Information about the market, users' needs in specific contexts, technological potentialities and sustainability principles and drivers must be collected and summarized so that they can be shared before and during the event.

9.2.1 Knowledge gathering and exchange
Step 1 - Establish a two-way dialogue

The aim is develop and circulate a pre-briefing document that defines the boundary of the explorative and creative sessions. This implies the collection and distribution of information and knowledge from and to the partners.

Tasks and processes
• Clarify in a statement the overall aim of the creative workshop.
• Explain the meaning of 'sustainability' as a new emerging idea of progress opening challenges and opportunities for the business (triple bottom line definition and guiding principles).
• Gather sufficient information on the topics of exploration: current quantitative market data (growing markets, underdeveloped markets); qualitative socio-cultural trends and social relevance (society and market); insight into specific people's needs (outcomes of previous research field investigations). And, on the basis of this information, select the most promising contexts (users in particular spaces and socio-cultural conditions) to be addressed in the generation of new value propositions.
• Ask the partners to provide feedback on the content circulated, and input for the preparation of the workshop briefing.

Tools
The main tools utilized at this stage vary from quantitative tables for markets' data, to scripts / narratives for future trends directions, to clusters concerning users' needs and requirements. Additional tools relate to ways used to increase business awareness on sustainability and its economic, social and environmental principles.

Timeline
Approximately 10 days should be allowed for this step with: the research partners (4 people) working for 3 days for the definition of the pre-briefing document (knowledge gathering, packaging and distribution); the industrial partners working for 4 / 8 hours to provide input and feedback to the pre-briefing document (knowledge sharing and decision making).
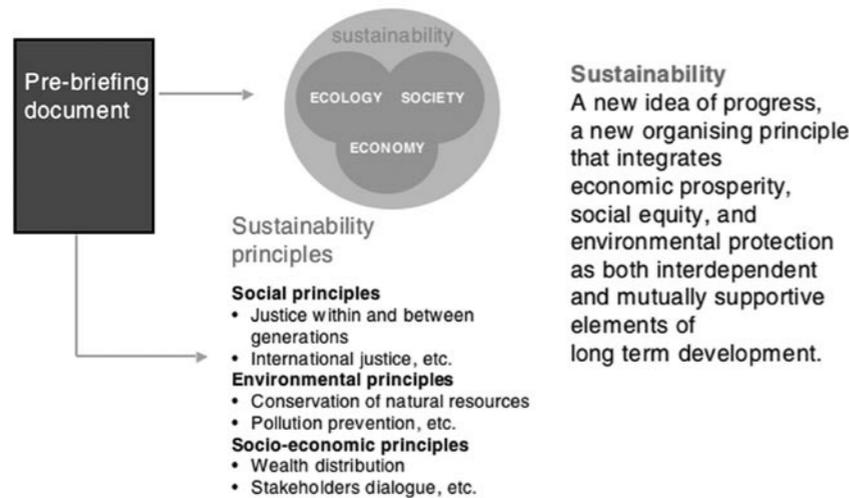
Toolbox 1 - Sustainability and a few fundamental principles.

This diagram summarizes some of the information included in the pre-briefing document of the 'People with reduced access to healthy food' workshop carried out in 2002: sustainability, and some of its underpinning fundamental principles, to guide any business activity with ambitions of future oriented development goals.

Step 2 - Preparation of homework

The aim is to develop a design brief that structures the content to be used in the creative sessions, and contains objectives and instructions for each partner. This involves some specific preparation activities.

Tasks and processes
• Define the workshop agenda and its structure, working out the plenary and group sessions in detail, the specific content to be communicated and the articulation of the exercises to be carried out throughout the entire ideation process.
• Composition of a briefing document for all the partners, including: a summary of the information previously circulated; a short description of the workshop process; an explanation of the major sustainability drivers that are currently influencing the market; specific assignments as preparation for the event.
• Develop the assignments.
  - Business representatives: organization of a short presentation explaining their own core business and strategic intents, their expectations for the creative session, the major sustainability drivers that they value, and their specific business focus / contribution for this project (positioning and goals).
  - Technology experts: organization of a short presentation explaining the potentialities offered by relevant knowledge concerning their areas of competence (knowledge sharing).
  - Researchers and designers: translation of findings on real-life people's needs emerging from the contexts previously selected into inspirational communication material (knowledge sharing); translation of other relevant content in digestible and short information summaries.

Tools
The main tools utilized at this stage range from formal PowerPoint presentations, prototypes and demos for industrial partners to posters, pictures, leaflets, videos for researchers and designers. In particular, mapping tools can be used to visually indicate 'soft' and 'hard' sustainability drivers concerning: society (values such as ethics, responsibility, care, balance, self-empowerment, social cohesion, belonging, holism, etc.); environment (drivers such as population growth, climate change, depletion of resources, land / water contamination, air pollution, loss of biodiversity, etc.); and economy (drivers such as cost efficiency, regulation and taxes, NGOs (Non-Governmental-Organizations) pressure, shareholders value, brand equity, public demand, employees motivation, etc.).

Timeline
A 5 day (approximately) timeline should be considered for this step with: the researchers and the designers (4 people) working for 3 days on the definition of the document and the organization of the workshop (from agenda setting to tools development); the industrial partners and the experts working for 4 / 8 hours to read the briefing document and arrange their input to bring into the workshop.
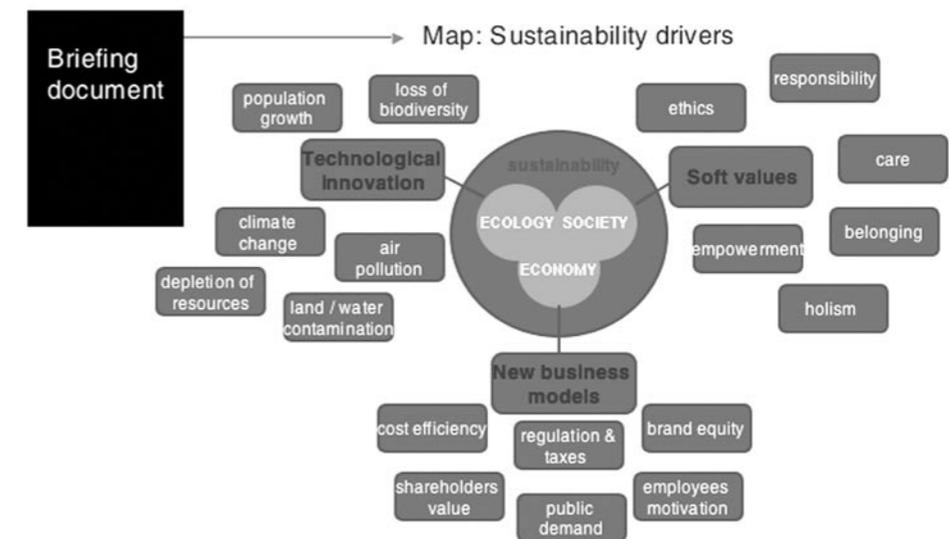
Toolbox 2 - Mapping sustainability drivers.

This map visualizes the information included in the briefing document of the 'People with reduced access to healthy food' workshop carried out in 2002: sustainability 'hard' and 'soft' drivers which are currently changing the competitive landscape of enterprises. The map has been used to trigger the industrial partners to think about their core business and its relation to these drivers, to better scope the sustainability 'ambitions' of the workshop.

9.3 During the workshop

A creative process requires a balance between individual thinking, team work and plenary discussions. It requires sessions of knowledge assimilation and reflection as well as brainstorming sessions for idea generation and scenario-envisioning. And it inevitably alternates moments of speed work with moments of crisis.

For each of these sessions, various design tools can support the different activities: either to feed and guide them or to keep track of the results achieved step by step. The outcome, however, also depends very much on the clarity of the assignments provided to the workshop participants, in terms of roles and responsibilities to be carried out and performed, and on an appropriate leadership. In other words, it depends on the right combination of two factors: framework and people.

9.3.1 Creating concepts and building scenarios
Step 3 - Outline a common vision
The aim is to bring the partners together in order to align their know-how and merge their strategic intents in a mutually accepted goal and direction. This is the start of the workshop activities.

Tasks and processes
• Opening of the three day workshop activities: rules definition by the facilitator and 'mind-frame' setting by the researchers / designers, which encourage a debate in the plenary on the objectives to be achieved, the ingredients to be considered (industrialization, contextualisation and sustainability) and the boundaries to be respected in this attempt [Session A].
• Share the business interests in / expectations from the partnership, and the competencies offered for the creation of new *product-service systems* (value of the partnership).
  - Introduction of the industrial partners via different communication tools: after the presentation of each industrial partner, all the participants are invited to write down a few key issues triggered by this session on post-its [Session B].
• Mapping of the emerging issues on tools for discussion, such as value network posters, and design orientation criteria posters (system thinking approach – contextualisation, and sustainability) followed by a plenary debate aiming to the creation of a consensus on the direction to take [Session C].

Tools
In addition to the various communication tools that the industrial partners can utilize to share their core business competencies, particular technologies and focus interests, some additional instruments to steer the debate at this stage could be: value network maps; design orientation criteria posters.

Value network maps relate the life-cycle-phases of possible business answers in the field of

investigation to the corresponding users' activities: these maps help to define focus areas and therefore to specify the boundaries of the creative sessions[61].

Design orientation criteria posters provide a list of key elements to be considered in thinking about new value propositions in terms of: flexible and open *product-service systems* rather than standard mass products (contextualisation vs. globalisation); sustainable solutions rather than eco-efficient products (system innovation vs. product innovation). Criteria reported in the poster on 'contextualisation' can include: standardization of components vs. product standardization; use of locally appropriate technologies and materials; increase modularity; increase elements 'interfaceability', formalization of service procedures but use of local service providers; enabling of networking and connectivity. Criteria reported in the poster on 'sustainability' can include: valorise local environmental and social resources; use / re-use existing infrastructures; reduce material and energy intensity; reduce chemicals; close the material loop; support the spirit of sharing and common use; use renewable energy; minimize mobility needs.

Timeline
For a 3 day workshop (1st day), this step requires approximately: 1 hour for [Session A]; 2 hours for [Session B]; 30 minutes for [Session C].
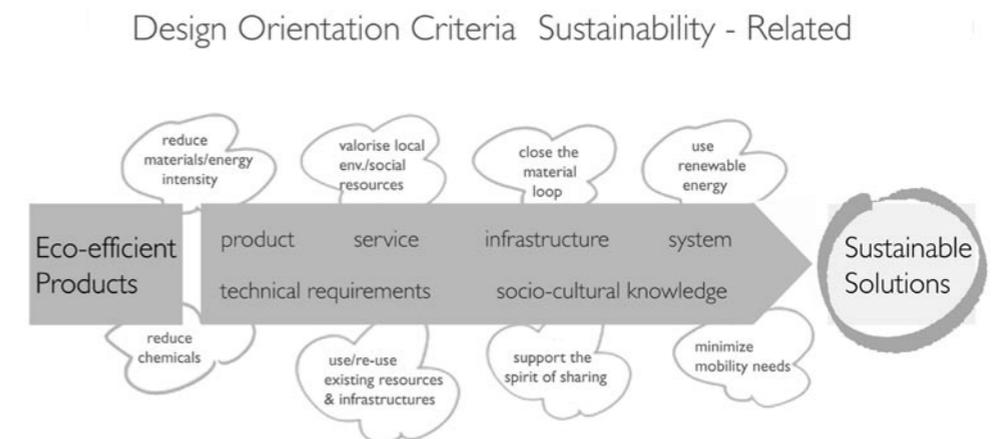
Toolbox 3 - Design orientation criteria sustainability-related.

This poster visualizes sustainability-related design orientation criteria presented during the 'People with reduced access to healthy food' workshop carried out in 2002. These criteria have been used to guide the participants in thinking about new business value propositions capable of presenting environmental and social quality.

[61] As an example, the 'People with reduced access to healthy food' workshop has utilised a value network map illustrating phases of food delivery / shopping, preparation and consumption. For each of these phases, specific activities were listed to support the workshop participants in identifying the main points of attention to be addressed during the brainstorming session. In the case of 'preparation' for instance, user activities such as clean, process, cook, preserve, store, dispose, recycle, etc. were mentioned. In the case of 'consumption' users activities included setting, serve, eat, socialize, enjoy, clean-up, and so on.

Step 4 - Understand users' needs

The aim is to share knowledge on users' needs and requirements, and identify related key issues and opportunities for improvement. This includes the explanation of specific contexts investigated in field-researches to gain an insight into people's real life needs.

Tasks and processes
• Describe user's latent and explicit needs emerging from the analysis of the information compiled during the preparatory phase of the workshop (informative and inspirational material).
  - Presentation by the researchers of people's needs and activities performed in specific contexts (for example, home, community centres, commercial spaces) at a particular time, including: clusters of general issues emerging across the several contexts object of investigation; specification of the key issues emerging from each context analysed; use of visual material in real-life experiences as sources of inspiration for idea generation [Session A].
• Divide the workshop participants into small groups - mixing together one designer, one researcher, one industrial partner (technology or business expert).
  - Ask them to analyse one or more contexts in order to digest the information presented and to point out the most promising ones (or others not originally included) for the brainstorming activities: context sheet exercise [Session B];
  - Ask the industrial partners to take the lead in the selection of the most relevant issues and opportunities to be considered for the formulation of new value propositions (market opportunities): context sheet exercise [Session B].

Tools
The transfer of knowledge about people's explicit and latent needs in their everyday life contexts can take place in very different ways. In addition to the use of PowerPoint presentations and verbal articulation, more 'inspirational' tools can include the use of videos and pictures showing issues faced by the users in rich details. More comprehensive inspirational information can also be shared through narratives supported by cards describing user profiles, including their activities carried out to face problems emerging in specific circumstances, at a particular time.

Discussion among the workshop participants and the prioritisation of contexts can be facilitated by the distribution of templates containing trigger questions (context exploration template). However, at this stage any considerations related to users and users activities in contexts can be openly addressed and noted.

Timeline
For a 3 day workshop (1st day), this step requires approximately: 45 minutes for [Session A]; 45 minutes for [Session B].

Toolbox 4 - Cards describing key issues emerging in specific contexts of investigation.

These cards illustrate issues emerging from the analysis of contexts investigated in the 'People with reduced access to healthy food' workshop carried out in 2002. They have been used to provide the workshop participants with a better insight into people's explicit and latent needs related to food delivery / shopping, preparation and consumption in specific contexts.

Step 5 - Explore 'out-of-the-box' ideas

The aim is to explore new visionary ideas. This involves individual thinking and group brainstorming for the generation of ideas of *product-service systems* outside current business and technology limitations.

Tasks and processes
• Use the contexts' information and the key issues / opportunities pointed out by the business to produce initial thoughts on new, potentially desirable answers.
  - Ask the participants to - individually - write down two issues or opportunities off the tops of their heads (trigger-words from the knowledge assimilated so far along the process), and discuss their notes within the same groups created for the previous exercise. This will get them in the mood for imagining any 'crazy' or 'futuristic' idea [Session A].
  - Then ask the participants to generate 'out-of-the-box' ideas (singly or in pairs) focusing

on one or more contexts ('out-of-the-box' exercise): share the ideas generated within the group by rotating the templates, for further enrichment and exploration; prioritise the ideas through a group discussion [Session B].
• Recall the plenary to present the outcomes of the working groups and to agree on the most relevant focus areas to be addressed in the next workshop activities [Session C].
• Collect any outstanding questions for users (targeted and involved in previous context field study) to make them available for telephone interviews by the researchers [Session D].

Tools
At this stage, relatively open templates can be utilized to record the design activities. It is sufficient to provide a framework requiring the compilation of such information as the title of the 'out-of-the-box' idea, a few sentences on users in their contexts, and some notes on key features of the solutions illustrated by some preliminary sketches.

Timeline
For a 3 day workshop (1st day), this step requires approximately: 15 minutes for [Session A]; 1 hour for [Session B]; 20 minutes for [Session C]; 15 minutes for [Session D].

Step 6 - Create business value propositions
The aim is to co-create realistic business offers. This includes individual thinking and teamwork to envision ideas for sustainable *product-service systems* marketable in the short / medium-term.

Tasks and processes
• Present additional information eventually collected from the users by the researchers at the end of the previous step [Session A].
• Use the knowledge shared the previous day about users and contexts, technological potentialities and business relevance (key issues / opportunities pointed by the industrial partners), to generate realistic ideas of *product-service systems*.
  - Ask the workshop participants to start to think individually (using inspirations taken from the 'out-of-the-box' ideas or from scratch) by focusing on short / medium-term market opportunities: *product-service systems* template [Session B].
• Discuss the new concepts in teams and shape the most promising ones into business value propositions.
  - Divide the workshop participants into groups of a maximum of 4 people (balancing the mix of expertise / competencies, and ensuring the presence of one designer per group).
  - Ask the participants to discuss their individual ideas in the team, enriching and extending the concepts - if possible - to different contexts that could require similar solutions: make use of a matrix linking issues across different contexts [Session C].
• Outline the business rationale for the most promising concepts, including: business relationships among the partners; benefits for the end-users and all the stakeholders

involved; potential environmental and social value.
  - Ask the participants (in particular the industrial partners) to figure out the materials, financial, and knowledge / information flows linking the various stakeholders; make use of a separate 'value network' template [Session D].

Tools
Three major tools can help in steering the creative process at this stage: a *product-service systems* template; a matrix linking issues across different contexts; a 'value network' template. The *product-service systems* template is intended to stimulate holistic 'thinking', inviting the workshop participants to describe the new solution in its key material and immaterial elements, overall performance and value for partners, environment and society. It is a design tool that invites an illustration of the solution in its manifestations at a particular time and place. The challenge here is not so much to be able to sketch the physical product but to communicate services and relations.

The matrix reporting the key issues discovered during the contexts analysis, and the list of the contexts selected to explore new business opportunities, seems another handy qualitative instrument that can be used to verify the market potential of a new concept: its application for the resolution of one or more issues in contexts different to the one for which it has been originally thought.

Last, but not least, the 'value network' template offers the chance to verify the business feasibility of a solution during its conceptualisation. It invites the industrial partners to work out and describe how a new concept could be economically sustainable and generate revenues, or other kinds of business value, for the partners involved, providing in this way important information for concept shaping.

Timeline
For a 3 day workshop (2nd day), this step requires approximately: 5 minutes for [Session A]; 40 minutes for [Session B]; 40 minutes for [Session C]; 1 hour for [Session D].
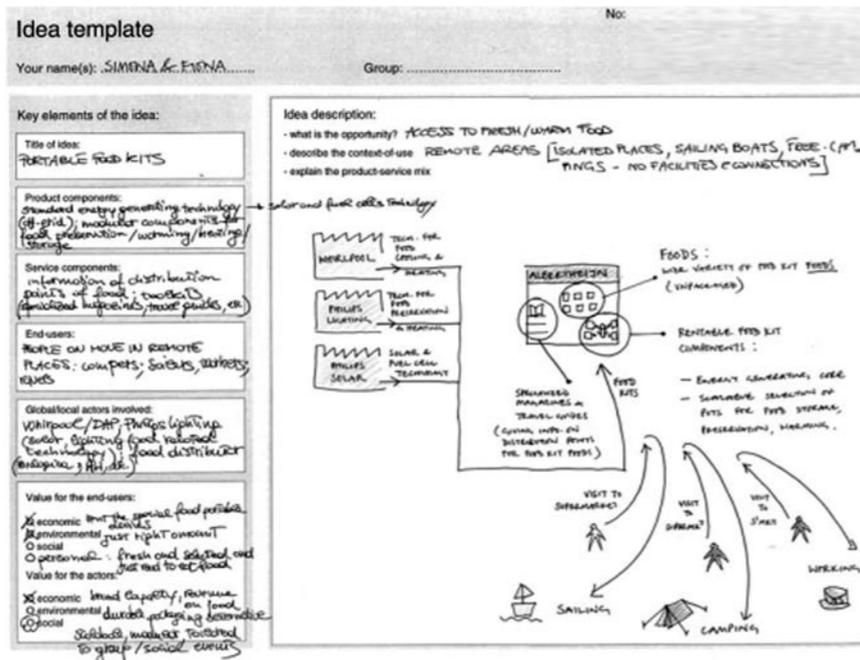
Toolbox 5 - *Product-service systems* design template.

This template was used in one of the concept generation sessions that took place during the 'People with reduced access to healthy food' workshop carried out in 2002. It contains a general framework to guide the participants in the representation of their value propositions formulated using a 'system thinking' approach. In this respect, it stimulates the consideration of some key ingredients necessary to describe new concepts of sustainable *product-service systems*.

Step 7 - Primary concepts evaluation

The aim is to identify the most promising business value propositions. This involves an initial evaluation of the concepts from a business, end-user and sustainability perspective.

Tasks and processes
- Create three boards for the evaluation of the concepts generated by the teams when considering different perspectives: the value for the end-user; the value for the business; the environmental and social value.
  - Assign only one representative role per participant for their judgment in relation to such perspectives [Session A].
- Explain the most promising business propositions in the plenary session.
  - Ask each team leader (industrial partners) to present the strongest concepts produced and their underpinning business rationale [Session B].
- Rank the concepts.
  - Ask each workshop participant to vote twice: once considering the general concept of attractiveness from a personal point of view; and once considering the concept performance in relation to the assigned perspective (based on the knowledge and

criteria used so far in the workshop). This phase signals the end of the workshop for the industrial partners and external experts [Session C].

Tools
This step does not require particular tools. The outcome of the ranking phase can be easily visualized with the use of three flip charts showing the votes assigned by the participants (linking the different voting perspectives to corresponding colour sticks).

Timeline
For a 3 day workshop (2nd day), this step requires approximately: 10 minutes for [Session A]; 40 minutes for [Session B]; 10 minutes for [Session C].

Step 8 - Concepts mapping

The aim is to specify further the potentialities of all the most promising business value propositions. This involves a critical review of the concepts by the design and research team.

Tasks and processes
- Analyse all the concepts generated in the last creative session and cluster them according to their value: high; medium; low.
  - Create groups of at least 2 people (one researcher and one designer), and assign them a certain number of concepts for the specification of their end-user benefits, as well as their potential environmental / social value (refer to the design-for-sustainability templates), and their business value, when / if missing in the original information [Session A].
- Indicate which concepts seem to present the most interesting market opportunities from a qualitative point of view (refer to the contexts matrix).
  - The small teams come together to map the reviewed concepts by identifying which of them are able to satisfy more than one issue across different contexts [Session B].
- Select the top concepts (from two to five) for their further articulation, by considering the results of both the primary rough evaluation (previous session including the industrial partners) and the analysis carried out only by the designers and researchers team [Session C].

Tools
The layer of information required at this stage can be added on top of the outcomes achieved in previous sessions. For instance, end-users benefits can be specified on the *product-service system* template used to describe the key ingredients of the new concepts and their overall performance. And a qualitative evaluation of the market opportunities of the concepts can be carried out by making use of the context matrix (linking issues to contexts) as a mapping tool.

However, in order to specify the potential of concepts in terms of environmental and social performance, a 'design-for-sustainability' template can help to give design indications

about which aspects could be improved or stretched to produce better results. Giving equal importance to environmental and social issues, guidelines in this direction can be summarized, for example, in five main clusters and specific related criteria:
• design for longevity (aesthetic & functional up-grading, modularity and scalability, durability, recovery in its various forms)
• design for dematerialization (miniaturization, integration and multi-functionality, virtualisation, biodegradability)
• design for efficient and clean energy (solar / wind power, human power, hydrogen power, hybrid systems)
• design for cultural diversity (valorise local resources, make use of appropriate technologies, respect of traditional habits, enhance individual and community empowerment)
• design for sharing (space, assets, time, knowledge).

Timeline
For a 3 day workshop (2nd day), this step requires approximately: 90 minutes for [Session A]; 30 minutes for [Session B]; 15 minutes for [Session C].

Toolbox 6 - Design-for-sustainability template.

This template was used during the 'People with reduced access to healthy food' workshop carried out in 2002. It contains a framework for identifying the environmental and social qualitative value of the new solutions, and a few specific design guidelines to improve / stretch such values.

Step 9 - Concepts and scenarios shaping
The aim is to articulate and visualize the most attractive emerging concepts of *product-service systems*. This includes some initial design activities by a team of researchers and designers to create a communicable story around the new value propositions and their contexts of applications.

Tasks and processes
• Describe and visualize the selected concepts in their product and service components, their context/s of application, and their overall performances.
  - Researchers and designers, in groups of two, work together in shaping the selected concepts (two to five). This activity includes: a richer explanation of the solution-elements and their features; the representation of the interaction between the users and the solutions in their particular physical and socio-cultural spaces (via storyboards); the description of the end-users' benefits and sustainability value; the illustration (via flow-charts) of the value network created by the stakeholders involved in the production, distribution and use of the solutions [Session A].
• Report the concepts and their scenarios in the plenary session.
  - At this stage, the scenarios generated so far need to be presented in the form of a story. This is, in fact, the time for the consolidation of a consistent and easy way of communicating the relevance of the new value propositions to the users who made themselves available for input [Session B].

Tools
Storyboards can be considered very useful tools during this step of the process. A sequence of sketches supported by brief explanatory sentences can effectively communicate the performance of the new *product-service systems* in specific situations and at a particular time. The objective is to make visible the user interaction with the product and service components and the achieved results.

Timeline
For a 3 day workshop (3rd day), this step requires approximately: 3 hours and 30 minutes for [Session A]; 30 minutes for [Session B].

Step 10 - Get feedback from the users
The aim is to adjust and enrich the concepts with input from their potential users. This includes the direct involvement of the users in the last stage of the design workshop.

Tasks and processes
• Bring to the workshop some of the users (between 3 to 5 people) who participated in the field study and / or in the consumer research activities addressed to feed the creative process.
  - The researchers and the designers (a maximum of 4 people) introduce briefly the overall goal of the workshop, and how the information provided by the users has been used in the process of ideas and concepts creation [Session A].

• Present to the users the concepts and scenarios generated during the workshop.
  - The designers explain the new business value propositions (with the support of graphic material including sketches and story boards) asking each user to reserve particular attention to such aspects as: problem solving; benefits generated; attractiveness and convenience; environmental and social advantages [Session B].
• Collect feedback and input from the users for the improvement of the concepts / scenarios.
  - The users are asked to evaluate the concepts either by providing eventual new insights on how the new solutions could contribute to the resolution of their specific problems in a better way; or by giving general comments on what aspects of the solutions they value more [Session C].

Tools
Cards used to describe key issues emerging in specific contexts of investigation at an early stage of the workshop, as well as graphic tools (storyboards) specifically elaborated to communicate how the new concepts can contribute to the resolution of such issues, can support the verbal exposure of researchers and designers. The key at this stage is a clear and simple communication of the narrative built around the new business value propositions and their features.

Timeline
For a 3 day workshop (3rd day), this step requires approximately: 15 minutes for [Session A]; 30 minutes for [Session B]; 90 minutes for [Session C].
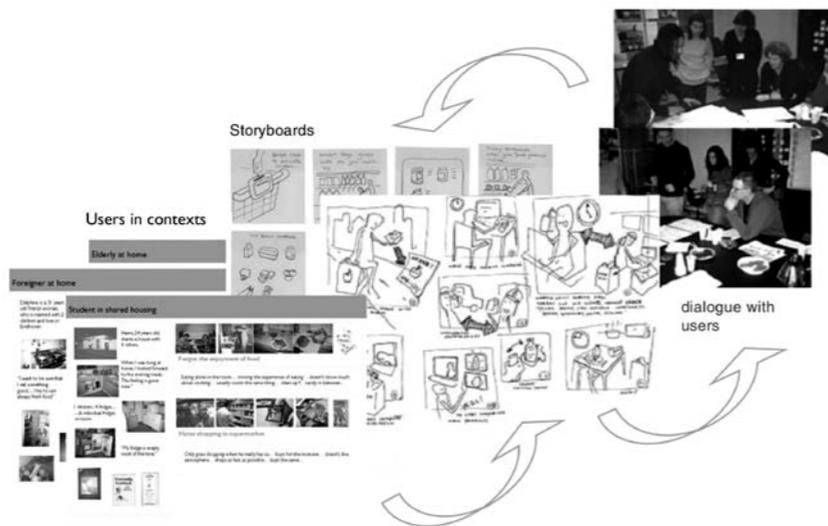
Toolbox 7 - Collection of users' input on the new concepts.

This image show the path followed for the collection of user feedback in the phase of concepts shaping, during the 'People with reduced access to healthy food' workshop carried out in 2002. The path starts with the explanation of the cards utilized to outline the major issues related to food (delivery / shopping, preparation and consumption). It continues by linking them verbally to the storyboards here used as a tool to establish a dialogue with the users, in the attempt to receive suggestions for concepts improvement / adjustments.

9.4 After the workshop
The material generated at the end of a couple of days of a creative workshop is usually only rough sketches and draft concepts delivered in different visual formats. To become the object of further discussion at business level, such material must be compiled and communicated in a comprehensive and accessible manner.

At this stage it is important to record all the results produced and the process followed, and work out graphically the most promising envisioned solutions in their functions, quality performances and single elements. This is the time when designers can best use their holistic skills to bridge technology and business competencies with individual and societal requirements, and their graphic skills to 'concretise' ideas, by making visible their added value.

9.4.1 Visualization and communication
Step 11 - Concepts articulation
The aim is to work out the selected value propositions and their scenarios. This is a continuation of the design activities by a team of researchers and designers, to translate the rough concepts into more comprehensive *product-service systems*.

Tasks and processes
• Create a complete overview of the new business value propositions (between two to five) in terms of their product, service and communication components, by making visible which sort of issues they are intended to solve, and how they are intended to solve it.
  - The researchers and designers (4 people) articulate the solutions in terms of their product specifications / service aspects, including the suggestions previously collected by the users [Session A].
• Visualize the performance of the solutions in their contexts of application: from the users' experience and interaction, to the functions performed by the global and local stakeholders involved in their production and delivery system.
  - The designers (2 people) work out / refine the concepts and their story boards to clearly communicate tangible and intangible values emerging in the new *product-service systems* [Session B].
• Visualize the business rationale underpinning the solutions and list all their solution elements.
  - The designers (2 people) create value network charts that include the material, information / knowledge and financial flows concerning the promotion of each *product-service system* [Session C].
  - The designers and the researchers (4 people) deconstruct the solutions into their global and local elements, and environmental and social aspects [Session D].
• Evaluate the market potentialities of the solutions to cover various contexts of application.
  - The designers and the researchers (4 people) re-map the new *product-service systems* in the context matrix, evidencing their potential to cover multiple contexts and issues [Session E].

Tools

This is the time to translate the content generated into digital formats for quick reproduction and distribution. With the aid of graphic programs, the hand-made sketches and storyboards can be refined in digital (and printable) leaflets. With the aid of PowerPoint files, the value network charts can be visualized and various layers of details from different perspectives added.

Timeline

For approximately a 10 day schedule, this step requires: 1 / 2 days for [Session A]; 6 days for [Session B] and [Session C]; 1 day [Session D]; 2 hours [Session E].
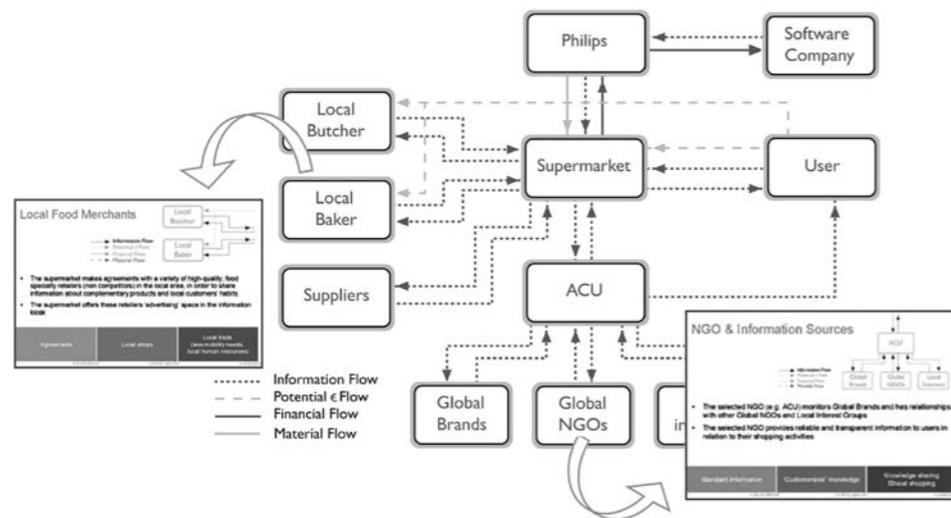
Toolbox 8 - Example of value network chart.

This image shows the visual representation of the financial, knowledge / information and materials flows underpinning the business rationale of one of the concepts of *product-service systems* generated during the 'People with reduced access to healthy food' workshop carried out in 2002. The image, in PowerPoint format, outlines the partner promoters, complementary local partners and their links. By clicking on the names of specific partners, more detailed information can be displayed, specifying single benefits, global and local components of the solution and its expected environmental and social values.

Step 12 - Report back to the partners

The aim is to create communication materials to fully document the outcomes of the creative process. This implies the compilation of reports in digital (and printable) formats that are able to support the partner promoters in the solutions review, evaluation and development phases.

Tasks and processes
• Write the minutes of the workshop and distribute them (digitally) to all the participants.
  - One researcher should compile the minutes of the workshop process, including all the outcomes of the creative session, and circulate them [Session A].

• Communicate the re-worked solutions to the users for their final validation.
  - The researchers and the designers (maximum 4 people) should organize a second review with the users to present to them the new version of the concepts resulting from the integration of their previous input [Session B].
• Compile comprehensive reports documenting the final solutions and their scenarios, and distribute them (digitally) to the industrial partners for their review and follow up.
  - After considering and including all further feedback from the users, the designers (2 people) should make reports that record the final version of the new business value propositions and their story boards [Session C].

Tools

Concerning the new round of concepts to be communicated to the users, the majority of the visual material produced so far can be easily selected and used to stimulate the discussion. Concerning the communication addressed to the workshop participants, the correct balance between written text and visuals is important. This is not only to easily remind all the partners about the content produced, but also to provide them with valuable tools for communication in their eventual attempt to involve other key partners in the solution development phase. PowerPoint documents can be considered the most accessible instruments to all at this stage.

Timeline

For approximately a 6 day schedule, this step requires: 2 days for [Session A]; 3 hours for [Session B]; 3 days for [Session D].
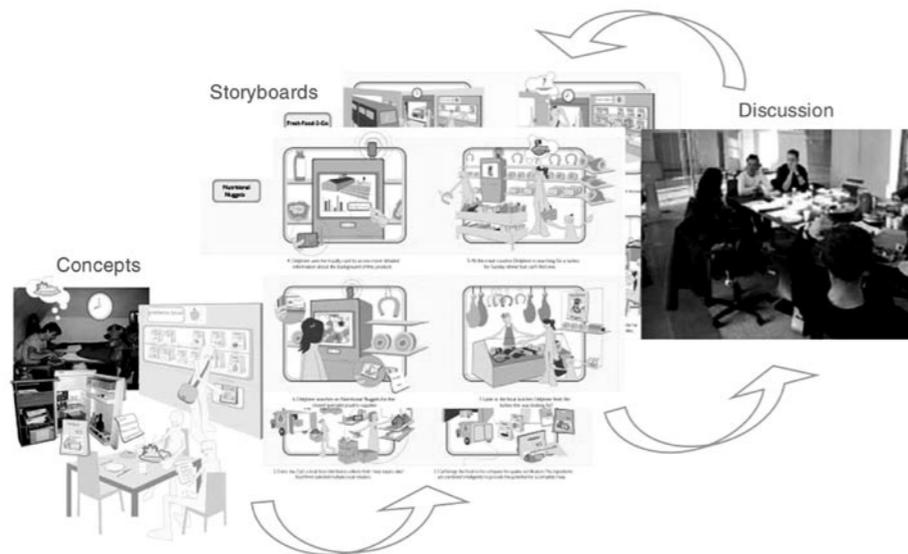
Toolbox 9 - Graphic material used in support of a verbal presentation to the users.

This image shows a few graphic tools utilized with some users in the concept validation phase, during the 'People with reduced access to healthy food' workshop carried out in 2002. It visualizes a user's issue related to access to healthy food, its resolution and the group discussion taking place with a couple of real users that could potentially benefit the new value propositions.

9.5 Observations

As already mentioned, the co-design approach described in this chapter is a qualitative practical instrument. It is intended to steer the creative process towards the achievement of economic value for the business on the one hand, and customer satisfaction on the other, while at the same time delivering social and environmental benefits to society. It is not, however, an instrument for quantifying such results. Nor does it replace conventional eco-design practices and technological changes designed to gain incremental environmental product or service improvements: it is an instrument of a different nature. It goes beyond technological changes towards social innovation in stimulating radical transformations of industrially-oriented patterns of production and consumption. Therefore, its use is recommended as a way of envisioning new solutions within radical innovation projects.

Nevertheless, since it can be deconstructed through - not necessarily linear - steps and tasks with their own specific aims, it can easily be adjusted to different situations and time scales. For instance, some of its steps can be applied during initial brainstorming sessions to reduce the risk of entering into partnerships with participants with different strategic interests and intents. Or it can be applied to create new concepts that fit within a certain vision already established by the business, or to visualize and articulate the economic, social and environmental components of a new *product-service system* already in an embryonic stage.

In comparison with the design methods reviewed in the theoretical part of this study, the co-design approach described above uses a holistic attitude to take two main factors simultaneously into account:

• both environmental and socially guiding principles, design orientation criteria and filters at the very beginning of the concept creation process
• the direct involvement of end-users in the concept creation process, as one of the several actors participating in the value-network.

In addition, to facilitate its replication, it tries to outline all the necessary competencies and the time required to perform each of the suggested steps.

The major limitation, it should be said, is that this approach has not considered establishing mechanisms for the continuation of a triple bottom line framework when the business proceeds to the next phase of solution development. As a result, some of the sustainability qualities of the new *product-service systems* envisioned in the creative process risk - at this stage - being lost if environmental and social corporate rules and business practices are not put in place in the execution of the other steps required by entire value-network. A further involvement of the researchers and the designers is therefore recommended not only for sorting out the detailed design aspects of the new solutions, but also as a way of guarding those soft values and qualities too often underestimated by business developers.

Specific findings emerging during its experimentation are reported in detail in the next chapter, within a dedicated section.

10 Conclusions and recommendations

This last chapter lists a series of conclusions and recommendations based on: reflections emerging from the theory discussed in Part One; the lessons acquired with the two experiments that have taken place within the Philips context and which, ultimately, resulted in the development of the co-design approach.

It ends with a brief outline of possible further research topics of investigation.

10.1 Learning from the theory

The first part of this study examined theories and empirical cases of *product-service systems* as a way of supporting business development and wealth generation, while at the same time encouraging a dematerialization of current production and consumption systems to the benefits of the natural environment and society. The transition from an industrially-oriented economy to a knowledge and service economy - characterized by a fast and broad diffusion of information and communication technology - has indeed created new conditions for doing business. Services have multiplied the options for the diversification of the offer - partially - overcoming the problem of rapid technological obsolescence, to assure major competitiveness. Digital services have, in several cases, replaced hardware functions, reduced or optimised the transportation activities of people and goods, and encouraged new patterns of product usage based on different forms of access.

When these aspects are combined with corporate environmental and social responsibility, or stewardship programmes, we have seen that triple bottom line ambitions become central, balancing economic targets with ethical and environmental issues. Considered from this perspective, theory and practice have shown that win-win solutions require a sustainability-driven innovation: the successful economic exploitation of new ideas regarding ways of production, marketing, distribution, and overall use that are able to create personal meaning, social equity, and environmental quality. Cultural and organizational business transformations, as well as the adoption of new design methods, become necessary ingredients for re-thinking current answers or finding new answers in this direction.

Working from the literature and from the business and design experiences emerging in the *product-service systems* area, some lessons can be summarized to guide enterprises on this challenging journey.

10.1.1. Business and design lessons

Realize that effectiveness means more than efficiency

Sustainability theories argue that eco-efficiency is a necessary, although not in itself completely sufficient, condition for the construction of a healthy society in the future. In particular, some theories assert that technology alone, even an environmentally friendly technology, cannot create sustainable value for 8 to 10 billion people in the years to come. And environmental product improvements using such eco-design criteria as energy and material saving, renewable resources, and so on can lose their benefits when the offer does not answer effectively to the customer's needs, wants and specific requirements. Only those solutions able to tackle concrete needs and problems in the best possible way, over time, have a chance of staying longer in the market and contributing consistently to triple bottom line achievements. Therefore, before thinking of new business value propositions, it is vital to fully understand:

- hidden or explicit customers' demands
- local socio-cultural values and physical infrastructures where such a demand takes form and is manifested.

"Understanding customers' needs, aspirations and requirements"

Value results and not products

What people currently value in advanced societies is not so much the material and tangible components of a business offer but its results, in terms of its functional performance, the experience provided, and the meanings represented. Since, from this perspective, the economic value of a solution is becoming increasingly related to its intangible benefits, new dynamics of value creation with a lower environmental impact and higher social purpose are now becoming more feasible than ever. New emerging entrepreneurial paths in this direction tend to emphasize:

- the service and the content stream of a solution (versus product value)
- brand equity and reputation aspects (as indicators of wealth)
- the promotion of patterns of consumption based on *access* and *usage* (parallel sharing, leasing, renting, pay-per-use, etc.) rather than *ownership.*

This allows for a radical re-thinking of the nature of the business offer via the investigation of *product-service systems* able to match technological potentialities with social innovation to gain competitive and long term sustainable advantages.

"Re-thinking the nature of the offer: creating value from values"

View partnership-building as a way of working

Competitive and sustainable *product-service systems* can rarely both be provided by a single company. Enterprises today need to establish alliances with suppliers, retailers, other business partners and, sometimes, not-for-profit organizations and public bodies, to co-produce adequate answers for users with increasingly complex lifestyles and societies with high expectations.

By sharing complementary competencies, expertise and capabilities, it is possible for enterprises to concentrate on their own core business while being able to broadly differentiate their portfolio of offers. By partnering with ad hoc global and local actors, they can discover innovative paths for marketing more context-specific solutions, while at the same time sharing costs and reducing the risks of innovation / development, as well as achieving scale economies in production / distribution. There are three key ingredients to such a strategy:

- the mixing and matching of global know-how with local knowledge
- making use of standard technologies but adapting them to local applications
- leveraging on local available human and environmental resources, and infrastructures.

"Co-creating value in a global market and local contexts"

Treat users as innovators

In a value co-creation process, professional customers and end-users can assume an important role. They can be involved in the design and development of a new business offer to better meet their individual specifications. Indeed, many users today want to be considered more than just passive receivers of a solution that can relieve them of certain activities and functions; they want increasingly to feel empowered in the personalization of the products and the services that they use. The business tendency is, therefore, to enable them to take steps to get more value out of a product to enhance their own productivity, capacity and self-fulfilment. In this regard, it is important for the business to:

- view users as the major experts in the resolution of their everyday problems
- involve users not only in the 'solution testing' phase but at an earlier stage, to gather their input to the 'concept creation' phase
- provide the users with open *product-service systems* that can ultimately - to a certain extent - be personalized.

"Innovating with real life knowledge"

Create better business models rather than get to the market first

In a knowledge and service economy, linear and hierarchical management 'thinking' is increasingly being replaced by contingent and adaptive 'thinking' that acknowledges the need to generate different ways of doing business. Value chains are being replaced by value networks, and - consequently - rigid management forms typical of industrial product-oriented organizations are progressively being replaced by flexible and dynamic

management formulas able to deal with a fast changing market that demands added-value solutions. These formulas imply the creation of new business models underpinned by the following basic internal cultural and organizational features.

• 'New visions' and 'creativity' and 'entrepreneurialism' are becoming crucial in a market in which decisions have to be made without the benefit of complete information.
• Knowledge is often externally developed but internally adapted and integrated.
• Specific 'content' and 'services' capabilities are delivered by an internal division / group, or by the creation of a new subsidiary company, or by the entire company following a change in its original mission, structure, and competencies.
• An incubation process is often necessary for the exploitation of the most innovative business ideas.
• Commercial patterns different from the usual one-time relationship of 'make / buy' are considered by leveraging on leasing, renting and pay-per-use schemes.
• Co-branding formulas become 'usual' practices in a process of value co-creation that includes different stakeholders.

"Doing business in new ways and not only new business ideas"

Diversify the options for revenue generation

Triple bottom line based *product-service systems* can be lucrative businesses. Companies showing environmental sensitivity and ethical leadership in the proposition of new combinations of tangible and intangible aspects in their business offers can gain profit, as well as brand reputation. However, it must be said that in many cases wealth creation (costs reduction and profit) often relates to the various forms of business exploitation related to the role that companies decide to play in the value network. Possibilities for business exploitation include the:

• use of re-furbished technologies and components in second-hand or new business value propositions (cost reductions)
• marketing of finished or semi-finished products outside conventional sales contracts (for example, increasing current market shares via leasing, renting and pay-per-use schemes)
• commercialisation of new digital devices or specific interfaces (i.e. the generation of new specific markets)
• exploitation of intellectual property rights (i.e. profit on knowledge)
• supply of specific product, service components or technologies to other business actors (i.e. extending traditional markets through various partners)
• promoting new packages of product, service and communication components outside the company's traditional business (i.e. entering new markets).

"Exploiting multiple forms and channels for wealth creation"

View design as a holistic and strategic approach

Aiming to create sustainable *product-service systems* requires moving from 'product thinking' to 'system thinking', from downstream 'as usual' eco-design practices to upstream activities able to integrate and translate a variety of inputs and information into competitive and sustainable value propositions. Viewed from this perspective, the design paradigm changes. Design cannot any longer be considered an activity reducible, for instance, to a 'make-up' exercise related to the choice of materials and colours, or to the 'engineering' phase of a solution. Nor can it be considered an activity taking place in isolation from the business value creation process. Design becomes instead an integral part of the business innovation process, with a key role to play in envisioning effective answers for actual or future demands by using information about society, technology and specific customers' requirements and expectations. Designers also become facilitators in a concept creation process involving different stakeholders. Seen from this viewpoint, design activities are increasingly characterized by the use of:

• a holistic approach that combines different expertise and know-how at a very early stage of the creative process
• a multidisciplinary team, including product and interaction designers, researchers, socio-cultural trends analysts, technology experts, marketing and business strategists
• a framework able to steer the creative process towards triple bottom line results through the use of design-related sustainability principles, criteria and tools
• an attitude to using and / or re-using currently available products and infrastructures.

"enhancing sustainable innovation by design"

10.2 Learning by doing: the methodological co-design approach

The co-design approach developed in this study can be considered the result of five years of design research in the field of *product-service systems*. It has been produced to capitalize on the knowledge made available on the subject in international business literature, contemporary European design projects and, in particular, on the two concepts generation workshops described in the experimental part of this thesis.

The challenges encountered in its development were related to a few paradoxes currently emerging in our economy. First, there is the dilemma of dealing with a society characterized by complex and sophisticated customer demands, and a business environment that is trying to provide meaningful and attractive answers to such a demand through simple applications. Secondly, we have the dilemma of collecting and handling a variety of knowledge needed to understand and anticipate current and future market requirements and constraints, while at the same time being under pressure to make fast decisions without the benefits of complete information. Finally, there is the need to balance intuition and creativity in the ideation phases of new value propositions of *product-service systems*, while putting in place a solid framework able to steer the process towards certain expected results.

Choosing the right expertise and participants, balancing individual activity with team work, permitting freedom of thought while applying analytical and structured activities became crucial in the definition of a design formula able to carry out concepts generation workshops placed at the core of new value creation processes. Overcoming these challenges, the co-design approach has been thought to provide a practical guide and related tools (tools-kit) to designers and workshop facilitators during the creation of sustainability-based, new business value propositions. It was expressly created to put in place a cost-effective, flexible, fast, easy-to-use instrument able to contribute to the business innovation process of today.

Findings emerging during its iterative process of development and refinement have been translated into the observations and recommendations reported below.

10.2.1 Specific findings of the experimentation
Set the scene properly
The preparation of the workshop participants and the definition of the design brief are activities too often underestimated in the organization of a concept creation process: this can irreversibly compromise the quality of the outcome. In this regard, it has been found that some basic knowledge gathering, exchange and assimilation need to take place before the participants come together to generate concepts: so that everyone possesses the same level of understanding of the content to be addressed. Moreover, a clear framework and agenda for carrying out the process needs to be considered in advance by:

• selecting the right mix of experts and creative 'thinkers' that could best contribute to the achievements of the expected results
• considering 'how' to organize knowledge sharing and brainstorming sessions, 'when' to use steering tools, and 'when' to leave space to free activities in the process
• planning carefully the time required for each activity to reserve enough room for discussion, but also for concept creation (including time to open up minds and to create focus)
• placing the content that needs to be shared into a communicable and digestible format, not only to inform, but also to inspire, the participants.

"sharing information and creating inspirational knowledge"

Distinguish leaders for facilitation and content provision
The facilitation process is vitally important and 'content leading' is essential in any innovative project with complex briefs. Experimentation has shown that to get quality results in a workshop, it is important to assign these tasks to two different leaders with the appropriate capabilities: even if working very closely to each other, they will assume independent roles. The facilitator needs to technically guide the process, keeping control of process, time and people, and explaining the exercises. He / she needs to be a strong and smart leader who:

• encourages and speeds activities, or changes the process when necessary
• chooses team-leaders to steer the process during working group sessions
• ensures that everything produced and discussed is recorded.

The content leader needs to explain the brief, making clear the workshop objectives and the expected results. In doing this, he / she needs to interact promptly with the audience to cover questions, and to ensure that all information necessary to feeding the workshop activities is:

• made available (by himself / herself, the participants and via communication tools)
• communicated at the right moment in the process.

"guiding and feeding creativity to get better outcomes"

Specify roles and contributions of participants
A solid framework, content and facilitation leadership become valuable only if combined with motivated and knowledgeable participants able to contribute to the overall results. Business representatives, sustainability experts, researchers, designers and various ad hoc experts are vital for the creation of an environment in which innovative ideas can be translated into powerful market propositions. However, their physical presence and their involvement are not always necessary - or even recommended - at every phase of the process. Practice has shown that different tasks and their related activities require a balance of different expertises, depending on the aims to be achieved. Therefore, the following considerations should be kept in mind when organizing such a process.

• A business presence is very important, especially during the initial activities, to make clear the project's positioning, vision and direction. But at a certain moment, it is equally important that business leaves the designers to work independently (to avoid interruptions to the creative flow).
• The users' involvement must also be planned carefully, both to make them comfortable when participating and speaking in a session with a restricted team of researchers and designers, and to avoid creating high expectations in them with regard to final results (that in the end - to be marketed – effectively need to deal with so many variables).

"co-designing by leveraging on each other competencies and expertise in the right way"

Make use of tailored design tools
A creative process that has to deliver solutions respecting several parameters and fulfil certain expectations needs to make use of appropriate design instruments. Indeed, appropriate design tools can help participants, step by step, in generating ideas and shaping them according to the requirements of the original brief: they can steer the 'thinking' process, guiding the activities and facilitating the record of their outcome. In particular, it emerges from the experiments that design instruments can:

- effectively communicate informative and 'inspirational' knowledge with different levels of specification during different stages of the 'thinking' process (i.e. technology and market information, sustainability requirements, users-in-contexts knowledge, etc.)
- stimulate the creation of comparable results through the use of templates that ask participants to consider a few common ingredients when envisioning solutions (from idea generation to scenario building), while documenting the outcomes and, therefore, facilitating their dissemination, both during and after the workshop.

"enhancing the creation of comparable results"

Evaluate the results at the half way stage
Evaluation and filtering are important tasks for narrowing down the many ideas flourishing in brainstorming sessions and, therefore, in selecting those ones more in line with the original design brief. However, they are also important tasks in re-orienting and adjusting such ideas by stretching their embryonic qualities and features. In particular, they can be considered occasions for contributing to the shaping of the emerging concepts using a triple bottom line perspective. In this regard, it is extremely important to:

- make a qualitative concepts' evaluation to understand the market potentialities of the hypothesized solutions before proceeding to their detailed elaboration
- analyse the potential social and environmental value of the new concepts at an early stage, to improve and stretch - eventually - such values
- understand the concepts' flexibility - how well they can be customized for different applications - before proceeding with their ranking.

"assessing the concepts by triple bottom line parameters"

Outline the business rationales of the design concepts
The difference between an idea of *product-service systems* at a stage of design concept or at a stage of feasible economic value proposition is expressed in the articulation of its business rationale: 'how' can a concept assume economic value and how can it be commercialised? The explanation of an innovative idea's value creation dynamic, as well as the identification of the potential - global and local - partners needed to bring it successfully to the market, substantiate a solution and get business attention. But not only. It has been found that, if this task is performed during concept shaping and articulation, it contributes to the identification of the most appropriate solution elements, especially in terms of product and service features. An effective way to perform this task outlines:

- the knowledge / information flow underpinning the content delivered
- the material flow, including all hardware and physical assets exchanged
- the financial flow, specifying 'who' gains 'what' in the complete value-network.

"envisioning the emerging value-networks with knowledge, material and financial flows"

Visualize and package the outcome to facilitate follow-up actions
The previous step experimented with the methodological co-design approach focused on the packaging of all content generated through the use of various formats. Indeed, visualization and communication are important activities capable of supporting a business's decision makers in proceeding towards the next step: solutions development. In this regard, it is important to make fully available:

- all the content generated, from initial out-of-the-box ideas to end solutions and scenarios
- the outcome of the discussions that have taken place, including divergences and agreements on results and the process followed
- a complete visualization of the most promising value propositions of *product-service systems* and their related envisioning scenarios.

"encouraging decision making via a clear communication process"

10.3 Next possible research direction
The observations and recommendations listed above conclude this particular investigation. However, in no way do they represent the end of all the work still to be done, both in the short and long term, in determining how to diffuse triple bottom line based solutions in complex economies. Indeed, methodologies and tools on sustainable *product-service systems* have been elaborated on and experimented with in advanced societies, but their application in developing and emerging markets - which represent the 5 billion 'underserved' people of the world - is still a very open question. It is also a question that is bound to become crucial in the next decade, since many enterprises have already recognized these new markets as the next big opportunity for economic development.

The philosophy and the principles proposed with the co-design approach developed with this study are broadly applicable. The creation of affordable and sustainable solutions can start from the same ingredients: understanding the local physical and socio-cultural contexts; partnerships building; co-creation of value and users participations. Nevertheless, customized methods and tools need to be developed to become operative and effective in such markets. The main questions that arise in this regard are as follows.

- How can we investigate people's priority needs, wants, and even aspirations, in territories characterized by different socio-cultural values and belief systems?
- How can we establish a democratic process of value co-creation in which both global and local actors can win?
- How can we facilitate the socio-economic development of local communities, and respect - at the same time - the natural environment?

More specifically:

• how can we bring the 'voice' of potential future customers into a co-design process aimed at providing solutions that can answer their specific requirements?
• how can we make sure that environmental and social issues are considered equally in such a process?

Business experiments and academic investigations have just started to address a few of these questions, all of which could become material for a new research topic.

The hope, so far, is that this action-research study has brought forward a useful and practical design approach: an approach that enables the creation of competitive *product-service systems* which may ultimately provide a better answer to a new idea of **sustainability-driven progress**, by being related to users in their specific contexts of life, and by being sensitive to environmental and social issues.

APPENDICES

APPENDIX 1

Background information for workshop A:
'People with reduced mobility and
personal well-being'

List of workshop A participants:
'People with reduced mobility and personal well-being'

Philips Design
10th - 11th of May, 1999
Eindhoven

From Philips Design (process and organization / facilitation of the workshop)
Albert Verburg - Web Design
Bertrand Rigot - Strategic Design
Jeroen Raijmakers - Philips Medical Systems
Job Rutgers - Advanced Interaction Design
Josephine Green - Trends & Strategy
Liesbeth Scholten - Advanced Interaction Design
Pete Matthews - Advanced Interaction Design
Reon Brand - Trends & Strategy
Roland Bird - Strategic Design
Ron Oosterholt - User Interface Design
Simona Rocchi - Trends & Strategy

From Philips
Geert Christiaansen - Home Networking Group, Philips Consumer Electronics
Judith Masthoff - Philips Research

From University
Ezio Manzini - Politecnico di Milano
Mika Pantzar - Helsinki School of Economics

Workshop programme May 10th (1st day)

09.00 - 09.45	Welcome + introductory activity
09.45 - 10.15	Exploratory discussion: *What is a service? What is a product?*
10.15 - 10.30	Workshop briefing (aim, focus, expectations)
10.30 - 10.45	Break
10.45 - 11.30	'Towards a new product-services mix': theory and experiences
11.30 - 12.30	Exploratory discussion: *sustainability*, *healthcare* and *lifelong learning*
12.30 - 13.30	Lunch
13.30 - 14.30	Activities + needs mind-mapping exercise
14.30 - 15.15	Needs formalization + products/services identification
15.15 - 15.35	Break
15.35 - 16.15	Opportunities for *healthcare*
16.25 - 17.30	Concept generation: *healthcare*
17.30 - 18.00	Idea prioritization + general feedback

Workshop programme May 11th (2nd day)

09.00 - 09.20	Welcome + summary of the previous day
09.20 - 10.00	Opportunities for *lifelong learning*
10.00 - 11.00	Concept generation: *lifelong learning*
11.00 - 11.15	Break
11.15 - 11.45	Continuation concept generation / review
11.45 - 12.30	Concept review + selection
12.30 - 13.30	Lunch
13.30 - 15.00	Final concepts detailing + visualization
15.00 - 15.20	Break
15.20 - 17.00	Continuation final concepts detailing + visualization
17.00 - 17.50	Groups presentation
17.50 - 18.00	Next steps & closing

Concepts assessment: criteria for the selection

The following criteria[62] were used for evaluating and filtering the 28 concepts produced in the workshop. The scoring was done on a scale of 1-3.

TECHNOLOGICAL FEASIBILITY in the short-medium term (between 1 to 3 years)

- **Availability**
  [1] Technology is still in a process of development.
  [2] Technology can be easily developed.
  [3] Technology is already available on the market.

- **Difficulty of implementation**
  [1] High complexity of technology (time required for the implementation of the concept: from three to five years).
  [2] Medium complexity of technology (time required for the implementation of the concept: from one to three years).
  [3] Low complexity of technology (time required for the implementation of the concept: less than one year).

- **Competence fit**
  [1] Know-how on technology to be built up from scratch.
  [2] Know-how on technology accessible through partners.
  [3] Know-how on technology in house.

ECONOMIC FEASIBILITY

- **Market attractiveness**
  Perceived value in terms of degree to which the concept offers clear benefits to the user in comparison to already existing products/solutions:
  [1] social latent demand
  [2] demand organized on non-commercial basis
  [3] explicit commercial demand.

  Size of the need:
  [1] niche product-service systems
  [2] sizeable target group
  [3] mass appeal.

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[62] Many of the quoted criteria have been extrapolated from previous experiences that took place in Philips Design for technology and business assessment phases, in particular in relation to a project carried out for Philips Domestic Appliances (1998).

How far the concept is perceived by the user as difficult:
[1] it requires particular knowledge and skills
[2] requires some basic knowledge
[3] easy interaction.

• Business opportunities
Patentability as unique business competitive advantage:
[1] market share battle
[2] generic competition
[3] no current competition.

Potential for implementation of the concepts:
[1] strategic alliances
[2] various Philips businesses
[3] single Product Division mainstream business.

Commercial fit:
[1] creation of new distribution channels
[2] available alternative channels of distribution
[3] distribution chains already in place.

POTENTIAL CUSTOMIZATION

• Flexibility of application
The emerging product-service systems target different specific segments of population
(they can be easily differentiated and up-graded):
[1] low flexibility of application
[2] medium flexibility of application
[3] high flexibility of application.

• Level of customisation
The emerging product-service systems can provide for the satisfaction of individual
people's needs. Customisation has been pursued for each concept by adding specific
service and product components to a standard technological package:
[1] customisation in relation to target groups' needs
[2] customisation in relation to segmented users' needs
[3] customisation in relation to single user's requirements.

SUSTAINABILITY AT SOCIO-TECHNOLOGICAL SYSTEM SCALE

• Environmental aspects
Valorisation of the use of existing infrastructures/resources:
[1] no real improvement in the use of existing physical infrastructures/resources
[2] limited use of current available physical infrastructures/resources
[3] optimisation of current available physical infrastructures of support.

Reduction of the transport intensity:
[1] no reduction of mobility
[2] reduction of mobility on periodic basis
[3] reduction of mobility on a daily basis.

• Social aspects
[1] low use of existing social resources and networks (for example, capitalizing on local
social institutionalised assistance networks)
[2] optimisation of existing social resources and networks
[3] creation of new social links and self-support groups

Improvement of well-being conditions by leveraging on the diffusion of an information
and service cultural paradigm:
[1] ICT does not support the creation of personal well being conditions
[2] ICT supports the creation of personal well being conditions
[3] ICT generate better quality of life conditions for the community.

APPENDIX 2

Background information for workshop B:
'People with reduced access to healthy food'

List of workshop B participants:
'People with reduced access to healthy food'

Philips Design
28th – 29th – 30th November, 2002
Eindhoven

From Philips Design (process and organization / facilitation of the workshop)
Alex Tan
Anja Janssen
Christina Lindsay
Fiona Rees
Geke Deetman
Liesbeth Scholten
Robert Kortenoeven
Remco van der Velden
Simona Rocchi

From Philips
Philips Lighting / Solar - Mark Vermeulen (also representing Steven Pleging of Philips Solar)
Philips Research - Cees Ronda

From Duni
Erik Indekeu
Filip Fransen

From TNO Industries
Michel van Schie

From Trittico
Raoul Dumoulin

From Whirlpool
Claudio Civanelli
Davide Gerola

Workshop programme November 28th (1st day)

09.00 - 09.30   Arrival and coffee
09.30 - 09.50   Introduction by Geke Deetman & Liesbeth Scholten
09.50 - 10.30   Background, aim of the workshop and briefing by Simona Rocchi
10:30 - 10.55   Presentation by Erik Indekeu, Duni
10.55 - 11.20   Presentation by Raoul Dumoulin, Trittico
11.20 - 11.30   Break
11.30 - 11.55   Presentation by Claudio Civanelli, Whirlpool
11.55 - 12.20   Presentation by Cees Ronda, Philips Research
12.20 - 13.10   Lunch
13.10 - 13.30   Presentation by Mark Vermeulen, Philips Lighting / Solar
13.30 - 13.50   Individual post-it exercise + discussion
13.50 - 14.50   'Contexts' presentation by Christina Lindsay & Remco v.d. Velden
14.50 - 15.30   Exercise: context of use exploration in 3 groups
15.30 - 15.45   Break (with small exercise)
15.45 - 16.45   Exercise: 'out-of-the-box' idea generation in 3 groups
16.45 - 17.15   Wrap up discussion & presentation of ideas
17.15 - 17.30   Closing

Workshop programme November 29th (2nd day)

09.00 - 09.10   Introduction
09.10 - 09.30   Summary of the post-it exercise of the first day
09.30 - 10.10   Idea generation in pairs
10.10 - 10.45   Idea extension in groups
10.45 - 10.50   Break, value network and template description bySimona Rocchi
10.50 - 11.45   Business rationale exercise in groups
11.45 - 13.00   Presentations and concepts evaluation
13.00 - 13.30   Conclusions / closing discussions (industrial partners leave)
13.30 - 14.00   Lunch
14.00 - 14.15   Agenda for next design activities and discussion by Liesbeth Scholten
14.15 - 14.30   Review of the concepts
14.30 - 15.30   Concepts enrichments: users perspective and sustainability
15.30 - 15.45   Break
15.45 - 16.45   Concept clustering, mapping and filtering
16.45 - 17.00   Closing and introduction to next day by Liesbeth Scholten

Workshop programme November 30th (3rd day)

09.30 - 09.45   Introduction and aim of the day by Simona Rocchi
09.45 - 12.30   Concepts articulation and story boards
12.30 - 13.30   Lunch
13.30 - 14.00   Status of the working activities and discussion
14.00 - 14.30   Finalization of the story boards
14.30 - 15.15   Presentations to the users (recruited from the field work)
15.15 - 15.45   Feedback from the users
15.45 - 17.00   Working together with the users: concepts enrichment
17.00 - 17.15   Closing: summing up and conclusions
17.15 - 18.30   Wrap-up party

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Summary

In the coming decades, societies will have to learn how to flourish while decreasing their total production and consumption of physical goods. This is certainly an environmental challenge but also a socio-cultural, economic and political challenge. Indeed, to be eco-efficient merely by optimising the level of industrial production processes is, although a required change, insufficient to satisfy the 'needs' and the 'wants' of the 8 to 10 billion people expected by 2025. The path towards a more sustainable future requires a change both in the way products and services are made, marketed and distributed (new patterns of production), and the way in which products and services are used (new patterns of consumption).

Enterprises searching for competitive and sustainable solutions in this direction have often started to go beyond the boundaries of their traditional business offers and experiment with innovative methods for value creation. They have started to richly combine tangible and intangible assets (products, services, experiences and meanings) into flexible and open *product-service systems*, systems that are better able to fit users' needs in their socio-cultural, physical and natural contexts. And in doing this, such enterprises are developing innovative business logics grounded in partnerships with multiple stakeholders at both the global and local scale, and in various patterns of usage, both facilitated by the fast diffusion of information, communication and networking technologies.

From this overall perspective, this study analyses theoretical references and empirical business examples[63] on the topic of *product-service systems* with reduced environmental impact, to understand its peculiarities and the emerging lessons that lead towards a sustainable growth. Particular attention is reserved for the role that design can play in facilitating today's business innovation process in advanced economies. The goal is to develop a broadly applicable and practical design approach to envisioning *sustainable product-service systems*[64].

One of the main outcomes of the study has been the elaboration of a design process - and its 'tools-kit' - by an action-research linking literature with experimentation practices carried out via two concept creation workshops taking place at Philips Design (the design service unit of Philips). By bringing environmental and social parameters - and the 'voice' of the users - into the ideas and concepts creation phase, this design process aims to increase

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[63] The field of investigation is digital networking and information and communication technology, with a particular focus on the electronics and consumer electronics sector in Western markets.
[64] *Sustainable product-service systems* (SPPS) are here defined as profitable combinations of integrated and mutually dependent product and service components able to fulfil a user's demands, while also containing the consumption of environmental resources and enhancing quality of life.

the chances for business to provide competitive, user-centred value propositions with limited environmental impact. Such a process proposes twelve practical steps - specifically, activities to support business innovation projects - by finding a practical way of making 'sustainability' part of their design briefs.
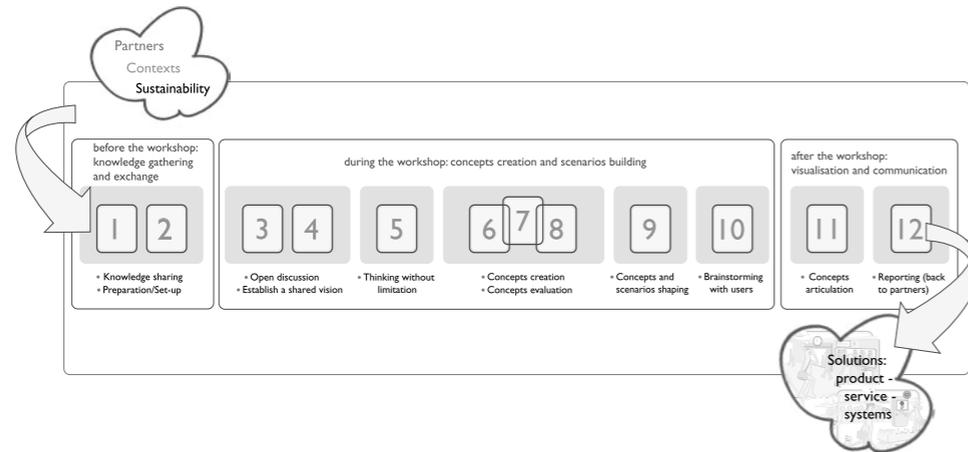

Figure - Co-designing sustainable value: visualization of twelve practical steps.

This scheme links twelve design steps for the co-creation of economic, social and environmental value with a few specific activities to be performed throughout the process.

Three building blocks can be recognised as the basis of this process.

• A triple bottom line steering framework in terms of sustainability-related guiding principles, design criteria and filters considered at the very beginning of the concept ideation phase.
• A dynamic of value co-creation for the definition of new global-local propositions involving actors with different competencies and expertise; in particular, the end-users.
• A view of product-service systems as combinations of product and service components that can modify their functions, and eventually growth, over time.

When considering these building blocks, it is important to remember that the process elaborated is not prescriptive but open to appropriate adaptations in response to different projects' requirements and the tasks to be achieved. It can also be deconstructed in a pre-workshop, workshop and post-workshop phase. Each phase requires specific expertise and knowledge about markets, technology, society and environmental / social concerns.

The overall approach is fundamentally based on qualitative knowledge. The sustainability value and the economic benefits that could potentially be achieved by its application are not, therefore, meant to be measured in quantitative terms. Indeed, it should be considered only as a preliminary to those quantitative methods normally used at later stages:

specifically, in the concept development phases, when the environmental and social performances are being measured. Furthermore, it does not replace conventional eco-design practices: it is an instrument of a different nature. It moves beyond the modification of products and their technological changes towards answers able to stimulate social innovation and, therefore, to facilitate a radical transformation of industrially-oriented patterns of production and consumption.

Completing the study, a series of observations and recommendations have been formulated - extracted from the theory and the experimentation - for the benefit of entrepreneurs and designers. After reflecting on the literature, it can be generally stated that cultural and organizational business transformations, as well as the adoption of a new design paradigm, can become fundamental conditions for pursuing a sustainable growth. Specifically, new business opportunities, as product-service systems, can be found by re-thinking current answers, or finding new answers, to societal needs and wants via an innovation process that must consider the following lessons.

• Realize that effectiveness means more than efficiency - "Understanding customers' needs, aspirations and requirements."
• Value results and not products - "Re-thinking the nature of the offer: creating value from values."
• View partnership-building as a way of working - "Co-creating value in a global market and local contexts."
• Treat users as innovators - "Innovating with real life knowledge."
• Create better business models rather than get to the market first - "Doing business in new ways and not only new business ideas."
• Diversify the options for revenue generation - "Exploiting multiple forms and channels for wealth creation."
• View design as a holistic and strategic approach - "enhancing sustainable innovation by design."

Based on conclusions resulting from the experimentation, it is evident that choosing the right expertise and participants, balancing individual activity with team work, and permitting freedom of thought while applying analytical and structured activities are all crucial activities in the definition of a design formula able to carry out concepts generation workshops placed at the core of new value creation processes. In particular, the following specific observations can be highlighted.

• Set the scene properly - "by sharing information and creating inspirational knowledge."
• Distinguish leaders for facilitation and content provision - "by guiding and feeding creativity to get better outcomes."
• Specify the roles and contributions of participants -"co-designing by leveraging on each other competencies and expertise in the right way."

- Make use of tailored design tools - "*to enhance the creation of comparable results*"
- Evaluate the results at the half way stage - "*assessing the concepts by triple bottom line parameters.*"
- Outline the business rationales of the design concepts - "*by envisioning the emerging value-networks with knowledge, material and financial flows.*"
- Visualize and package the outcome to facilitate follow-up actions - "*encouraging decision making via a clear communication process*"

These final observations and recommendations conclude this particular investigation. However, in no way do they represent the end of all the work still to be done - in both the short and long term - in determining how to diffuse triple bottom line based solutions in complex and dynamic markets. Nevertheless, the hope is that this action-research study has brought forward a useful contribution: a practical design approach that enables the creation of *product-service systems* that, by being related to users in their specific contexts of life, and by being sensitive to environmental and social issues, may ultimately better answer a new idea of sustainability-driven progress.

Nederlandstalige Samenvatting (Summary in Dutch)

In de komende decennia zal de maatschappij moeten leren zich verder te ontplooien en tegelijkertijd de totale produktie en consumptie van goederen laten afnemen. Dat is niet alleen een milieu uitdaging maar ook een sociaal-culturele, economische en politieke uitdaging. Hoewel het eco-efficiënt optimaliseren van industriële produktieprocessen een vereiste verandering is, is zij onvoldoende om de behoeften en de wensen te bevredigen van de verwachte 8 tot 10 miljard mensen in 2025. Het pad naar een duurzamer toekomst vereist een verandering van zowel de wijze waarop produkten en diensten worden gemaakt, verhandeld en gedistribueerd (nieuwe produktie patronen) als waarop produkten en diensten worden gebruikt (nieuwe consumptie patronen).

Ondernemingen die op zoek zijn naar concurrerende en duurzame oplossingen in deze richting zijn vaak begonnen te experimenteren met innovatieve methoden van waarde creatie over de grenzen van hun traditionele bedrijfsinspanningen heen. Zij zijn begonnen om materiële en immateriële activa (produkten, diensten, ervaringen en betekenisgeving) succesvol te combineren met flexibele en open *produkt-service systemen*; systemen die beter in staat zijn om tegemoet te komen aan de context van de sociaal-culturele, fysieke en natuurlijke behoeften van gebruikers. Daardoor ontwikkelen die ondernemingen innovatieve bedrijfsconcepten die gebaseerd zijn op partnerschap met verschillende *stakeholders* op zowel wereldschaal als lokaal niveau en in verschillende gebruikspatronen; de snelle verspreiding van informatie, communicatie en netwerk technologieën voorziet in de voorwaarden hiervoor.

Deze studie analyseert, op basis van dit overkoepelende perspectief, de theoretische referenties en de empirische bedrijfsvoorbeelden[65] van de *produkt-service systemen* met verminderde milieubelasting om zo de bijzonderheden van de zich voordoende lessen, die naar duurzame groei leiden, te begrijpen. Speciale aandacht wordt besteed aan de rol die *het ontwerpen* kan spelen in het scheppen van de voorwaarden voor de huidige bedrijfsinnovatie processen in geavanceerde economieën. Het doel is een uitgebreid toepasbare en praktische *ontwerp* benadering te ontwikkelen om te voorzien in *duurzame produkt-service systemen*[66].

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[65] Het onderzoeksveld is de digitale netwerk-, informatie en communicatie technologie met speciale aandacht voor zowel de algemene als consumenten electronica sector in westerse markten.
[66] *Duurzame produkt-service systemen* zijn hier gedefinieerd als winstgevende combinaties van geïntegreerde en wederzijds afhankelijke produkt en service componenten die in staat zijn om consumentenvragen te beantwoorden, waarbij ook aandacht wordt besteed aan milieubronnen en de verbetering van de kwaliteit van leven.

Eén van de voornaamste uitkomsten van de studie is de uitwerking geweest van een ontwerp-proces – inclusief een *tools-kit* – door middel van de interactie tussen *action-research* literatuur en praktijk experimenten die zijn uitgevoerd in twee concept creatie workshops die bij Philips Design (de ontwerp service afdeling van Philips) hebben plaatsgevonden. Door milieu en sociale parameters – alsmede de *stem* van de gebruikers - in de ideeën en concept creatie fase te betrekken, streeft dit ontwerp proces naar het vergroten van kansen voor bedrijven om te voorzien in concurrerende, gebruikersgerichte voorstellen met een beperkt milieu-effect. Zo'n proces houdt in om door twaalf stappen in de praktijk – met name activiteiten om bedrijfsinnovatie projecten te ondersteunen – een praktische invulling van *duurzaamheid* als onderdeel van hun ontwerpinstructies te ontwikkelen.
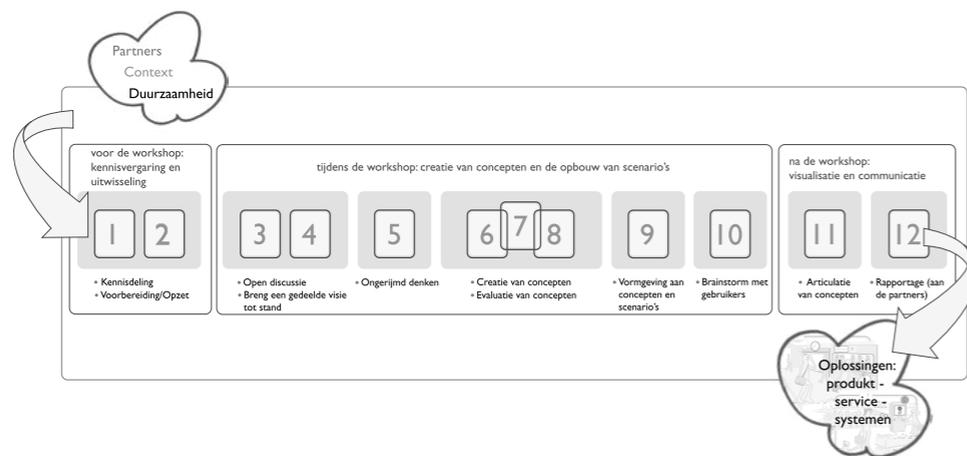
Figuur - Het co-ontwerpen van duurzame waarde: de visualisering van twaalf praktische stappen.

Dit schema verbindt twaalf ontwerpstappen voor de co-creatie van economische, sociale en milieuwaarde met een paar specifiek doorlopende activiteiten in alle proces fasen.

Drie bouwstenen staan aan de basis van dit proces.

- Een door *triple bottom line* principes gestuurd raamwerk in termen van aan duurzaamheid gerelateerde richtlijnen, ontwerp criteria en filters dat aan het allereerste begin van de concept ideeënvormingsfase in beschouwing wordt genomen.
- Een dynamische waarde co-creatie voor de definitie van nieuwe *global-local* voorstellen die actoren met verschillende competenties en kennis er bij betrekken; met name de eindgebruikers.
- Een opvatting over *produkt-service systemen* als combinatie van produkt en service componenten die hun functies, en eventuele groei, over langere tijd kunnen veranderen.

Bij de beschouwing van deze bouwstenen is het belangrijk om te onthouden dat het ontwikkelde proces niet beschrijvend is, maar open om geschikte veranderingen door te voeren in antwoord op de verschillende projecteisen en de te bereiken doelen mogelijk te maken. De benadering kan ook worden ontmanteld en opnieuw opgebouwd in bijeenkomsten vóór en na de *co-creatie workshop*. Elke fase vereist specifieke expertise en kennis van markten, technologie, maatschappij, milieu en sociale zorg.

De overkoepelende benadering is fundamenteel gebaseerd op kwalitatieve kennis. De duurzaamheidswaarde en de economische voordelen, die potentieel door die toepassing kunnen worden bereikt zijn daarom niet bedoeld om in kwantitatieve termen gemeten te worden. De benadering zou echter alleen als een voorloper van kwantitatieve methoden die normaliter in latere fasen worden gebruikt, beschouwd moeten worden: met name in de concept ontwikkelingsfasen, wanneer de milieu en sociale effecten worden gemeten. De benadering komt niet in de plaats van conventionele *eco-design* praktijken: het is een instrument van een andere aard. Het stijgt uit boven de wijziging van produkten en hun technologische veranderingen in de richting van antwoorden die sociale innovatie kunnen stimuleren en daarom de voorwaarden kunnen scheppen voor een radicale transformatie van industrie-georiënteerde produktie- en consumptie-patronen.

Bij het voltooien van de studie is op basis van theorie en experimenten een aantal observaties geanalyseerd en aanbevelingen geformuleerd ten behoeve van ondernemers en ontwerpers. Na reflectie op de literatuur kan in het algemeen worden gesteld, dat zowel culturele en bedrijfsorganisatie transformaties als de adoptie van een nieuw ontwerp paradigma, fundamentele voorwaarden kunnen worden voor de ontwikkeling naar duurzame groei. Vooral nieuwe *business* kansen zoals *produkt-service systemen* kunnen worden gevonden door het opnieuw denken over de huidige antwoorden, of het vinden van nieuwe antwoorden op maatschappelijke behoeften en wensen met behulp van een innovatieproces waarvoor de volgende lessen moeten worden overwogen.

- Realiseer je dat effectiviteit meer betekent dan efficiency - "*Het begrijpen van behoeften, aspiraties en eisen van consumenten.*"
- Waardeer resultaten en niet produkten - "*Het opnieuw denken over de aard van het aanbod: het creëren van waarde uit waarden.*"
- Beschouw het opbouwen van partnerships als een manier van werken - "*Co-creatie van waarde in een wereldmarkt en in een lokale context.*"
- Behandel gebruikers als innovators - "*Het innoveren met kennis van het dagelijkse leven.*"
- Creëer, in plaats van eerst je intrede op de markt te doen, betere bedrijfsmodellen - "*Het doen van zaken op een nieuwe manier en niet alleen ideeën over nieuwe zaken.*"
- Onderscheid de opties voor het genereren van opbrengsten - "*Het exploiteren van verschillende vormen en kanalen voor welvaart-creatie.*"
- Beschouw *ontwerpen* als een holistische en strategische benadering - "*Het vergroten van duurzame innovatie door ontwerpen.*"

Op basis van de conclusies over de experimenten wordt het duidelijk dat de keuze voor de juiste expertise en deelnemers, die individuele activiteiten en *team-work* in balans brengen, en die zich zowel gedachtenvrijheid permitteren als analytische en structurele activiteiten toepassen, allemaal cruciale activiteiten zijn in de definitie van een ontwerpformule die het mogelijk maakt om concept-genererende workshops te organiseren binnen het hart van nieuwe waardecreatie processen. De volgende specifieke observaties kunnen in het bijzonder worden benadrukt.

- Organiseer de vereiste duidelijkheid voor de bijeenkomst - "*door informatie uitwisseling en de creatie van inspirerende kennis.*"
- Onderscheid leiders voor de facilitering en de inhoud van de bijeenkomst - "*door het leiden van en voeding geven aan creativiteit worden betere uitkomsten verkregen.*"
- Specificeer de rollen en de bijdragen van de deelnemers - "*het mee-ontwerpen door de inbreng van elkaar's competenties en kennis op de juiste manier.*"
- Maak gebruik van pasklare ontwerpinstrumenten - "*het versterken van de creatie van vergelijkbare resultaten*"
- Evalueer de resultaten halverwege - "*het inschatten van de concepten door 'triple bottom line' parameters.*"
- Schets het bedrijfsbelang van de ontwerpconcepten - "*door het zichtbaar maken van opkomende waarde-netwerken met kennis-, materiële en financiële stromen.*"
- Visualiseer de uitkomst en wend haar aan om vervolgacties te faciliteren - "*het aanmoedigen van de besluitvorming door een helder communicatie proces*"

Deze laatste observaties en aanbevelingen besluiten dit bijzondere onderzoek. Zij representeren echter op geen enkele wijze het einde aan al het werk dat – zowel op de korte als de lange termijn - nog gedaan moet worden in het vaststellen van hoe op *triple bottom line* gebaseerde oplossingen te verspreiden in complexe en dynamische markten. Desalniettemin is de hoop dat deze *action-research* studie een bruikbare bijdrage heeft opgeleverd: een *praktijk-ontwerp* benadering die de creatie van *produkt-service systemen* mogelijk maakt door de relatie met gebruikers in hun specifieke levenscontext, alsmede door de gevoeligheid voor milieu en sociale aspecten, zodat op termijn een beter antwoord gegeven kan worden op het nieuwe vooruitgangsidee met duurzaamheid als drijfveer.

Glossary

Business culture
The predominant values and ideas that characterize all the events, processes and structures in a company (e.g. leadership style, personnel policy, organizational structure).

Customer / client
Either a professional user or an end-user.

Design scenario
A visualization of a solution and its interaction with the user(s).

Design-for-sustainability
A result-oriented design process aimed to stimulate technological changes and social innovation in the current systems of production and consumption, resulting in a decrease in the use of environmental resources and an enhancement of people's quality of life, today and in the future.

Eco-design
A design process that implies the application of environmental criteria to the prevention of waste and the minimization of a product's environmental impact during its material life-cycle.

Eco-efficiency
A management strategy that seeks to maximize the productivity of energy and material inputs to reduce resource consumption and pollution / waste per unit output, and to generate cost savings and competitive advantage.

Environmental sustainability
System conditions by which human activities, at the worldwide and regional level, do not threaten the natural environment beyond its capacity to tolerate disturbance without irreversibly losing its balance, now and in the future.

Innovation
The successful exploitation of new ideas. A vital ingredient for competitiveness, productivity and social gain within businesses and organizations.

Paradigm
A worldview that consists of shared, non-contradictory assumptions and values.

Product

A material artefact (or physical asset) whose purpose is to satisfy and support people's activities.

Quality-of-life

Previously an idea of well-being and progress measured in economic terms, whereby quality of life is closely related to high income. Today, especially in Western societies, quality of life is beginning to take account of other 'soft' benefits such as work-life-balance, emotional well-being, empowerment, social cohesion and belonging. These views include factors such as food, clothing, freedom, wealth, economic stability, health, safety, education and relationships.

Rebound effect

The phenomenon by which choices that had been considered positive for the environment have generated new problems (unexpected consequences) once put into practice.

Service

An act that one party undertakes for the utility, satisfaction and support of another party's activities.

Social sustainability

The conditions of a system by which human activities, at the worldwide and regional level, respect the ethical principles and responsibilities of present and future generations.

Solution

A business answer to a customer's needs that uses an appropriate set of products, services and knowledge to achieve a certain result.

Sustainability

The conditions of a system by which human activities, at the worldwide and regional level, operate with respect for the greater equity, quality of life and environmental well-being of present and future generations.

Sustainable product-service systems (SPSS)

Profitable combinations of integrated and mutually dependent product and service components able to fulfil a user's demand, while at the same time containing the consumption of environmental resources and enhancing the quality of life.

Sustainable innovation

The successful economic exploitation of new ideas regarding ways of production, marketing, distribution, and above all use able to create personal meaning, social value, and environmental quality.

Triple bottom line

A business terminology used to indicate the simultaneous pursuing of economic prosperity, environmental quality and social equity.

User-in-context

A user in a specific physical space and with specific socio-cultural conditions.

Value-chain

The generic, value-adding, activities of an organization, reaching from upstream supplier inputs to the downstream delivery to final customers. The main activities are logistics, production, sales and marketing, and maintenance.

Value network / constellation

A value-creating system within which different actors - suppliers, business and strategic partners, allies, customers - work together to co-produce economic value.

About the author

Simona Rocchi has both a Master of Science in *'Architecture with a specialisation in Industrial Design'* (Politecnico di Milano, Italy) and a Master in Science in *'Environmental Management and Policy'* (International Institute for Industrial Environmental Economics, Lund University, Sweden). She is frequently invited to give lectures at different European Universities and is a visiting professor at the Faculty of Business Administration at the Externado University of Bogota, Colombia.

She started her professional career at the Politecnico di Milano, working at the 'Project-Product-Environment' centre, where she dealt with environmental product policies and sustainable design strategies. She has also collaborated with such international research centres as the IIIEE at Lund University, Sweden and the IÖW Institute in Heidelberg, Germany.

Since September 1998, she has worked for Philips Design, in Eindhoven in the Netherlands, as a Design Director. At Philips Design she handles corporate projects related to sustainable development and design research activities. She is responsible for the internal design research sustainability programme; while at Philips Corporate, she is part of the Task-force on New Sustainable Business Initiative. She is also the author of several publications on sustainability and innovation design process.