Product-Service System Concept as a Means of Reaching Sustainable Consumption?

Oksana Mont
The International Institute for Industrial Environmental Economics at Lund University
P.O Box 196, Tegnersplatsen 4, SE-221 00 Lund, Sweden
Fax: +46 46 222 0230
E-mail: oksana.mont@iiiee.lu.se

Abstract
This study provides a better understanding of a product-service system and discusses its intended contribution to the shift towards more sustainable patterns of consumption. It shows that the idea of function provision originates from existing business examples of service extension to customers, the major driver of which is business opportunity. The concept of PSS takes one step further and pursues the idea of "more quality of life with less material intensity" by decoupling economic and consumption growth from environmental impact. In order to realise this, this study analyses the role of authorities, consumers, and producers in minimising environmental impacts of consumption. It suggests patterns of consumer involvement, and analyses policies and instruments that can serve as a starting point for introducing PSSs. Several examples of Nordic companies that are moving towards more service-oriented offers are provided. Discussion is held on the possible consequences for society, businesses and private consumers of the PSS concept's introduction and dissemination.

Keywords
Product-Service System, consumption, consumers, environmental management tools, Extended Producer Responsibility, Integrated Product Policy, implications.

Introduction

This article is the result of a research project "Reaching sustainable consumption through the concept of a product-service system (PSS)", which was conducted by the International Institute of Industrial Environmental Economics and financed by the Nordic Council of Ministers.

The study provides a better understanding of a product-service system and discusses its intended contribution to the shift towards more sustainable patterns of consumption. It shows that the idea of function provision originates from existing business examples of service

extension to customers, the major driver of which is business opportunity. The concept of PSS takes one step further and pursues the idea of “more quality of life with less material intensity” by decoupling economic and consumption growth from environmental impact.
In order to evaluate existing preconditions for such idea, this study analyses the role of authorities, consumers, and producers in minimising environmental impacts of consumption. It comments on patterns of consumer involvement, and analyses policies and instruments that can serve as a starting point for introducing PSSs, with a special attention devoted to IPP and EPR. Several examples of Nordic companies that are moving towards more service-oriented offers are provided. Discussion is held on the possible consequences for society, businesses and private consumers of the PSS concept’s introduction and dissemination.

Product-service systems

The PSS concept is a combination of approaches guided by the goals of sustainability and business opportunity. There is no consensus regarding definition of this concept and in this study, *a product-service system is defined as a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models*. The intended contribution of the product-service system concept to the existing body of environmental policies and methods is that it aims at building a bridge between the technical/environmental sciences, focusing on the intrinsic functional qualities of product-services, and sociological/psychological disciplines that consider the identity value of products-services and the dynamics of the decision-making process of consumers.
Recent recognition of the influence of the *subjective dimension of consumption process* has motivated the concept of the product-service system. The PSS concept proposes to address this issue at the design phase of a product-service by providing several alternatives of product use to the final consumer. It suggests to influence consumption choices of private consumers through suggesting approaches for producers. The reasons for this are numerous effective policies that do not directly target individuals and that, often by focusing on technology and institutions, accomplish desired goals more effectively. For example, improving emissions control technology in automobiles, a policy that was directed mainly at manufacturers, did more to reduce urban air pollution than any practicable policy directed at driving patterns or behaviour could have done.
The PSS concept suggests that we need to design not just products, but *product-service systems*, thus implying that service design should be given the same attention as product design. There is an economic reason for this. Product and production design resulted in an increased productivity leading to the situation where the cost of production is a small part of the costs involved in making a product available to the consumer. The *service part* in the

PSS concept includes a system that comprises services that make products available to the consumer (marketing, advertising, sales, scenarios) and those that ensure all externalities associated with products' release on the market are internalised either economically or physically—through different existing or created schemes and arrangements (systems of reverse logistics). The cost of organising the "service part" becomes high, and, thus, in order to minimise the total cost, producers need to optimise/improve productivity of services. Thus, an incentive is created to reduce costs of supporting services. In order to accomplish this, criteria for the *PSS design,* which address the aforementioned points, should be included up-front in the design phase, which adds design rules and guidelines above and beyond the current design and design for environment (DfE) criteria.

One of the main changes that might facilitate the development of the PSS concept would be the internalisation of environmental costs and changes in the labour costs, so it would become economically viable to close the material loop in the economy. The grounds for this could be the fact that no economy can last forever if it systematically depletes its sources of supply. Eventually, these costs would loop back to undermine the society that imposed them. Thus, the traditional open loop economy should be succeeded by the closed-loop economy, in which the cradle-to-grave approach would be naturally modified into cradle-to-cradle.

The switch to producing product-services implies that material goods are considered to be productive assets that deliver the function to the consumer, and thus they need to be used for as long a time as possible. The industrial focus on producing and selling products is shifted and extended further down the value chain—what is "sold" is the value of the product, and thus the goal is to improve the efficiency of this new value generating system and the effectiveness with which value is extracted from products by consumers.

Thus, consumers become co-producers of value through extracting the function of products, ensuring that the offer finds market acceptance. Long-term relations with consumers become a matter of securing the market share for the PSS provider and the future market potential for new products of the same company. The customer productivity becomes the focus of management's attention as much as the effectiveness of their own employees and equipment. The direct feedback from consumers to producers ensures continuous improvement of the product-service system.

The PSS concept suggests as well that the point-of-sale becomes the point-of-service. This entails changes in the design of the "sale" stage that should include different *techniques of selling product-service systems* and *alternatives of product use*. Alternatives of product use have the double purpose of providing consumers with information (general, financial and environmental) and stimulating behavioural change towards more environmentally beneficial options. An evaluation of these alternatives should therefore include the life cycle based description and the environmental and financial effects of the alternatives.

To be successful, the concept of product-service system requires further elaboration along with effective incentives, accurate and available information, accessible facilities, social support systems, and cultural norms that reward a closed-loop economy and sustainable consumption practices.

Consumers' role in PSS

The idea of product-service systems has been mostly explored in business-to-business relationships when companies see new business opportunities in generating profit by providing services. However, the rebound effects, associated with ever increasing consumption levels, are not being addressed in these examples. Shading light on the PSS potential to modify consumer behaviour and the differences in roles of different consumer types might become a first step in addressing the rebound problem. Therefore, this study considered three types of consumers and evaluated their potential role in moving from products to less material product-service offers.

Private consumers

The issue about consumption patterns of private consumers is very closely tied to the definition of needs and wants. It is usually assumed that needs are pertinent to biological or bodily necessities, while wants are not biologically determined, but are acquired by learning. Once they are attained and their ability to give satisfaction has been learned, wants become habitual and at a certain level can be perceived as needs.

The important question in dealing with the needs-wants refers to the *meaning* people attach to goods and services. It is clear that people purchase goods and services for their qualities and functions, as well as for the symbolic or identity value of products and services.[1] Some authors show that for many consumers today, the symbolic value of products has become even more important than the physical aspects of goods,[2] and traditional marketing strategies further cultivate this trend.[3]

The dividing line between needs and wants is, thus, not objective and immutable, but is socially determined and constantly changing, drawn at different levels in different societies, and by different people.[4] With the constant progress and rise of welfare, there is a point, at which a luxury item becomes a necessity, e.g., tap water or lawn mowers, but the welfare effect of even greater consumption seems dubious, and, in many cases, even negative. Social indicators in many Western countries tend to show that, above a certain level, social welfare does not continue to grow at the same rate as the economy expands. For example, changes in the GDP and indexes of welfare or human progress such as the ISEW (Index of Sustainable Economic Welfare)[5], or the GPI (Genuine Progress Indicator) were similar until the 1970's, after which the ISEW and GPI increased at a much lower rate or even decreased.

Max-Neef carried out empirical work in the 1980's on 19 countries and showed that in rich countries, the quality of life fell because of so-called "threshold hypothesis".[6] According to him, every society has a "period in which economic growth brings about an improvement in the quality of life, ... but only up to a point...beyond which, if there is more economic growth, quality of life may begin to deteriorate"[7].

Therefore, many authors associate the management of consumption with the so-called sufficiency revolution[8], which refers to the issue of how much is enough for a good life. Unfortunately, our comprehension of the sufficiency revolution is still in the initial stage[9]. However, it is assumed that the shift from material-based aspirations towards post-material priorities in, for instance, self-realisation, provide better prerequisites for functional economy, in which high service intensity and flexibility can be combined with an effective material utilisation. This view is supported by recent surveys, which indicate that people want to have financial security and live in material comfort, but also that their deepest aspirations are non-material ones. People express a strong desire for a greater sense of balance in their lives—to bring material gains into harmony with the non-material rewards of life[10]. They perceive a connection between the amounts that are bought and consumed and environmental damage, but their understanding of the link is somewhat vague. Thus it is clear that sustainable consumption cannot be solely based on environmental considerations. What is needed is a closer investigation of the notion of quality of life that people will find easier to reflect upon. Quality of life can become a basis for choosing the next steps in both environmental and economic policies.

Until now, private consumers and households were not the leading force towards a more sustainable society. The lack of consumers' involvement in moving towards a more sustainable society and in influencing consumption patterns, can be partially explained by the indirect nature of tools to affect consumption, which are at their disposal, and difficulty to find an adequate stimuli provided to them. The private consumers are typically regarded as those, to whom economic reasoning that works perfectly for companies, should also apply [11]. There is, however, a substantial difference between the two types of actors, private consumers and businesses. Private consumers may allow themselves to maximise their welfare by shifting their demand from consumption to non-consumptive leisure activities or services outside the monetary system [12], but such a shift is not available to business consumers, whose actions are grounded on the economic rational. However, the shift by private customers is not yet happening. Although, the results of many polls suggest that concern over environmental problems has risen substantially [13], changes in pro-environmental behaviour have been seemingly minimal [14], and even less with regards to changing to non-consumptive patterns. This can be partially explained by the fact that the environmental consequences of purchasing decisions rarely affect consumers individually

and immediately. This implies that environmental aspects are not likely to gain a high priority in consumer decision-making, unless they are accompanied by such features of products or services that will sell them. It is commonly acknowledged that environmental aspects are likely to receive higher attention when they are connected to individual aspects such as personal health and private economy.

Businesses

Businesses are companies and organisations that are based on economic rationale with the main goal of maximising profit [15]. The current way of maximising their welfare is output oriented, based on the increase of number and volume of products and production sites, increased efficiency, and cheap labour force. Businesses depend on private consumers in generating and increasing their profit. Therefore, they, in each and every way, promote the material way of satisfying private consumers' wants by investing into advertising and by supporting policies that encourage the material growth. This group is easier to influence in case the environmental rationality is connected to economic rationality: directly (maximising profit) or indirectly (improved image).

Businesses are quite organised *(*sector-wise and into chains), and therefore, it is easier for the government to reach them and to develop incentives and mechanisms of influence. On the other hand, due to the fact that our economy-oriented society depends on the activities of the companies, they acquire big power and exercise it in, for example, the development of political and economic instruments in their favour. However, if they act within the framework set by the government, they find the most economically efficient ways of reaching the goals. The recent trend in developing policies is that the government develops policy frameworks, while companies are finding ways of reaching the goals in the most efficient ways. Therefore, business consumers are a very important consumer class, who have the power to exercise their consumer's needs and desires and influence the supply side.

Public sector

Public sector comprises government, public authorities and public institutions. The public sector, as a consumer, is an important economic actor. It usually has large building and vehicle stocks, manages significant land surfaces, and is a big consumer of goods and services. The sheer size of the public sector in total purchasing transactions makes its potential impact on the environment self-evident. The public sector can considerably influence the production sector by including environmental demands into their purchases. It can set an example in sustainable consumption through environmentally sound public procurement and administration, influencing the demand-side.

Authorities and government especially play an important role, because, in addition to obtaining needed products and services, they can promote specific social and economic objectives through their procurement policies. While price and performance are usually the primary determining factors in their purchasing decisions, they are often examined within a broader context that includes wider policy objectives. Authorities' and governments' purchasing programmes, for example, can be used to promote the purchase of products manufactured locally, to protect small business interests, to revitalise or stimulate growth in selected industries, and to encourage research and development in areas deemed important to national interests. As a result, incorporating environmental concerns into public purchasing decisions is a natural extension of the role of authorities and governments in protecting the nation's environment.

The government can establish policies that directly or indirectly influence consumer behaviour and/or producers' performance. The government can apply economic instruments to change consumption patterns by influencing these two actors. However, the power of the government is limited because it depends on the economic performance of businesses and on the voting power of private consumers, though, use of voluntary instruments does not seem to encounter any barriers from either of actors.

Findings

An important conclusion from this study is that private consumers often have a rather constrained capacity to change their behaviour. Others take decisions about consumption in society on behalf of private consumers, i.e. along supply chains, in planning of the infrastructure and so on. The private consumers act within social, technological and market boundaries, as well as the boundaries of their own knowledge. Other players in the society provide them with incentives and images of lifestyles that benefit and provide profit only to those players, while damaging society, nature and common goods.

On the other hand, organisational consumers (businesses and institutions) have many more possibilities to influence consumption patterns than private consumers. Business consumers are often producers as well and have a number of demands and pressures regarding their purchases and supplies. Their activity is bound by economic rationale, which can stimulate them to find new ways of satisfying consumer needs other than by material ways, if a proper framework is set, based on societal values. There is no doubt that the handling of the sustainable consumption agenda will be challenging, especially as improving product efficiency and safety have been traditionally perceived as more important than influencing the amount of products on the market. Institutions also have a greater ability to exercise their consumer power than private consumers, due to bulk purchases and, in the case of authorities, because of the social/collective rationale they might pursue.

A focus on consumers and their relations with products can provide an opportunity for considering the social element of the sustainable development triad. Products are tied to behaviours and social and organisational values. They play a crucial role in providing the entitlement of different households or social groups to given lifestyles or livelihoods. Inequalities of entitlement to environmental resources underlie many of the social and political inequalities that persist in societies. Innovative product-oriented environmental instruments and policies should find new ways of linking to social concerns, taking into account the following results of this review on the nature of consumption, consumption patterns and environment:

- There is no direct correlation between environmental attitudes and environmental behaviour. Appropriate incentives (image-, value-, tradition-creating) and infrastructures are needed to facilitate the shift.
- Environmental aspects are likely to receive higher attention when they are connected to individual aspects such as personal health, customised solutions and alternatives that provide more value, and financial benefits.
- Proper instruments should be developed for different consumer groups (private, business and institutional consumers) that would stimulate more sustainable patterns of consumption.

It is assumed that the development of methods of environmental management and policy will be evolving simultaneously and constantly with the continuous comprehension of the concepts of sustainable consumption, sustainable lifestyle, and quality of life.

Are there tools that promote the PSS concept?

An overview of policy and management tools

The overview of policy and management tools revealed a large number of approaches and examples that address or illustrate parts of the life cycle or elements of PSS-like solutions, but there is a clear lack of integrated policies, instruments, and approaches that aim at minimising environmental impact of the use phase.

There is a historic explanation to the identified situation. Environmental policy has traditionally been organised according to environmental categories: air, water, and land. Recently the focus in policy and management tools shifted towards addressing different life cycle stages and some methods and instruments were developed to address environmental impact across the entire life cycle of a product. However, to a large extent, decisions are still made to address the problems of one or several stages, often without careful analysis of how the results will affect the environmental impact in total and interact with other stages. In an increasingly dense context of environmental approaches, these interactions and mutual influences become more complex and difficult to manage. This risks an uneven allocation of

regulatory and economic resources in the pursuit of different environmental goals, and may lead to unintended tradeoffs between different goals (since a set of actions for reducing one environmental impact may affect a set of actions targeted at a different impact—the classical problem of shifting burdens between media can now be seen as a shift of burden between life cycle stages).

Thus, the major finding of the review of the policy and management instruments and tools concerns their large number and the consequent compartmentalisation of environmental instruments and policy tools. Figure 1 Mapping out methods of environmental management and policy" plots out some of the policy and management tools on the life cycle stages of a product. The optimal application may, for instance, mean employment of certain tools and utilisation of their results in the development and use of other tools. The optimal use also refers to finding the most efficient ways a company could allocate resources (to different tools and approaches) to provide a function to its consumers, because clearly management tools compete for resources at the company level.

The outlined situation also leads to the difficulty of implementing and measuring the effectiveness of different policies and approaches, due to gaps in data, conceptual difficulties and methodological problems.

Integrated Product Policy

Recognition of the outlined problems has led to attempts to implement more "integrated" policy measures, such as the directive on integrated pollution prevention and control (IPPC) and the environmental management systems. Neither of these approaches is a perfect solution since there are no broadly accepted ways of judging the tradeoffs that may exist between different environmental outcomes. Moreover, the scope of integration still remains across islands in the economic or environmental system. IPPC and EMS do not take into account the whole life cycle of a product, but focus on each of the stages of the production system separately. Current Integrated Product Policy (IPP) efforts provide hope for a more consistent and coherent policy framework both within various product related policies and between these and other policy areas. The problem of integration is dealt with head-on in IPP, which seeks to modify the environmental burdens associated with a product or service in a holistic way.

The integrated product policy is still in an infant stage, and how the actual national IPPs will look will depend on various factors, including:

- existing product related environmental instruments and policies in the countries and degree of effectiveness in achieving goals with such instruments and policies;
- division of roles among various stakeholders, including the relation among the governmental bodies and between the central government and local governments;

- power relations between various stakeholders; and
- other societal factors such as people's attitude towards regulation, perception about money, confidence towards central government, the degree to which people are used to the participatory approach, etc.

It can be said that IPP would be, ideally, a "best policy mix" to promote environmentally less burdensome products and product systems. If the aforementioned elements, commonly found as characteristics of IPP, are transformed into an actual IPP, such an IPP would provide a framework that enhances the development of PSS.

The study indicates that a non-prescriptive regulatory framework is needed, which would create terms of references for companies to find business opportunity through provision of function and adding value to consumers with the final goal of improving quality of life by less material ways of satisfying needs and wants. Integrated product policy has been identified as an example of policy, which has a certain potential to facilitate the shift toward functional economy. However, functional thinking is currently not present in the IPP documentation. Thus, before any detailed recommendations could be given on the role of IPP for supporting or promoting the PSS concept, the IPP nature and scope must be clarified and accepted. Different nations have different views on IPP. Some nations place emphasis on the support to/encouragement of voluntary actions by industries. Others, including the Nordic states, regard IPP as a co-ordination framework for existing product-related instruments, including regulatory instruments, and as a way to co-ordinate product policy with other environmental policies such as waste, chemical, and consumer policy. The latter approach provides a better opportunity for governments to facilitate the development of the PSS concept by setting up a non-prescriptive policy framework.

Extended Producer Responsibility (EPR)

Extended Producer Responsibility (EPR) principle and strategy are identified as a necessary prerequisite for stimulating improvements in the product and product system and as the most direct means of incorporating incentives for cost optimisation in the product systems. However, the study also identified that currently the EPR-based operational strategies pay insufficient attention to the consumption stage. Therefore, certain changes should be made in the focus on existing EPR-based policies to highlight the importance of allocating the responsibility for the use phase, in order to improve its environmental profile.

It is important to note that the application of the EPR principle is not limited to the end-of-life phase, as can be found from the aforementioned definition. Manufacturers are often the most suitable actors to change properties of products so that the overall environmental impact of the products is reduced. In the meantime, it is often the manufacturers who have, or have access to, the information related to the environmental characteristics of the products. It is

thus suitable to give responsibility to the producers to provide information on the environmental impacts of their products generated from various phases of life cycle. Allocating mandatory, informative responsibility to the producer have been discussed extensively in Sweden, and can be implemented in the form of, for example, a mandatory environmental product declaration or a labelling scheme. This informative responsibility has been given in forms such as, mandatory labelling of hazardous substances and an obligation to provide information pertaining to the end-of-life management of electrical and electronic equipment to the treatment facilities. Such information would help consumers make an environmentally conscious choice when deciding on a product service system. On the other hand, adequate environmental education should be given to the consumers to enable them to understand the information provided.

Some elements of the existing EPR programmes, such as:

- a collection infrastructure of the end-of-life products;
- requirement of environmentally sound treatment of the end-of-life products; and
- provision of information to the users about the collection system such as the location of deposit stations;

can provide a basis for the development of the product-service systems.

Similarity and inter-relationship between EPR and PSS can be found in terms of the location of ownership. Namely, it has been discussed that the ultimate manifestation of the concept of EPR would be the retaining of ownership of the products on the side of producers [16]. This is in line with what functional sales are based on and the PSS approach intends to achieve. It can be said that the concept of EPR would serve as an underlying principle for PSS.

In the existing EPR programmes, the significance of the role of consumers in relation to the conditions of products handed in to the collection points did not receive much recognition. Improvements can be made through provision of information on more careful and efficient use of products from producers to consumers [17]. Sellers of products, who have direct contact with consumers, can play an important role in improving the situation. In addition to information that is traditionally provided to customers, such as quality, price, performance, information on alternatives of product use, on revalorised product, and on the total environmental cost can be provided. A prerequisite to this involvement of sellers as providers of environmental information, is sufficient environmental education of the sellers themselves.

Examples of Nordic companies

Examples of PSS-like practices in Nordic companies are mostly found in business to business interactions, but they still often lack a system approach, focusing on the selling function as one element of a product-service system (car sharing schemes). Even though the existence of such cases is encouraging for further development of the PSS concept, close

attention should be paid to evaluating environmental profiles of such functional offers to justify their superiority to the notion of ownership detainment by consumers. Still uncertain is the possibility of employing the functional thinking in relationships between businesses and private consumers.

There is an increasing number of business examples, driven by business opportunity and innovative ideas, that shift the reliance on selling products towards provision of services or extending the product offers by services. Recently, these examples became a focus of the research community that recognised a potential for environmental gains and possibility of decoupling economic growth from environment damage. However, it should be stressed that realising these gains is not automatic. Currently, it is difficult to say that the existing examples are less environmental burdensome. However, the fact that they exist, provide an opportunity to evaluate their environmental profiles and possibly develop strategies for developing more sustainable ways of generating profits for companies that satisfy consumer needs and, at the same time, minimise environmental impact. Examples of three companies are presented below that demonstrate existing business practices that are likely to promote the shift towards functional thinking, which is recognised for having the potential to contribute to more sustainable patterns of consumption.

In the area of Commercial Cleaning Equipment, *Electrolux Euroclean*, Sweden has shifted from supplying products to providing function. The ownership of the product is retained by company and the conventional sales strategy has been replaced by leasing and service contracts. The customer pays a fixed leasing fee and receives, besides the product for a leasing period

- a survey that defines her/his needs,
- training of how to properly use the equipment,
- a development of a proper process method,
- maintenance of the product throughout its lifetime, assurance that the machine will be recycled at its EOL stage [18].

An evaluation of the user needs showed that environmental savings could be obtained throughout the life cycle of the supplied products. Proper identification of what equipment is required ensures that the operating hours are optimised, while consumer training safeguards that the machine is handled properly and associated energy and chemical consumption are kept at the optimal level. Maintenance is carried out by the service engineers from Electrolux, ensuring the return of used, but functional parts to Electrolux. Professional maintenance also ensures that components remain in as good a condition as possible until they are discarded. It is planned that after being returned, the products shall be reconditioned and offered to new customers in the cleaning service. Reconditioned products shall also be used as exchange

products if a product fails while being used by a customer—instead of carrying out advanced repairs on site, the customer gets another (reconditioned) product.

The company *Alit*, Iceland (originated from the IT-department Straumsvik Aluminium Smelter, thus Al-IT) offers computer services designed to serve the customers' need. This is partly done by hosting hardware and software at Alit's central facility, making it possible to share these among several small companies, providing the opportunity of using, but not buying expensive, quickly outdated, over-dimensioned equipment. Alit specialises in so-called “thin client” services. Their customers only purchase simple hardware such as screens, keyboards and printers, but the main equipment (microprocessors, hard drives, etc.) is located at Alit's facility. Such arrangements prolong the lifetime of the companies' hardware from 2-3 years to up to 5-6 years, and at the same time, lowering the investment cost for each new “generation” significantly, as well as the operation cost. This doesn't even require a big bandwidth, as most of the data transferred between Alit and their customers are only screen objects. All the processing takes place at the central server.

According to the company representatives, the “thin client” service does not only prolong the lifetime of hardware and reduce the material intensity and waste management concerns. It also improves the working environment, as there is far less electrical equipment at the companies' offices. The limited hardware they need does not, for instance, include any fans or any other mechanical parts, which make noise. Alit also seeks to guide their customers in choosing equipment, by, for instance, promoting flat computer screens.

Vattenfall, Sweden has developed various overall solutions for the outsourcing of energy facilities. The concept is based on the principle of assuming the responsibility for operation, maintenance and investments in different types of facilities, for example, heating and climate, cooling and compressed air, electricity installations and energy systems. The customer gains the benefits of greater operational reliability and more efficient energy consumption as well as access to released capital, time and personnel, and can use more resources for its core business.

The environmental profiles of outlined above functional offers need to be evaluated in order to justify their superiority to the notion of ownership detainment by consumers. An important issue revealed in the course of the study is the need for the development of a common methodology for evaluating existing and new practices. Service industries also call for a proper attention in terms of evaluating their environmental impacts, but in addition a possibility to learn from their expertise in service design and development needs to be explored.

Discussion

This chapter discusses the possible consequences and implications of the introduction and dissemination of the product-service system concept in the society, including businesses and private consumers.

PSS and society

The PSS concept rests on the premise of decoupling current economic growth from environment degradation. However, this does not imply that economic growth should stop, the question might be that it might be different and be measured by using revised indicators. An option for continuing economic growth can be envisaged: society can pursue qualitative economic development, in which the quality of goods and services is improved through resource efficient processes, but the physical volume of output does not increase. Proper attention should be given to ensuring that the total society output is not increasing, while people are being given quality of life. In this respect, it is interesting to envisage how the PSSs development might affect existing systems and people.

Infrastructure

- The demand for more sustainable consumption in a household context has become, and will be even more, dependent on development in the supporting infrastructure. Ensuring the availability of the infrastructure, such as waste collection points and networks of reverse logistics, can become particularly relevant.
- The provision of customised solutions and product use alternatives for final consumers might lead to the need of a more rigorous analysis of local traditions and cultures to ensure that the alternatives are accepted. Conducting such analysis would probably require additional local work forces to be employed and involved, along with necessary infrastructure, such as offices.

Employment

The *cyclic economy* presents a new sphere in each sector of manufacturing, which has the potential to re-create value and create jobs. Shifting sources of public revenue from labour to resources would likely create jobs by making labour cheaper. Two trends can be distinguished:

- Shifting from a throughput economy to the one where longevity of products becomes the standard of success, would offer additional hope by increasing the need for labour, because maintaining, updating, and repairing products, buildings, and infrastructures is considerably more labour intensive than manufacturing new ones (at least with current methods).

- There will probably be also more jobs required in education due to the increasing scale of services and the general speed of progress. Most services will require an adequate level of education and life-long education over the individuals' life.

What should, however, be taken into account is that an increase in the number of jobs needed for provision of functions and systems entail higher expenditure on labour.

Environment

The PSS concept might have considerable implications for the environment both positive and negative. The product-service system has the potential to reduce resources and energy flows in the society by dealing with consumption efficiency. It also focuses on minimising environmental impacts associated with consumption. By trying to reduce the total input into the economy and by suggesting new ways of profit generation for companies and new ways of spending money for consumers, it tries to address the rebound effect.

However, functional sales and the product-service system approach are not intrinsically environmentally preferable to selling products. The environmental profile of product-service systems, to a large extent, depends on the systems design and efficiency of all established or used networks and infrastructures. It is assumed that the systematic approach suggested by the PSS approach might avoid sub-optimisation and minimise the counter-productivity between different policy and management instruments and tools. However, approaches need to be developed to ensure the development of PSSs of a truly system-based nature with an environmental efficiency goal.

PSS and businesses

Many companies in Nordic countries already see benefits in moving towards selling functions—business opportunity, established long-term relationships with consumers, and ensured market shares. However, it should be highlighted that the function-driven changes might require a fundamental shift in the ways organisations work, both internally and externally.

Internally, the shift towards functional thinking challenges, for example, the financial system that has to establish new functional units for its performance. The producer could be given an incentive to generate profit from adding supporting and maintenance services, up-grading opportunities and efficiency-use services to their products. Externally, the development of PSSs depends, to a large extent, on the company's success in building partnerships along the product chains. This partnerships might be formed at several levels:

- company—to facilitate information transfer from producers to retailers and to consumers,
- sectoral, such as the development of standardised products and modules to facilitate reverse logistics and local assembly,

- cross-sectoral, such as the establishment of cross-sectoral networks for reverse logistics.

Along and within the product chains, traditional responsibilities for products are extended through the additional responsibility for service. Reduced material flow might also require stronger co-operation with suppliers and knowledge about decision-making processes of different actors involved in the system. Information from the service provision stage can be easily transferred to the design stage and manufacturing, thus the entire system becomes more responsive to changing market parameters and is probably, inherently more likely to stimulate innovation. These conditions can be met much more easily by local and regional enterprises than by global players, due to their closeness to the market and consumers. Alternatively, big players are usually more advanced in the issues of environmental management and can be awaiting new approaches that combine economic rationale with business opportunity and improved environmental performance.

The introduction of functional thinking might encounter large infrastructure barriers, as companies along the entire supply chain have made investments in their current technology and production structure. This may eventually lead to a situation where the composition of certain supply chains actually changes. However, companies can also choose to utilise already existing infrastructure and to make necessary adjustments to make their extended supply chains efficient.

The successful development of a product-service system requires that manufacturers and service providers extend their involvement with the products they design and produce and responsibility for them to phases in the life cycle, which are usually outside the traditional buyer-seller relationship [19], such as take back, recovery, reuse, refurbishment, and remanufacturing. Successful take back schemes are already developed for several products in Nordic countries, however, further dissemination of the schemes for other product categories is required.

Functional thinking has implications for competitive advantage as it provides an opportunity for companies to compete on new grounds. The entire idea of competition based on selling more products is shifting towards establishing long term relationships with consumers and providing more function, comfort, satisfaction and quality of life. This existing trend should be positive for the emergence of PSSs.

The use phase of a product within the PSS concept requires more attention following the EPR principle. Producers could minimise the environmental impact of the use phase by providing alternatives of product use to the final consumers. This would create a stimulus for producers to make sure that consumers can understand the information presented and have an incentive (preferably economic) to use the products in the most efficient way. In the end, producers could design all these aspects (what information and how to present, what types

of incentives for consumers, networks and infrastructures in the society to bring the product at the end of its current use back into the production system, etc.) together with designing their products. The PSS concept also emphasises meeting the needs of consumers by making their consumption more effective, instead of producing more products, which requires building more production facilities and a constant influx of money for their maintenance. Extracting maximum utility out of products (efficient consumption) might lead to a stable or declining demand for the import of industrial raw materials and some finished goods, and instead create dependence on local facilities for prolonging the life cycles of these products. The PSS concept might lead a company to reposition its corporate strategy from essentially a material producer to an enterprise, whose strategy is to increase quality of life for the customers through knowledge and function provision. This transition would not be fast or easy. But it is already an on-going process in some companies.

It is envisioned that advertising industry will play an important role in shaping the tastes and wants of consumers. In the functional settings, the advertising industry may be used to educate consumers with regard to environmental problems associated with consumption patterns. Increased awareness of the problem may enhance attitude changes, which in turn may result in behavioural changes such as the use of the environmentally rational PSSs, which will generate profit for the producers.

PSS and private consumers

Possible implications for private consumers and households will most probably comprise more active and conscious involvement into extracting the product function, questioning the necessity of the function, and hopefully finding alternative/less material ways of bringing satisfaction and improving quality of life. Most probably, private consumers and households will not be the ones initiating changes, but they could be involved in choosing and following the already evaluated and tested options. In general, a more active involvement of consumers and households is envisioned in the functional economy, which includes both asking for the function to be fulfilled and for life cycle costing.

It is more probable, that only after having acquired the knowledge about environmental and financial implications of the choices and existing alternatives, private consumers and households will be able to make more environmentally preferable choices and might become interested in providing a feedback to producers about the design of PSS and the ease of following the proposed alternatives. In the PSS alternatives, customers might co-create value together with producers. The cyclic nature that is envisaged for product-service systems suggests that there are no final consumers in this emerging framework. The materials and used products at the end of the current use still have value and might be used by others, both private consumers and businesses or producers. Following the logic of the chain

management, these might than set requirements to their suppliers (private consumers) concerning the product or service quality, including environmental profile. By getting external demands (both informative and economic), private consumers may become involved and interested in taking care for the product condition, when it enters the collection centre.

Conclusions

The study explored the concept product-service systems and its potential to influence current consumption patterns by studying different types of consumers, their potential role in introducing and shaping PSSs, and prospective patterns of consumer involvement. An overview of environmental management tools and approaches was conducted and interviews made in order to investigate whether current body of tools facilitates or is likely to promote the PSS concept. Several examples of Nordic companies that are moving towards more service-oriented offers were found. The main conclusions and findings are presented below.

- A lack of integrated policies, instruments, and practices that would aim at minimising the environmental impact of the final consumption was identified. An overview of policy instruments and tools with regard to their utility for shifting consumption patterns towards more sustainable ones showed that most of the tools and policy principles have not paid considerable attention to the use (consumer) phase. It is clear that most of the tools were not developed specifically to improve the environmental profile of the use phase or to address the rebound effects that stem from increasing consumption. Existing approaches and tools provide virtually no alternative to the existing consumption system.
- Examples of PSS-like practices are mostly found in business to business interactions, but they often lack a system approach. Even though the existence of such cases is encouraging for the further development of the PSS concept, close attention should be paid to evaluating the environmental profiles of such functional offers. Closer attention is needed to investigate the mechanisms in companies that allow for the shift from selling products to providing functions. Still uncertain is the possibility of applying functional thinking to relationships between businesses and private consumers.
- The policy framework for the shift towards sustainable consumption must be laid now. A non-prescriptive regulatory framework set by government is needed, which would create terms of references for companies to find a business opportunity through the provision of function and adding value to consumers with the final goal of improving quality of life by less material ways of satisfying needs and wants.
- Integrated product policy has been identified as an example of policy, which has a certain potential to facilitate the shift toward functional economy. It is clear that the

integrated nature of IPP provides a suitable background for the PSS development. However, the analysis of existing documents on IPP showed that although services are mentioned in the IPP, the main attention is still on products. Functional thinking is currently not present in the IPP documentation.

- The EPR principle and strategy are identified as a necessary prerequisite for stimulating product and product system improvements, and as the most direct means of building incentives for cost optimisation and improvements into the product systems. Currently, the EPR-based operational strategies pay less attention to the consumption stage. Therefore, certain changes should be made in the focus of existing EPR-based policies to highlight the importance of allocating the responsibility for the use phase in order to improve its environmental profile.
- The need to operationalise the PSS concept implies a consequent urgent need for a significant research programme to work with companies to project detailed concepts of how existing products and businesses could evolve towards product-service systems. It is envisaged that the PSS concept will not provide a single standard alternative that leads towards more sustainable consumption patterns, as it delivers no ready-made solution to reaching a sustainable society. Instead, it may help to define alternatives and criteria that could facilitate the shift towards more sustainable society through the functional economy. This study suggests that in order to develop and implement PSSs successfully, an integrated approach that combines the industrial, political and consumer perspective is needed.

References

[1] Bauman Z. Thinking sociologically. Oxford: Blackwell, 1990.

[2] Leiss W. The icons of marketplace. Theory, Culture & Society, 1983; 1 (3): 10-21.

[3] Ibid. 1.

[4] Halleröd. Poverty in Sweden: a new approach to the direct measurement of consensual poverty. Umeå Studies in Sociology: Umeå, 1994.

[5] Daly H.E, Cobb W. For the common good: redirecting the economy toward community, the environment and a sustainable future. Beacon Press: Boston, 1989.

[6] Max-Neef M. Economic growth and quality of life: a threshold hypothesis. Ecological Economics 1995; 15: 115-118.

[7] Ibid. 6, p. 17.

[8] Sufficiency solutions refer to organising activities in more intelligent ways, in which the need for product is eliminated in Heiskanen E, Jalas M. Dematerialization through services - a review and evaluation of the debate. Ministry of Environment: Helsinki, 2000; 436: p. 12.

[9] Sachs W. Planet dialectics: explorations in environment and development. London: Zed, 1999.
[10] Consumers International. Consumers and the environment: meeting needs, changing lifestyles, 1997.
[11] Hirsch F. Social limits to growth. 2nd edn. Cambridge, MA: Harvard University Press, 1976.
[12] Featherstone, M. Consumer culture and postmodernism. London: Sage, 1991.
[13] Dunlap RE. Public Opinion in the 1980s: Clear consensus, ambiguous commitment. Environment 1991; 33: 10-15, 32-37.
[14] Jenkinson Kay. The consumer interest in the environment. European Environment 7, 1997; 3: 85-91; Balderjahn I. Personality Variables and Environmental Attitudes as Predictors of Ecologically Responsible Consumption Patterns. Journal of Business Research 1988; 17: 51-56.
[15] Hirsch F. Social limits to growth. 2nd edn. Cambridge, MA: Harvard University Press, 1976.
[16] See for further discussion and examples White AL, Stoughton M, Feng L. Servicizing: The quiet transition to extended product responsibility. Tellus Institute: Boston, 1999.
[17] See also panel 6 of the Teknisk Framsyn as a strategy for the year 2015. TekniskFramsyn. Material och materialflöden i samhället (Material and material flows). Stockholm, 2000.
[18] Agri J, Andersson E, Ashkin A, Söderström J. Selling functions - a study of environmental and economic effects of selling functions. CPM Report no. 6/25, Chalmers, February, 1999: 21-30.
[19] White AL, Stoughton M, Feng L. Servicizing: The quiet transition to extended product responsibility. Tellus Institute: Boston, 1999.

Tables

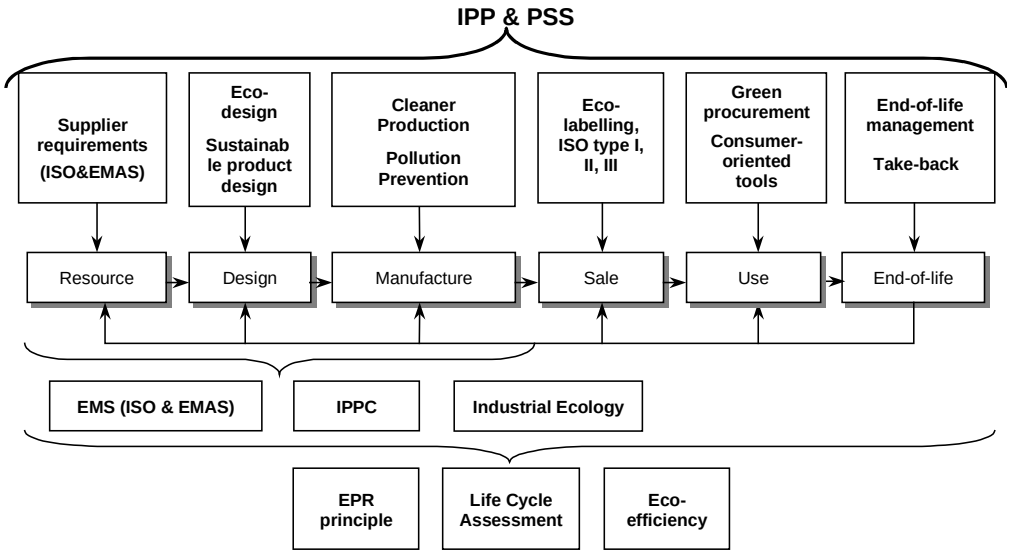

Figure 1 Mapping out methods of environmental management and policy