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CONCEPTUALISING THE FUNCTIONAL SERVICE ECONOMY

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Abstract

The objective of this thesis is to highlight the value potential for companies to move into FSE; this value can be linked to the value offering, the productivity, the profitability, the competitiveness, etc. The managerial and strategic approach to the concept as well as a clear definition and its historical emergence are the value of the thesis since they have not been discussed yet. This thesis aims at conceptualising the *Functional Service Economy* (FSE) by providing a renewed definition, characteristics and strategic stakes for FSE. Our research enabled us to develop this FSE definition:

FSE is a shift in business models, integrating products and services into complex adaptive system (the solution), that aims at providing functional use of products while optimising processes and maximising value creation, wealth, and resource productivity.

To recount the evolution of FSE, we have first studied surrounded and grounded concepts: Servitization, Product-Service System (PSS), and Service-dominant Logic (SDL). Servitization, the umbrella concept, sets the stage to PSS and FSE, near concepts with some particularities, especially their vision about the position of the product in the system/solution and the value conception. FSE goes beyond because of its vision of value, originated from a Service-dominant Logic. Therefore, we can consider that FSE is a PSS that is settled with value conception and grounded logic from a SDL perspective. The importance of the function of the solution is driven by the aim at generating as much value as possible, combining products and services, like the SDL suggests it.

We also found that the central aspect of FSE is that it enables an improved resource productivity, leading to surplus generation. This surplus induces a wealth creation on the long-term, spread among parties who have incentives to pursue the partnership. Besides, we designed a renewed typology composed of two main categories: Sale of use (function)/Use-oriented service (including Functional sales), and Performance contract/Result-oriented service (including Least cost supply such as Chemical management service).

Then, we have strengthened the theoretical research by an overview of three case companies, well-settled companies that have decided to embrace FSE in parallel with their traditional business. These companies are Xerox, Michelin-Michelin Solutions, and Dow Chemical-SAFECHEM.

Finally, in addition to the FSE conceptualisation, we highlighted some strategic interests for managers. These are linked to the fact that FSE provides optimised functional solution. Briefly they can be summarised as the possibility of: locking in customers, locking out competition and increasing the differentiation level; catching residual value lost in product when sold; aligning incentive with customers; decoupling resource use and value creation/economic success; optimising processes; developing more customised offering, etc. All together, it leads to a better resource productivity and an improved structural productivity, resulting in enhanced profitability and competitiveness.

Nevertheless, we are only focused on B2B market. We also decided to orient the research on a theoretical point of view. Additional researches providing in-depth analysis of case companies would be useful to go further on this concept of FSE.

Keywords: Functional Service Economy – Functional sales – Conceptualisation – Value offering – Product-Service System

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Abbreviations and definitions

Abbreviations:

B2B: Business to Business

FSE: Functional Service Economy

B2C: Business to Consumer

GDL: Good-dominant Logic

B2G: Business to Government

PSS: Product-Service System

C2C: Consumer to Consumer

SDL: Service-dominant Logic

Definitions:

Functional Service Economy: *FSE is a shift in business models, integrating products and services into complex adaptive system (the solution), that aims at providing functional use of products while optimising processes and maximising value creation, wealth, and resource productivity. (Own definition)*

Product: *“A tangible commodity manufactured to be sold. It is capable of ‘falling on your toes’ and of fulfilling a user’s need” (Goedkoop et al., 1999)*

Product-Service System: *“A system of products, services, networks of actors and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models” (Mont, 2004)*

Service-dominant Logic: *“(SDL) shifts the focus away from goods to service, from operand resources to operant resources, from being to doing, and somewhat less precisely, from what is exchanged to the process of exchange and from the tangible to the intangible. Arguably it also refocuses us on the role of exchange in general” (Vargo & Lusch, 2006)*

Servitization: *“the increased offering of fuller market packages or ‘bundles’ of customer focussed combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings” (Vandermerwe & Rada, 1988)*

Service: *“application of specialized competences (knowledge and skills) through deeds, processes and performances for the benefit of another entity or the entity itself” (Vargo & Lusch, 2004)*

System: *“A collection of elements including their relations” (Goedkoop et al., 1999)*

Value: *“an improvement in system well-being and we can measure value in terms of a system’s adaptiveness or ability to fit in its environment” (Vargo et al., 2008)*

Value co-creation: *“a joint function of the actions of the provider(s) and the consumer(s)” (Vargo & Lusch, 2006)*

Introduction

I. Servitized economy, presages of the Functional Service Economy

Before 1800s, manufacturing and services companies were clearly distinct, without any overlapping of their activities (Schmenner, 2009). Then, later in 1800s, manufacturing companies have begun to offer selected services in addition to their product sales. This is a consequence of the internationalisation and the high-volume production, which have led to specialised marketing and new distribution requirements (Schmenner, 2009). This move into *the realm of services* was often linked to a wish to get closer to customers.

Step by step, the boundaries between manufacturing and services markets have been blurred, companies adding more and more services to their offering. This concept, known as *Servitization*, had also managerial reasoning since it enabled to strengthen barriers to entry¹ (Schmenner, 2009). Nowadays 70 percent of the EU's economic activity is borne by the services sector, which employs close to 70 percent of the EU's workforce (Neely, 2007).

Another reason for this rise in services comes from the inability of Western countries to compete on the basis of costs (mainly due to higher workforce costs). These countries have to find other ways of competitiveness; adding value through services with a high-skilled workforce is one of the possibilities.

Furthermore, other trends have pushed manufacturing companies to open their portfolio to services. First, a demand was driven by the customers who required more services and comprehensive solutions. Secondly, the installed base of product² was growing increasingly. Providing services such as maintenance became necessary to avoid competitors to enter that profitable market. It was also a way of reinforcing the customers' loyalty. Lastly, providing services enabled companies to diversify their portfolio and helped them to be less dependent on resource prices (resources have highly fluctuating prices, which tend to increase due to growing resource scarcity).

¹ This is still a driver today, as we will see later in the thesis

² Installed base of product: "*total number of products currently under use*" (Oliva & Kallenberg, 2003)

Hence, these trends show us the increasing interest for Servitization. Neely (2009) sets the stage of the *Servitization* concept (and the other concepts studied here, which ensue from Servitization) by stating that:

“From a supplier perspective, Servitization is a way of increasing sales revenues, while from a customer perspective Servitization offers a route of reducing risk and decreasing or at least stabilising and making predictable maintenance and support costs” (Neely, 2009, p2).

Nevertheless, this enthusiasm for services and manufacturing Servitization is balanced by some studies such as Neely et al. (2011) that analysed OSIRIS database and did not find a significant rise in servitized manufacturing firms. Besides, it is interesting to notice that Servitization *affects* and *evolves* differently among countries, which leads us to think that Servitization is not as systematic as some believe it, yet.

The concept of Servitization has evolved over ages and new close-related concepts have emerged. In 2012, European Parliament ordered a study on *Leasing Society* to understand better the growing trend of product leasing. The underlying idea of a *leasing society* is that companies are looking for meeting customers' needs in the best way, by leasing products rather than selling them (Fischer et al., 2012).

Nevertheless, *Leasing Society* is not the most known concept, neither the central focus of this thesis, but rather another name given to business linked to *Functional Service Economy*, the real subject of this thesis. Before exploring this notion, an understanding of broader concepts is required. Among them, Service-Dominant Logic, led mainly by Vargo & Lusch, stresses the value added by services and a shift in dominant logic from product to service (from Industrial Economy to a new economy, service-oriented). Another widely recognised and discussed concept is the one called Product-Service System. It is a very broad concept, recovering any system/solution combining product(s) and service(s), which has attracted numerous of scientific authors.

This thesis has thus the objective of exploring a specific type of Product-Service System (PSS), the *Functional Service Economy* (FSE). It can be briefly defined as *“a set of innovative business models that integrate products and services into winning solutions to create wealth and jobs with considerably less resource consumption, and provide economic incentives to internalise the costs of risk and waste”* (Stahel, 2010, p2). The main idea under a FSE business

model is about “*substituting the sale of the use of a good for the sale of the good itself*” (Bourg & Buclet, 2005).

More and more authors have acknowledged a shift in importance from product to solution, leading to the predominance of partners to suppliers, of outcomes to output, of relationship to transaction, etc. This is typically what the FSE expects. Next chapters will provide a better understanding of FSE and its links to the other surrounding concepts.

II. Position of the thesis

The aim of this thesis is to build a conceptualisation of the Functional Service Economy concept. To do so, first, a distinction between *Servitization*, *Product-Service System* (PSS), *Service-dominant Logic* (SDL) and *Functional Service Economy* (FSE) is conducted. Secondly, case companies enable us to reinforce the theoretical principles. Both combined will lead to a renewed definition of Functional Service Economy as well as its main characteristics. Finally, a discussion on strategic interests for companies to embrace FSE will provide some arguments for managers to decide if they would like to shift their strategy to a FSE based strategy.

It is important to define and clarify first the different concepts used in this thesis. Indeed, they overlap each other. Besides, authors are not always consistent. The main uncertainty is about the concepts of Servitization, PSS and FSE. For the purpose of the thesis, one should consider Servitization as the umbrella term (it is simply adding more service), then comes PSS (companies where product and service are put together in a bundle), and the most specific concept is FSE (a typical case of PSS with a focus on the function and usage of goods). This distinction will be deeper developed later.

Furthermore, numerous of the PSS and FSE authors are environmentally oriented. The French concept of FSE has a clear objective to be more sustainable and environmentally friendly. And authors like O. Mont, discussing about PSS and functional sales, also have an environmental angle to study the concept. The thesis tries to get rid of this environmental label for two reasons. First, the focus is on the managerial side of the concept, with an interest in the impact on the firm strategy. Secondly, the evidences on the global environmental benefits of PSS solutions have not been proved yet. Even the most environmentally focused authors (like Mont herself) acknowledge that those benefits vary from one company to another, without being able to generalise about it.

Besides, to the extent of my knowledge, this thesis is the first to combine both French-speaking and English-speaking literature on *Functional Service Economy* and *Economie de Fonctionnalité* (the French concept). FSE itself is mainly discussed by one English-speaking author, Stahel. Nevertheless, Mont, Ölundh & Ritzén also talk about functional sales (a grounded principle of FSE). The French-speaking authors sometimes refer briefly to Stahel, but always in French. Additionally, French authors discuss more the concept on an ecological point of view, in ecological-oriented papers rather than in managerial- or business-oriented papers and journals. Therefore, this thesis wants to bring another view by a dedicated conceptualisation, more business-oriented and available in English for a wider potential accessibility.

For the purpose of the thesis, a choice was made on the scope of the FSE concept. We will focus only on B2B transactions, provided by companies that have already been active in that sector of activity. These companies have decided to move into FSE business model for their traditional activity (they have modified in some points their business, obviously, but they stay in their traditional business sector as well). This choice is simply since, in my opinion, B2B market represents the best the full potential of FSE as discussed later.

III. Research question and scope of the study

Previous authors have often kept environmental concern as a milestone in their publications, at the expense of more managerial considerations. This thesis wants first to recount the evolution to the FSE concept, to better understand its grounded principles, with a business perspective. Then, it will allow us to redesign a FSE definition as well as its main characteristics, bringing a renewed conceptualisation. These steps aim at providing an answer to the research question, which is:

What can the Functional Service Economy bring to the value offering and to the competitiveness of companies?

The objective is to highlight the value potential for companies to move into Functional Service Economy. This value can be linked to the value offering, the productivity, the profitability or the competitiveness of the providing firm. The interest is to discover how the shift to a FSE business model/strategy influences the different levels of the company; and therefore what advantages result from this move.

This managerial and strategic approach to the concept as well as a clear definition and its historical emergence have not been discussed yet. Hence, this thesis brings something new to the literature by exploring FSE on that angle.

The next sections follow this plan. First, a review of literature defines and studies the main concepts and their characteristics, recounting the evolution of FSE. Then, we compare these concepts, analysing their similarities on their main aspects, always with FSE as the centre of the comparison. In the third chapter, three case companies are detailed to shed the light on practical applications of FSE. These chapters lead to the Chapter 4, which suggests a renewed definition for FSE as well as an elaboration of its main characteristics and an adapted typology. The last outcome offers the justification for managers to embrace FSE, detailing the strategic advantages of FSE. This is in this Chapter 4 we conceptualise FSE and answer the research question.

Chapter 1: Literature review

The literature review is split into three main parts, starting from a more general service-related concept, Servitization and one specific view, the Service-dominant Logic, continuing with Product-Service Systems to end up with the Functional Service Economy concept. These concepts (except for Service-dominant Logic) are gradually inclusive; Functional Service Economy being a type of Product-Service Systems oriented on functional sales, and Product-Service Systems being a case of Servitization. Therefore, the characteristics of the concepts are cumulative and, except if something else is specified, discussions about Servitization apply to Product-Service System and so on.

1.1. Servitization and Service-dominant Logic

The initial part of the literature review first deals with the broad concept of Servitization. This is also the most known concept among those we are studying in the thesis. Then, the focus will be on the Service-dominant Logic, a logic that takes the opposite view to the traditional manufacturing economy.

1.1.1. Servitization

As we have already seen in the introduction, services and products have been moved closer for several decades. Nevertheless, the conceptualisation of Servitization itself is much more recent, as the reader will discover in this section.

1.1.1.1. Initial view of Servitization

Vandermerwe & Rada (1988) were the first to set the stage for the Servitization concept, by explicitly using the term *Servitization* (Baines et al., 2009a). Already in 1980's, companies were increasingly “*adding value to their core corporate offerings through services*” (Vandermerwe & Rada, 1988, p.314). They acknowledged the importance of *bundles* instead of a specific focus either on good or on service. The authors describe services, compared to goods, as “*performed rather than produced and [...] essentially intangible*” (Vandermerwe & Rada, 1988, p.315). Baines et al., (2009a) suggest defining services as “*economic activity that does not result in ownership of a tangible asset*” (p.1208).

The relationship between services and goods is not simple according to Vandermerwe & Rada (1988), they complement each other in the bundle but they can also substitute each other. Seeing this ambiguous goods-services relationship, they thus consider *bundle* as a “customer-focused combination of goods, services, support, self-service, and knowledge” (Vandermerwe & Rada, 1988, p.316). This new services-goods relationship also came with an evolution of the consideration of the manufacturing industry. First, companies considered themselves being either a good or a service provider; then, they combined some services with offering of goods; finally, now, they provide a bundle where goods and services are integrated. Hence, boundaries between traditional manufacturing and services industries have become more and more blurred (Vandermerwe & Rada, 1988; Mont, 2002a), it is more and more difficult to associate one company to one operating sector.

Putting all those elements together leads them to define *Servitization* as “the increased offering of fuller market packages or ‘bundles’ of customer focussed combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings” (Vandermerwe & Rada, 1988, p.314).

A typical example of servitized company is IBM. Their primary business was to manufacture and sell computers. Nowadays they are offering hardware, middleware and software, as well as consulting services in technology and data related topics. Both ranges of offering reinforce each other and generate synergies. They have used their historical expertise and know-how to provide value added services and customer oriented solutions.

According to Baines et al. (2009b), who synthesized the literature on Servitization, authors commonly recognize Servitization as “the process of creating value by adding services to products” (p.547). More comprehensively, they consider Servitization as “the innovation of an organization’s capabilities and processes to shift from selling products to selling integrated products and services that deliver value in use” (Baines et al., 2009b, p.547). In another paper, Baines et al. (2009a) also focus on a slightly different concept, the *Product-centric Servitization*, defined as a business case “where a portfolio of services is directly coupled to a product offering”. The product is provided with services portfolio in order to support the asset itself and its use by the customer (Baines et al., 2009a, p.1210). The product is considered as an *asset* since it often represents an equipment of the value chain or it is used for supporting activities such as machine tools, engine, printer, manufacturing equipment, etc. With that vision, the product still remains central to both the value offering and the services portfolio, on

the contrary to Service-dominant Logic of Vargo & Lusch (2004) (see below, Section 1.2.1) and the Servitization concept as coined by Vandermerwe & Rada (1988).

Despite this equivocal relationship previously suggested, one aspect seems to appear among those firms' offering: a growing part of the added value is provided by services. Services are also more and more specialized which increases the global value of the offer (Vandermerwe & Rada, 1988). Mont (2002a) specifies that the creation of added value comes from *material* and *non-material aspects of products* such as technological improvements, intellectual property, brand names, etc.

Some papers acknowledge the benefit generated by the integration of services and goods into a solution³. Among others, Visnjic & Van Looy (2013) studied performance of Atlas Copco when embracing Servitization. Products and services have complemented each other leading to a revenue growth. Even more interesting, they found that labour-intensive services (due to increasing client proximity) tended to have a bigger impact on product sales. These *reciprocal spillovers* only appear on a long time scale while in a medium term some temporary decreases occurs, which is corroborated by other studies according to the authors (presence of a U-shape relationship with a need for critical mass of services to perform). Firms also need adequate managerial practices to boost this performing synergy, as well as a managerial determination to overcome the *dead valley* and to reach profitability on large scale. Neely (2009) confirms this observation; he also states that it is the decision to servitize which brings positive effects on profitability and the Servitization itself can have negative effects.

The change in focus is not only in the service-good view. Companies also have a mind shift in their approach to customers. They were previously focused on satisfying customer needs. Now, establishing and maintaining a good relationship with customers is the key and therefore the value offering has to be wider. Clients have thus a bigger and more important role; they are more powerful too (Vandermerwe & Rada, 1988). This increasing customer centricity feature is also recognized by authors such as Vargo & Lusch (2004), Oliva & Kallenberg (2003), or Baines et al. (2009b).

Baines et al. (2009a) also stress that the user does not automatically own the product. Indeed, ownership may be transferred to a third party (usually a financial partner), or kept by

³ Lambin (2009) defines a solution as “*a combination of products and services that create value beyond the sum of its parts*”.

the provider. In such case, transactions are on a “pay-per-use” contract, which spares customers paying out huge amount of money to purchase it. Hence, the manufacturing firm also takes care of risk of failure of the asset since the user only pays when the asset is running (Baines et al., 2009a). The interaction between manufacturer and its client is therefore reinforced and expanded all over the asset’s life cycle.

1.1.1.2. *Reasons and drivers for Servitization*

Following Vandermerwe & Rada (1988), academics are numerous to acknowledge the need for manufacturers to integrate services into their value offering. Among others, Oliva & Kallenberg (2003) develop a rationale for more services under three main points: *economic arguments* (more stable income through service offering, higher profit margin on services than on products, and long life cycle of products), *customers require more services* (e.g. flexibility and specialisation), and *competitive argument* (services cannot be imitated as easily as products, adding services reinforces barriers to competitors and it is a way of differentiation). They are truly convinced services drive companies to a better competitive position. Baines et al. (2009b) also highlight three, quite similar, drivers to Servitization: “*financial drivers (e.g. revenue stream and profit margin), strategic drivers (e.g. competitive opportunities and advantage) and marketing drivers (e.g. customer relationships and product differentiation)*” (p.558). Both sets of elements are aligned with the view of Vandermerwe & Rada (1988) who see three reasons for Servitization : *to lock in customers, to lock out competitors, and to increase differentiation*. These reasons, in a way, reinforce barriers to entry, strengthening the competitive position of the *servitized* firm. Schmenner (2009) considers that Servitization enables firms to build barriers through two ways: by product novelty and by process productivity.

Furthermore, a Servitization strategy enables companies to fulfil customers’ need of getting rid of worrying about costs of maintenance and repair (since it becomes a fixed price) (Baines et al., 2009a). Customers also require gradually more services to reinforce the product and to customise the offer as well (Vandermerwe & Rada, 1988); this is another reason to embrace Servitization. Moreover, it also prevents other companies attacking their after-sale business. There is thus a double benefit for the manufacturer, increasing value offering on the customer side and capturing more profit on a high margin business (Baines et al., 2009a).

Besides, Wise & Baumgartner (1999) emphasise the financial interest for firms to *go downstream*, meaning that by providing more services to customers (and thus moving down on the supply chain) companies can improve their profit. One of the reasons is that the installed

base of products⁴ is increasingly growing due to past purchases and longer product life spans (Wise & Baumgartner, 1999). Hence, there is a rational for manufacturing firms to provide services such as maintenance. This market generates “*higher margins and [...] require(s) fewer assets than product manufacturing*” (Wise & Baumgartner, 1999, p.134), but also requires an adapted strategy to capture value from these downstream opportunities.

1.1.1.3. Adopting a new servitized strategy

The manufacturing strategy has to be modified on three main aspects, according to Wise & Baumgartner (1999). First, firms need to *redefine the value chain* by looking at their value chain with a customer lens, and by considering the value chain throughout the entire product lifecycle in order to redefine the profit measurement. Secondly, they have to *build customer allegiance* since competition is not, only, on operational performance and a good customer relationship is vital to long-lasting profit view. Thirdly, they need to *rethink the meaning of vertical integration* because distribution channel grabs now lots of value that manufacturers could covet by redeploying themselves. Positioning themselves on these three traits is required for manufacturers in order to embrace this competitive advantage of going downstream.

On their side, Oliva & Kallenberg (2003) perceive this transition (the integration of services into the value offering) as a continuum, starting from *services as add-on* and going to *tangible goods as add-on*. This is a dynamic process and companies move by aiming at increasing service predominance. Therefore, each firm goes at its own rhythm according to its goals and capacities.

Another important aspect of the strategy is the primary objective of the firm. If a pure manufacturer uses resources and technologies to produce good quality products, a servitized manufacturer is driven by developing value added and customer oriented solution, thanks to skills and knowledge (Ahamed et al., 2013; Vandermerwe & Rada, 1988).

With the increase of products installed base, Oliva & Kallenberg (2003) see a potential for manufacturing firms to provide *installed base (IB) services*. They define those services as “*the range of product- or process- related services required by an end-user over the useful life of a product in order to run it effectively in the context of its operating process*” (Oliva & Kallenberg, 2003, p.163). They thus frame a process to integrate smoothly IB services into

⁴ Installed base of products: “*total number of products currently under use*” (Oliva & Kallenberg, 2003)

manufacturers' core business. With the words of Wise & Baumgartner (1999), one can say that those firms go downstream by enlarging their value chain and becoming service provider in addition to manufacturing firm. To go downstream and provide IB services, Oliva & Kallenberg (2003) have developed a process model for a smooth transition, helping firms to acquire new adequate structure and processes:

1. *Consolidating the product-related service offering* (putting current services under a single unit to improve their performance and implement a monitoring system). Reinartz & Ulaga (2008) suggest firms start by charging a fee to services they previously provided for free to clarify their value.
2. *Entering the IB service market* (assessing profit opportunity thanks to the monitoring system, then shifting to service-oriented culture vision and value services offering)
3. Expanding the IB service offering
 - a. *Expanding to relationship-based services* (changing the price system based on availability, assuming risk of product failure via maintenance contract, etc.)
 - b. *Expanding to process-centred services* (product belongs to a global offering, the firm is a solution provider)
4. *Taking over the end-user's operations* (maintenance and professional services provider, ultimate stage of the transition)

A deeper look into their process model tells us that the customer centric orientation of the firm results from two main different shifts (Oliva & Kallenberg, 2003). On one hand, the customer interaction moves from transaction-based to relationship-based nature (stage 3.a), from selling products/services to creating and maintaining a long-lasting relationship. On the other hand, the company shifts from *product-oriented services* to *user's process oriented services* (stage 3.b), moving “*from product efficacy [...] to the product's efficiency and effectiveness within the end user's process*” (Oliva & Kallenberg, 2003, p.169).

To link this process model with the *Service-dominant Logic* of Vargo & Lusch, we can observe that product is recognised as a part of a global solution starting from the stage 3.b. Before that stage, the prevalence is still on the product, and at that stage, the shift occurs towards a Service-dominant Logic. After going through both 3.a and 3.b, authors consider companies as *pure service organisations* (Oliva & Kallenberg, 2003). Baines et al. (2009b) and other academics do not share this idea of pure service organisation; they consider that a manufacturing firm cannot become a pure service organisation. Indeed, although services might

take an increasingly importance in these manufacturing firms (as well as a large share of the profit), they remain manufacturers and product is vital to the value offering as well.

1.1.1.4. *Challenges of Servitization*

Although it generates competitive advantages, such as *lower customer acquisition costs*, *lower knowledge acquisition cost*, and *lower capital requirements* (Oliva & Kallenberg, 2003), embracing Servitization, integrating services for manufacturers, always generates challenges to face. First of all, this integration of services into the value proposition is not as fast as one might think (due to several reasons such as not their business/competencies scope, no economic potential, no right service strategy, etc.) (Oliva & Kallenberg, 2003). Moreover, customers' needs and expectations are even more complex, they are more demanding. Thus, firms have to pay more attention to the quality of delivery but also to its accurateness (providing the right solution) (Baines et al. 2009b).

It is also important that firms understand what users really value in their services in order to effectively and efficiently design and provide this value offering. Another pragmatic issue is that the provider has to offer the bundle at a lower price than either user self-service or outsourcing to an independent *pure service* firm (Visnjic & Van Looy, 2013)⁵. This requires a high cost effectiveness both on product & service separately, and on the integrated bundle.

Baines et al. (2009b) summarize challenges into three main categories.

Integrated product-service design

Obviously, the product design has to be rethought in order to fulfil optimally users' needs but also to enable overhaul and other services delivery. The design is made to optimise the entire life performance of the asset and its services portfolio, and to enable an easy combination of services (and products) in order to facilitate the response to evolving customers' needs. Furthermore, operational processes have to be reviewed as well. It is not only about efficiently delivering a product anymore. It is all about integrating product and services efficient deliveries, despite of potential tensions that might emerge from this complex delivery system. Finally, internal organisational changes are also required. The company and its employees have to

⁵ For an accurate assessment, the client/user has to consider tangible cost but also hidden cost, especially for the self-service option which requires internal intangible resources (time, administrative work, etc.)

consider themselves as *service-oriented*. This is an essential step to be able to change value offering, product design, processes, etc. (Baines et al., 2009a).

Organizational strategy

In order to support customer allegiance, companies have to deliver the right product-service portfolio. Therefore, the strategy has to be service-oriented, customer-centric, focused on the outcome use, etc. (Oliva & Kallenberg, 2003; Wise & Baumgartner, 1999). The entire firm strategy has to be reviewed and aligned with the new objectives.

Organizational transformation

First, a specific service culture is required, through a shift in corporate mindset, new attitudes, service-oriented environment, and trained, committed and empowered people. That will probably generate some resistance coming from managers and employees (Baines et al., 2009b; Bartolomeo et al., 2003). Additionally practices, processes and global structures have to be rethought to fit with the new organisational strategy. Oliva & Kallenberg (2003) among others also stress the importance of separate business units to perform in services, with specific goals and performance criteria. Moreover, a transformation in the sales staff mindset and incentive has to occur to push them promoting both products and services (Reinartz and Ulaga, 2008).

These changes affect all the departments/units of the manufacturing firm: R&D, procurement, production, sales & marketing, after sales, etc. (Ahamed et al., 2013).

In addition to these challenges, providing IB services also comes with its own ones. Indeed, by providing IB services, manufacturers have to deal with two opposite strengths. First, by improving service quality, firms cut their replacement sales via an extended product life. Secondly, by improving the product quality and longevity, manufacturers potentially cut future service revenues (Oliva & Kallenberg, 2003). There is thus a balance to strike in order to optimise the total revenue stream of the company on a long-term basis.

Moreover, obviously, all the Oliva & Kallenberg's stages come with their own challenges. Mainly, manufacturing firms have to learn how to evolve in a service-oriented world, to acquire services capabilities, new knowledge and skills, to develop new marketing approach, etc. (Oliva and Kallenberg, 2003).

1.1.1.5. *New business model for new servitized strategies*

Servitization also leads to a new business model. Indeed the firm creates value both by selling products/assets and throughout its use. Hence, value results from transactional and relationship elements. Companies have to understand it to measure adequately that performance in order to communicate this improved value offering to customers (Baines et al., 2009a).

Wise and Baumgartner (1999) recognise four successful forms of business model when going downstream. The first one is *Embedded Services*, when companies integrate services previously performed by customers into the product offering, thanks to new technologies for example (Example: the on-board computer in cars says to you when you should plan an overhaul). *Comprehensive Services* is a business model aiming at providing a bundle of services surrounding their initial offering. One advantage of that option is the better perception of customer's expectation gained by the manufacturer, which helps to adapt the offering (Example: GE created GE Capital, the conglomerate's financial arm of GE, to offer financing solution to its customers, such as GE Locomotive clients). Then, the authors suggest combining "*products and services into a seamless offering that addresses a pressing customer need*" (p.138), and call it *Integrated Solutions*. In addition to retain customer allegiance, this business model enables to capture more value on recurring and solution upgrading services (Example: Apple developed platforms such as iTunes to provide additional services). Lastly, the *Distribution Control* model suggests to take control of distribution activities, coming into customer business and grabbing worthwhile part of the value chain (Example: Coca-Cola manages itself its entire distribution chain, going even to the store to restock the shelves).

Uлага & Reinartz (2011) suggest classifying manufacturing services into four categories: *product life cycle services* (supporting the product through all life cycle stages), *asset efficiency services* (gaining productivity, e.g. by data analysis and monitoring), *process support services* (helping users to enhance their business processes), and *process delegation services* (performing customers' processes).

1.1.2. Service-dominant Logic

Following Vandermerwe & Rada in the Servitization concept, Vargo & Lusch (2004) coined the so-called *Service-dominant Logic*, considered as a new dominant logic, by themselves and by several other academics in the following years. This section allows the reader to discover more about this logic.

1.1.2.1. *Service-dominant Logic foundation*

The *Service-dominant Logic* (SDL), with a focus on “*intangible resources, the co-creation of value and relationships*” (Vargo & Lusch, 2004, p.1), wants to take the opposite view to the common logic at that time, the *Good-dominant Logic* (GDL).

In order to understand this new logic, one should keep in mind the distinction made by Vargo and Lusch (2006) between the terms *services* (“*reflecting a special type of output – intangible product*”) and *service* (“*reflecting the process of using one’s resources for the benefit of another entity*”). One can notice that if Vandermerwe & Rada used the plural term (services), Vargo & Lusch preferred the singular term (service) to define the global concept. Thus, SDL relates to the singular form that is defined as the “*application of specialized competences (knowledge and skills) through deeds, processes and performances for the benefit of another entity or the entity itself*” (Vargo & Lusch, 2004, p.2).

To explain both SDL and GDL as well as that dominant logic shift, Vargo & Lusch use the concept of operand and operant resources⁶ defined by Constantin and Lusch (1994). They see operant resources as primary since these resources really produce effects by acting on other (operand or operant) resources. This distinction among resources enables them to state six main criteria on which GDL and SDL differ from each other (as summarized in Table 1).

⁶ “*Operand resources [are] ... resources on which an operation or act is performed to produce an effect ... operant resources [are resources] which are employed to act on operand resources (and other operant resources)*” (Vargo & Lusch, 2004, p.2)

	Traditional Goods-centred dominant logic	Emerging Service-centred dominant logic
Primary unit of exchange	Goods used as operand resources	Knowledge and skills as operand resources
Role of goods	Operand resources and end products	Transmitters of operand resources (intermediate products)
Role of customer	Operand resource, recipient of goods	Co-producer of service, primarily an operand resource, occasionally an operand resource
Determination and meaning of value	Determined by the producer and embedded in operand resource – Exchange value	Perceived and determined by the consumer (firm can only make value proposition), resulting from application of operand resources – Value in use
Firm-customer interaction	Transaction	Relational exchange and co-production
Source of economic growth	Surplus tangible resources and goods	Application and exchange of specialised knowledge and skills

Table 1 - Differences between SDL and GDL, adapted from Vargo & Lusch (2004)

We can use the case of IBM as an example to state clearly the distinction between the two logics. Historically IBM was a Goods-centered dominant company, focused on selling goods (unit of exchange: machines), goods were used as raw materials to create other, more valuable goods. The customers had only one role, they bought the IBM products, and they were not able to influence the value determination. The computer was provided *as is*, and value was already embedded on it before the delivery. The only interaction between the customer and IBM was a transaction when the client bought the product and received it. Economic growth was linked to the surplus made on the sales (profit generated by the product) and the amount of sales.

On the other hand, now IBM business is based on a Service-dominant Logic. To provide consulting services and to create customised solutions, IBM uses its staff expertise, knowledge

and skills; product being used as support for the service. Customers have an important role in the interaction, they co-produce the solution (by sharing data, working with IBM staff, etc.) and we face now a relational exchange. The value appears only in the use made by the clients. The solution can be very powerful, with top technologies; nevertheless, if it does not fit with the client's business, the solution is useless and without any value. Therefore, the customer perceived and decided the value, and the economic growth of IBM depends on the quality of its application and exchange of its specialised knowledge and skills (it depends on the quality and relevance of its solutions and services provided).

Although they are convinced of the predominance of SDL, Vargo & Lusch (2006) do not consider the shift from a good economy to a service economy as essential; the most important transition is “*the migration from operand resources to applied operand resources as the primary focus of exchange*” (p.51).

As the services-goods relationship stated by Vandermerwe & Rada led us to believe, the perception of goods has completely changed in SDL. Goods are considered as delivery tools, enablers of service (Vargo & Lusch, 2006), or vehicles for service delivery (Vargo et al., 2008). This emphasises their role as operand resources. People are exchanging services they need, and goods might be involved “*as a mechanism for service provision*”, considered as one of the ways of providing services (Vargo & Lusch, 2006). The view of services also shifted from a special case of goods (or an alternative to them) in GDL to units of output in SDL (Vargo & Lusch, 2006). Nevertheless, as stated above, Vargo & Lusch (2006) would rather use the singular form to depict the global logic, reflecting more “*the application of specialized skills and knowledge*”.

The shift intrinsically occurs on several levels, not only in the services-goods relationship, as they clearly explicit it here:

“It (SDL) shifts the focus away from goods to service, from operand resources to operand resources, from being to doing, and somewhat less precisely, from what is exchanged to the process of exchange and from the tangible to the intangible. Arguably it also refocuses us on the role of exchange in general” (Vargo & Lusch, 2006, p.51).

Their reflexion on the new logic led them to come up with eight *foundational premises* (FPs) (Vargo & Lusch, 2004) which ended up to ten FPs after a review of peers' comments and

critics on their first publication as well as their own evolving reflexion on the concept (Vargo & Lusch, 2008). Table 2 consists of the ten “new” foundational premises. These draw a clear picture of what is the SDL and the importance of services, operant resources and co-creation of value for this concept.

FPs	Modified/new foundational premise
FP1	Service is the fundamental basis of exchange
FP2	Indirect exchange masks the fundamental basis of exchange
FP3	Goods are a distribution mechanism for service provision
FP4	Operant resources are the fundamental source of competitive advantage
FP5	All economies are service economies
FP6	The customer is always a co-creator of value
FP7	The enterprise cannot deliver value, but only offer value propositions
FP8	A service-centred view is inherently customer oriented and relational
FP9	All social and economic actors are resource integrators
FP10	Value is always uniquely and phenomenologically determined by the beneficiary

Table 2 - SDL foundational premises, Vargo & Lusch (2008)

One can thus understand that operant resources are the key to competitive edge in the *new economy* (SDL) driving the value and benefits to the firm by their application to operand/other operant resources (Vargo & Lusch, 2006). They even suggest that “*by retaining ownership of good and simply charging a user fee*” companies might find “*a competitive advantage by focusing on the total process of consumption and use*” (Vargo & Lusch, 2004).

1.1.2.2. *A new value consideration*

Furthermore, another key is the new approach to value co-creation developed in the SDL. Vargo & Lusch (2004) state that value is co-created by the firm and its customers. One recognises here the customer centric view of Vandermerwe & Rada. The role of the clients switched from value destroyer to value creator, they are now endogenous to the process (Vargo & Lusch, 2006) and not *targets* anymore, passively receiving value created by the firm (Bettencourt et al., 2014). Hence, firms can only make value propositions but are unable to create value *alone* without their clients who are the only ones to determine the value at the end. Value co-creation is “*a joint function of the actions of the provider(s) and the consumer(s)*” (Vargo & Lusch, 2006). Therefore, the exchange of service(s) only happens through relationship, implied by the value co-creation initiated by both parties (Vargo & Lusch, 2006).

This relationship with customers is also evolving since they are looking for more specialised offer that will better fit to their needs. On one hand, it enables them to be served more adequately; but on the other hand, it brings them more dependency to that specific firm as well. The promotion is also modified and tends to be an ongoing communication process leading to a more customised dialogue (Vargo & Lusch, 2004). All together, SDL results in a *complex adaptive system* (Vargo & Lusch, 2004).

With SDL, value is nowadays based on processes rather than on units of output (Vargo et al., 2008). Value can thus be defined as “*an improvement in system well-being and we can measure value in terms of a system's adaptiveness or ability to fit in its environment*” (Vargo et al., 2008, p.149). In SDL, value is created by achieving a goal for clients or by resolving one of their problems (Bettencourt et al., 2014). The manufacturing firm is focused on optimising its help to customers, not on its production optimisation.

Linked to the two main logics, Vargo et al. (2008) distinguish two types of value: *value-in-use* and *value-in-exchange*. They associated value-in-exchange with Good-dominant Logic and value-in-use with Service-dominant Logic. Indeed, in GDL, firms manufacture goods and provide them through exchange. Value is created by this manufacturing and follows an exchange of goods and money. On the contrary, in SDL, the goods or services *per se* do not really bring value; it is the use of the service provided that creates value. Thus, the client takes totally part in the value co-creation. Companies are seen as *integrators of individual competences*, and by their action, they deliver services by transforming resources and competences to fulfil consumers' needs. (Vargo et al. 2008)

Although value-in-use is vital to SDL principle, value-in-exchange is still needed. The only way for value-in-use to go without value-in-exchange is when resources are freely available. As soon as you need to access resources owned by someone else, value-in-exchange goes with it as well. *“The process of co-creating value is driven by value-in-use, but mediated and monitored by value-in-exchange”* (Vargo et al., 2008, p.150).

To summarise their vision on value creation, Table 3 recaps the four value creation premises; useful to consider as a manufacturing firm aiming at putting a service lens on its business (developed by Bettencourt, Lusch & Vargo (2014)).

Value creation premises
Service is what is always hired [by the clients] to get a job done ⁷
The customer always co-creates value to get a job done successfully
All firms and individuals integrate resources to get an entire job done
Value is always specific to the context in which a job is done [value only comes through the job accomplishment, which leads to rephrase <i>value-in-use</i> into <i>value-in-achievement</i>]

Table 3 - Four Value Creation Premises (Bettencourt et al., 2014)

1.1.2.3. Service science and service system

Vargo et al. (2008) also state that value is co-created via interaction and mutual exchange. Therefore, organisations now face what they call configuration service systems. They define service system as *“a configuration of resources (including people, information, and technology) connected to other systems by value propositions”* and service science as *“the study of service systems and of the co-creation of value within complex configuration of resources”* (Vargo et al., 2008, p.145). According to the authors, SDL is a prerequisite for service science. They also extend the concept of service system to any group, entity of individuals who has to interact and exchange resources with other organisation(s). In service systems, value co-creation comes

⁷ In this paper, they add the concept of Jobs-to-be-Done to SDL to have a deeper analysis on value creation. They define Jobs-to-be-Done as the shift of *“a company’s innovation focus from what is being produced by firms to enabling customers to get their jobs done successfully”* (Bettencourt et al., 2014).

from the interaction and exchange of resources between all the actors, and core source of exchange is knowledge. This is similar to the SDL view.

1.2. Product-Service System

As already mentioned, Servitization is all about integrating services into the value offering, with a relative importance of the goods and services according to the firm (authors themselves recognise that predominance of one to the other is not always clear, and would rather stress the importance of the global offering, the provided solution). Numerous authors call *Product-Service System* (PSS) this solution integrating products and services. Baines et al. (2007) clearly state that PSS is a “*special case of Servitization*”, integrating a combination of services and products. They consider PSS as “*a market proposition that extends the traditional functionality of a product by incorporating additional services*” (Baines et al., 2007, p.1543).

The first PSS definition (see Table 5) was specified by Goedkoop et al. (1999, p.19), who also defined the three key elements of PSS (Table 4):

Product: “ <i>A tangible commodity manufactured to be sold. It is capable of ‘falling on your toes’ and of fulfilling a user’s need</i> ”
Service: “ <i>An activity (work) done for other with an economic value and often done on a commercial basis</i> ”
System: “ <i>A collection of elements including their relations</i> ”

Table 4 - Definition of the three key PSS elements (from Goedkoop et al., 1999)

Goedkoop et al. (1999) also highlight *the product, the service, and the combination of products, services and their relationships* as the key elements of PSS. Hence, they suggest a definition of product and service going in the same way as those detailed in the Servitization section (Section 1.1.1), but authors like Vandermerwe & Rada (1988) or Baines et al. (2009a) would rather use the plural form, services; and, as discussed, Vargo & Lusch (2006) make a distinction between the two forms.

Following them, several authors have published on PSS. Originally from Scandinavia and Northern Europe, the concept has now spread more globally. Different definitions are detailed in Table 5. In addition to the definition, Mont (2004) designed a framework for evaluating PSS. Both her definition and her framework emphasise four main PSS elements: *product, service, actor networks, and infrastructure*. The *system* element of Goedkoop et al. (1999) can thus be considered as split into *actor networks* and *infrastructure*.

Author	Definition of PSS
Goedkoop et al. (1999, p.20)	<i>“A marketable set of products and services capable of jointly fulfilling a user’s need. The product/ service ratio in this set can vary, either in terms of function fulfilment or economic value”</i>
Mont (2004, p.71)	<i>“A system of products, services, networks of actors and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models”</i>
Baines et al. (2007, p.3)	<i>“A PSS is an integrated product and service offering that delivers value in use. A PSS offers the opportunity to decouple economic success from material consumption and hence reduce the environmental impact of economic activity”</i>
Manzini & Vezzoli (2003, p.851)	<i>“An innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands”</i>
Tukker (2004, p.246) Tukker & Tischner (2006, p.1552)	<i>“Consist of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs”</i>

Table 5 - Definitions of Product-Service System

One can notice the importance of the environmental impact in these definitions (especially for Mont (2004) and Goedkoop et al. (1999)). However, not all the academics share this environmental concern, as suggest Beuren et al. (2013): *“The ultimate PSS objective is to increase a company’s competitiveness and profitability, and another of PSS objectives is to reduce the consumption of products”* (p.222). The consumption reduction is not the main goal, and is not directly linked to environmental concern, although they acknowledge later in their paper the importance of sustainable issue in PSS concept. Tukker & Tischner (2006) also consider environmental issue as part of PSS concept although missing from their definition. Actually, having a *greenfield mindset* to elaborate the PSS is one of their PSS pillars (the second

being the starting point of business development has to be the final functionality desired by users) (see Section 1.2.5 for full discussion and relevance on environmental impact).

Beyond the definition, authors consider PSS as a type of value proposition, where firms sell *satisfaction* to meet expectation of client's achievement. Mont (2004) considers PSS as a shift from *mass production* to *mass customisation* in order to provide *function of a product*. By reinforcing customer loyalty, by fulfilling customer needs and enabling them to focus on their core activities, PSS generates new sources of added value (and thus profit) for provider (Tukker, 2004).

Baines et al. (2007) consider PSS as the convergence of two trends, Servitization and productization⁸, as shown in Figure 1. PSS is therefore an evolution of the Servitization concept aiming at integrating even more products and services under a single offering. In addition, Baines et al. (2009b) synthesise the relation between PSS and Servitization as follow:

"The work on product-service systems (PSS) is particularly closely related (to Servitization). Many of the principles are identical. The difference arises in the motivation and geographical origin of the research communities. PSS is a Scandinavian concept which is closely coupled to the debates on sustainability and the reduction of environmental impact" (Baines et al., 2009b, p.548)

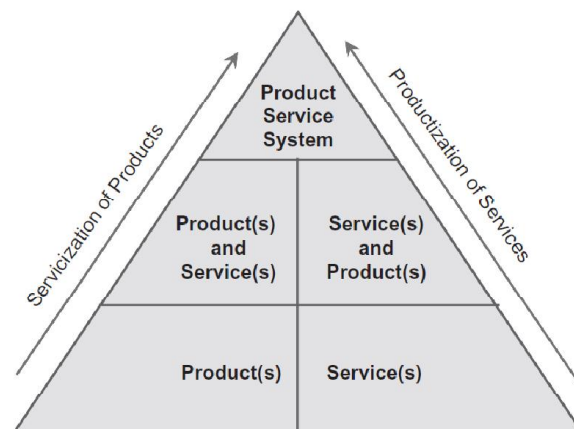


Figure 1 - Evolution of the PSS concept (Baines et al., 2007)

⁸ Productization is the same reasoning as Servitization but completely reversed, from services to products. Baines et al. (2007) define it as *"the evolution of the services component to include a product or a new service component marketed as a product"*

In addition to the PSS definition, Mont (2002a) defines the common main features of a PSS (see Figure 2). Primarily, a PSS comprises products, services or a combination of them (with sometimes substitutions of services for products), as also suggested by Goedkoop et al. (1999). Usually, even if services are prevalent, a material item remains in the PSS. Secondly, PSS is characterized by services performed at the point-of-sale (marketing, personal assistance, etc.). Thirdly, PSSs can be split into two categories according to their concepts of product use: use oriented (the user extracts product utility, e.g. leasing, renting, pooling, and sharing) or result oriented (the provider extracts the product utility for the user)⁹. Then, PSS has to be supported by maintenance services in order to extend the product life (e.g. repairing, monitoring, and cleaning). Lastly, revalorisation services are established to close the material cycle loop by recycling, remanufacturing, refurbishing, or reusing the product (or some of its parts).

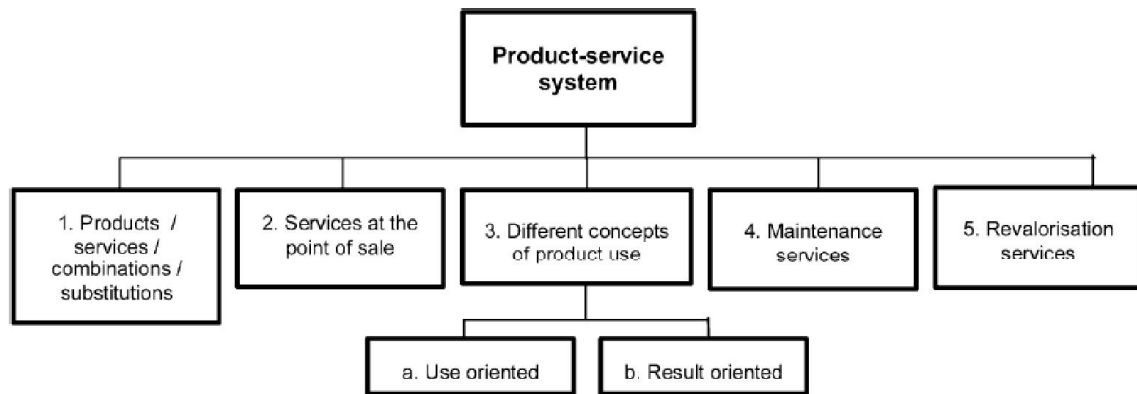


Figure 2 - PSS elements (Mont, 2002a)

1.2.1. PSS typology

Academics have highlighted various trends in the past two decades for the concept of PSS itself. They result from more global trends in the society such as a more leasing oriented society, the sale of product use and the substitution of goods by services, a *repair-society*, the consumer attitude moving to services, etc. (Mont, 2002a & 2004)

More specifically, the literature agrees on three main types of PSSs (Tukker, 2004; Baines et al., 2007; Reim et al., 2015), although some inconsistencies are frequent in the literature, authors generalising characteristics of one PSS type to all the categories, or creating

⁹ This is a more simplified subdivision of PSS types than the one explained in the next section

slightly different types. The three main categories are *Product-oriented PSS*, *Use-oriented PSS*, and *Result-oriented PSS*; and are detailed below (Table 6).

Product-Service System types	
<i>Product-oriented PSS</i>	Additional related services are added to the product that remains important to the transaction (e.g. maintenance, training, monitoring, recycling, etc.). Product ownership is always transferred to the user.
<i>Use-oriented PSS</i>	Selling use/availability of a product, like leasing or sharing. Although the product still remains central, the user does not own it anymore and pay a periodic fee for its use. Provider has to support more risks and responsibilities compare to a product-oriented PSS.
<i>Result-oriented PSS</i>	Providing a result/capability, instead of selling a product or its use. It is often a portfolio of services provided by the firm, with a retained ownership of the asset. The customer pays on a result basis. The emphasis is not on how to do it (with which pre-determined physical products) but rather on the final outcome. Therefore, provider supports full responsibility and risks.

Table 6 - PSS types & definitions

No matter the type of PSS, some characteristics remain the same. The service provider has to support more responsibilities (full life cycle, sometimes ownership, etc.). Customers are also often involved at an early stage compare to traditional manufacturing firm since they take part in the process from the design phase (at least to some extent, varying according to the PSS/firm). Moreover, the use phase is more important for both consumer and asset provider. The customer-provider relationship is also reinforced resulting in better customer loyalty and long-term relation. Basic services provided by the manufacturing firm are often similar as well.

Besides these three types, Neely (2009) suggests to add two other categories, namely *Integration-oriented PSS* and *Service-oriented PSS*. The first one occurs when a company goes downstream and integrates vertically while adding services to its offering, for example when going into distribution and retail market. Service-oriented PSS is about firms adding services to products when integrating services into the product. He takes the example of Intelligent

Vehicle Health Monitoring services as typical case of Service-oriented PSS. In term of dematerialisation of the solution, Neely (2009) considers Integration-oriented PSS as the first option, before Product-oriented PSS. He positions Service-oriented PSS right after Product-oriented PSS, but before Use-oriented PSS and Result-oriented PSS.

Tukker (2004) goes even further by designing eight different subtypes of PSS as summarized in Figure 3. One can recognise on this typology the *product-service continuum* of Oliva & Kallenberg (2003) and the three main types of PSS, as grounded foundation for the eight subtypes of PSS. Tukker observes that (from 1 to 8) “*the reliance on the product as the core component of the PSS decreases, and the need of a client is formulated in more abstract terms*” (Tukker, 2004, p.249). This typology is described below.

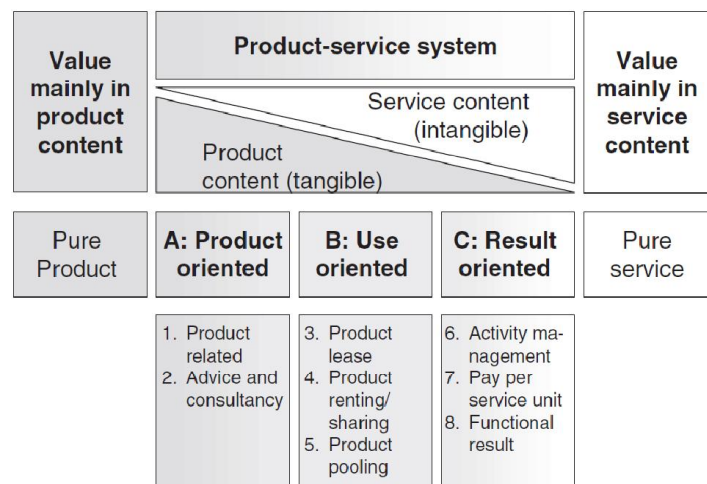


Figure 3 - Eight types of PSS (Tukker, 2004)

Product-oriented services:

1. *Product-related service*: services needed in the use phase are provided with the product at the point-of-sale.
2. *Advice and consultancy*: firm provides advice on the most efficient use of the product sold.

Use-oriented services:

3. *Product lease*: no transfer of ownership and regular fee paid by the lessee for an unlimited and individual access to the leased product. The provider takes care of maintenance, repair and control.

4. *Product renting or sharing*: no transfer of ownership and payment for product use. The provider takes care of maintenance, repair and control. However, different users can sequentially use the product.
5. *Product pooling*: ditto, but the product can be simultaneously used by different users.

Result-oriented services:

6. *Activity management/outsourcing*: a part of the client's activity is outsourced to a third party; the service is evaluated with performance indicators.
7. *Pay per service unit*: pay for the output of the product according to the level of use.
8. *Functional result*: agreement on a result delivery without direct relation to a specific technological system (provider free of how to deliver the result).

Tukker (2004) also assesses each of the eight PSS types on two characteristics: *the economic potential* and *the environmental potential*. He used four factors to assess the economic potential: *tangible and intangible value for the user, tangible costs and risk premium for the provider, capital/investment needs, and issues such as the providers' position in the value chain and client relations* (Tukker, 2004, p.246). The *relevance of certain impact reduction mechanisms* was used to assess the environmental potential.

He ended up with some findings. First, he states that the easiest applicable PSS is the Product-oriented services (the least radical). He stresses that Use-oriented services might frighten off users since they have to sacrifice a bit of their freedom to access the product (leasing, pooling or renting does not give you a full temporal access to the product). Regarding Result-oriented services, agreeing on the right performance criteria and prediction on user behaviour are the key issues, which might blow up the risk premium. Concerning the environmental potential, the different categories have different sustainable impacts, globally quite weak, even non-existent. However it seems having no worse environmental performance (compare to pure products), excepted for leasing PSS where ownerless use might lead to a less careful responsibility of users.

1.2.2. Ownership, risks and responsibilities

Like in SDL, the focus moved from the '*sale of product*' to the '*sale of use*' (Baines et al. 2007). However, the literature is not consistent with the ownership issue. With a quick look at the three main types of PSS, one can already notice that the user owns the product only in a Product-oriented PSS. In the two other types, the ownership usually remains in the hands of the

providing firm. Nevertheless, some authors have a more global view on PSS and do not make distinction among PSS types when discussing about ownership.

For example, Baines et al. (2007) consider that the user does not purchase the asset but rather pay for its use¹⁰, which leads to a reduction of the risks, responsibilities and costs supporting by the customer regarding the ownership of the asset (and transferred to the provider). However, although their view on ownership, they state “*PSS values asset performance or utilization rather than ownership*” (Baines et al., 2007, p.1888) reflecting a preponderance of asset use on its property. In addition, Mont (2002a) states that PSS “*are also often associated with changes in the ownership structure*” (p.238).

On the other hand, Lindahl et al. (2009) have conducted a survey on 34 PSS companies and it appears that ownership of products is transferred to the user in more than 70% of the studied cases. This result balances the theoretical point of view of authors with the current practices.¹¹

The ownership issue opens the doors to a more global issue, the distribution of rights, liabilities and risks between providers and customers. There are no specific rules and all PSSs have different allocations of them, in particular due to the PSS categories. One of the main reasons is the variable length of PSS contracts; long-term contracts (involving long-term relationship) have to offer benefits for all parties through the entire contract life, by sometimes redefining this *distribution*. These contracts also have to be drawn up more comprehensively and carefully for a Result-oriented PSS than for a Product-oriented PSS. Indeed Result-oriented contracts are much more complex, responsibilities and tasks are divided among parties (e.g. who is responsible when downtime of assets, etc.), liabilities have to be clearly settled, etc. Moreover, contracts have to prevent adverse behaviour risks by settling adequate incentives for parties (Reim et al., 2015). In brief, contracts have to be aligned adequately with the PSS type, and sharing of information goes on the same way.

¹⁰ From a *Tukker point of view* if the user pay for its use, it represents only one category of PSS. That shows us authors do not agree on a common typology of PSS.

¹¹ Results collected in 2005/2006 in Sweden (13), Japan (10), Germany (4), and Italy (7). Those results have to be balanced since the study is a bit old, but also since most of offering (of sampled firms) only comprised of physical products, maintenance and repair; and since products were mainly standard products and their development followed the same process as traditional products. Therefore, in my opinion, the study is only representative for a few PSS types as developed by Tukker (2004).

Supported risks (for the firm) often increase with responsibilities undertaken by the provider. Usually Result-oriented PSS is the most risky business model category (Reim et al., 2015) due to more outcome uncertainty. In the Use-oriented PSS, the main risk is adverse customer behaviour related to a proper use of the asset (Reim et al., 2015).

1.2.3. Life cycle consideration in PSS

No matter if the manufacturer keeps the ownership, it has to enlarge its involvement and responsibility through the total life cycle of the product¹² (or at least to a larger extent than traditional manufacturers) (Mont, 2002a; Beuren et al., 2013). Usually PSS includes “*take back, recovery, reuse and refurbishment, and remanufacturing*” (Mont, 2002a, p.241). Therefore, the firm is responsible for those services too. This leads to a renewal of product and service design (see Section 1.2.9) but also to a closer collaboration with suppliers.

Obviously, life cycle considerations apply to both used products and provided services, and are tackled when designing both. These considerations relate to all life cycle phases, i.e. manufacturing, usage, delivery, maintenance, recycling and remanufacturing (Sundin, 2009).

Moreover, if the product is returned to the provider, its performance all over its life cycle can be assessed by the firm before remanufacturing or refurbishing it. This feedback is highly knowledgeable for manufacturers in order to adjust its design and specification accordingly (Sundin, 2009). With this in mind, retained ownership is interesting for manufacturing firms.

1.2.4. Dematerialization in PSS

The concept of PSS often comes with this of dematerialization (“*reducing the material flows in production and consumption*” Mont, 2002a, p.237) since PSS splits value delivered and physical resources required. There is thus a decoupling of “*economic success from material consumption*” (Baines et al., 2007), a possibility to deliver value and meet users’ needs with dematerialized services. Mont (2004) argues, “*Functional sales*¹³ [PSSs] *create an opportunity to decouple economic value from consumption of energy and materials, but do not guarantee that this will necessarily occur*” (p.33). Hence, she is a bit more finely-shaded as she talks about

¹² Product life cycle is defined by Sundin (2009) as “*the progress of product from raw material, through production and use, to its final disposal*”

¹³ Mont (2004) considers *functional sales* as the *basic notion* of PSS. The distinction between PSS and functional sales is studied later

opportunity that can potentially occur! This is aligned with the discussion on environmental and sustainable issues of the next section.

1.2.5. Environmental and sustainable issues, a PSS concern

Many authors consider PSS as a way of lowering the manufacturing environmental impact (Mont, 2002a; Goedkoop et al., 2009). In practice nevertheless, it is not the case as conceded by several authors (Mont, 2002a & 2004; Tukker & Tischner, 2006). Mont (2004) acknowledges that delivering value-in-use do not automatically lead to environment enhancement. In addition, as state Tukker & Tischner (2006), “*PSSs are not inherently more sustainable as products*” (p.1553) (view shared by Bartolomeo et al. 2003). Mont (2004) adds that environmental performance are often a *side effect* for companies, not their primary goal. Tukker (2004) also explains that there is no clear evidence of sustainability improvement in many successful PSSs, and that most of *purpose-designed sustainable PSSs* have collapsed.

Moreover, seeing the various typology, there is no possibility to generalise such characteristic to all PSSs. However, academics agree on the fact that Product-oriented, Use-oriented and Result-oriented are gradually potentially more likely to develop sustainable value propositions (Tukker, 2004).

Multiple uses of products play an ambiguous role on environmental impact of PSS (Mont, 2002a). It really depends on the conditions of use, therefore customers play a relevant role on the final impact. On one hand, it can help to reduce environmental burden by lowering the total amount of products, and, when customers pay per use, by revealing the actual cost of using it and leading to a reduction in use. On the other hand, leasing/sharing/renting opens access to consumption to people who could not afford it when buying the product. When renting, you might also want to make profitable the time you access the product, thus you might overconsume it during this period.

In addition to this concern, some authors, such as Manzini & Vezzoli (2003), highlight that PSS could even generate counterproductive solution, sustainably speaking. Actually, PSS might engender unwanted side effects, the *rebound effects* (Manzini & Vezzoli, 2003; Bartolomeo et al., 2003)¹⁴. Indeed, PSS might modify, as a second effect, the consumer

¹⁴ Bartolomeo et al. (2003) list six types of rebound effects: cost effects (low price leads to more consumption), ‘*re-spend*’ effects (savings enable additional expenses), space effects (demand can be extended geographically and socially), time effects (less time required to do the task allows to allocate the free time to do something else),

behaviour, e.g. the money saved by the PSS solution might be spent on other products and therefore increase the global consumption. This potential negative impact is confirmed by Reim et al. (2015), who acknowledge the possibility of economic benefits linked to negative environmental impact.

Nevertheless, some intrinsic characteristics of PSS concept might lead to an improvement of the firm environmental impact (if the provider wants to be more responsible, PSS is a good way to do so). Since the provider supports more responsibilities (linked to ownership, or performance criteria for example) and thus internalises more costs, there is an interest for optimizing processes and maintaining high quality (Mont, 2002a). Those aspects might lead to a more sustainable global delivery process (as well as a profit optimisation), but they need assessment criteria specific to each PSS.

Reim et al. (2015) see two ways of improvement: *resource utilization* and *extent of innovation*. First optimizing utilization of resources can be achieved both by decreasing the total amount of product and by reducing material use. Diminishing material use goes with less waste and closing material cycles (via remanufacturing, refurbishing, reusing, recycling, etc.), in other words improving overall productivity of resources (Mont, 2002a). Total required amount of products is linked to the intensity of their use, their functional efficiency. That is reached by either reducing consumption (alternative use scenarios), reducing the need of using the product, or by increasing its lifetime and thus being used more times. Secondly, incremental and/or radical innovations enable to improve the efficiency and lifetime of products as well as to enhance processes, resources use, design and productivity, and to generate new service delivering added value. Radical innovation can also bring new ways of fulfilling user needs (especially in Result-oriented PSS) (Reim et al., 2015).

Other motivation for a more sustainable PSS can be found in legal conditions/requirements, in the wish to explore new technologies or to create innovative solution that are valuable by the customers, etc. (Reim et al. 2015)

behavioural effects (behavioural changes, responsibility, etc.), and platform effects (services platform opens the door to more consumption)

1.2.6. Drivers for PSS

Mont (2002a) summarises the main driver for PSS as a reaction to the “*evolution of the economic transition away from standardised and mass production towards flexibility, mass-customization and market driven by quality and added value rather than cost*” (p.240) . Moreover, stakeholders and the society are more and more concerned with environmental issues; reacting to their expectation is also an incentive for manufacturers (Mont, 2004). Nevertheless, governments lag behind in enforcing policies promoting really the management of environmental impact of companies throughout the whole product life cycle (Mont, 2004). A strengthening of such policies could lead companies to tackle this issue. Bartolomeo et al. (2003) suggest policies to “*internalise environmental factors into service innovation processes*”, considering them as the most attractive policies (for providers).

From the survey conducted by Lindahl et al. (2009), customer connection, customer demands and increased competition appear to be the main drivers for PSS providers, aiming at reinforcing relationship. It is also interesting to notice that, out of ten factors, *improve environmental image* is ranked at the last position whereas *improve company brand* is the fifth most important factor. Therefore, there was no link (at that time) between *green image* of the company and its brand recognition, at least in the mind of the firm.

Obviously, all the benefits described in the next section can be considered as drivers too.

1.2.7. Benefits and opportunities of PSS

Authors, like Mont (2002a), are really convinced in the potential of PSS to speed up the move to a more sustainable society. Beuren et al. (2013) state that major benefits comprise “*continuous improvement of the business, innovation in quality and the satisfaction of consumer demand*” (p.225). In addition, PSS can really bring synergies among profit, competitiveness and environmental benefits (Goedkoop et al., 1999; Mont, 2004), by *broadening the system to be optimized*, for example (Manzini & Vezzoli, 2006). This is the convergence of interests from parties in the system that leads to optimisation and efficiency (potentially eco-efficiency).

One can notice that a PSS is a system innovation. Consequently, it will face lots of resistance since people are usually reluctant to change. Therefore, potential benefits only appear when PSS fits with its specific context and is well designed for it (Tukker & Tischner, 2006).

Some benefits are specific to customers¹⁵. They can make savings by buying a system solution, which is better customised and with higher quality (Baines et al., 2007). They have a greater diversity of choices in product use (and ownership structure), associated services and payment structure (sometimes without huge investment) (Mont, 2002a). Moreover, they can benefit from PSS by outsourcing activities that are not in their core business (such as administrative or monitoring tasks) (Mont, 2004) and thus focus on what they do the best. However, that last point has to be balanced to avoid them to be stuck to one specific provider.

On the manufacturer side, benefits can also be numerous. First and foremost, PSS brings *strategic new market opportunities* to the firm (Mont, 2002a; Baines et al., 2007), thus it generates more profit. One way is the diversification by enlarging the range of offers, attaching services (and value) to products, and attracting more customer segments (Mont, 2002a & 2004). Another way is to reinforce the competitive edge since specific services are less easy to copy than products (Baines et al., 2007; Mont, 2002a & 2004). The market position can also be reinforced by securing current market share with this diversification. Therefore PSS enables to lock in (more) customers and to lock out competition, by increasing switching costs in particular (Reinartz & Ulaga, 2008). Then, by providing function instead of the product itself, the provider also grabs more information on how its products perform under use. Moreover, the firm can also reinforce loyalty and improve customer relationship, and can use the information gathered through this tighter relationship to improve system performance and to develop new solutions (Mont, 2002a & 2004; Beuren et al., 2013). Therefore, PSS is also a way of improving total value for users (more services and functionalities, last longer, etc.) (Mont, 2002a; Baines et al. 2007). In addition to that, innovating in PSS enables companies to anticipate some upcoming legislation (on waste management, sustainable aspects, etc.) and position them a step ahead (Mont, 2004).

Another benefit is that PSS can lower system costs (which is also a benefit for the society in general). Indeed, for Result-oriented PSS in particular, since the firm is responsible for all the costs enabling at providing a result, it has incentive to innovate, to adopt new technologies, to optimise processes and material uses in a way to reduce the global cost of the system (Tukker & Tischner, 2006; Baines et al. 2007).

¹⁵ One should remember we are mainly focus on B2B, thus customers are companies.

More globally, PSS comes with benefits for the society in general and the states. New services integrated in PSS create jobs by being more labour-intensive (Mont, 2002a). These jobs are more regional; hence, they are less likely to be delocalised. If PSS firms manage to decrease their resource consumption and waste generation, or at least consider a more sustainable approach to their business, this is beneficial for environment and the society (Baines et al., 2007). Government can also take inspiration from performing PSS to draw up new policies (Mont, 2002a).

1.2.8. Barriers to PSS adoption

The main barrier might be resistance to change, for both customers and corporates. This is an intrinsic characteristic of humans, who are more comfortable with known environment since change generates stressful situations.

On the customer side, the main barrier is the *cultural shift* occurring with ownerless consumption when user's needs are met without transfer of ownership¹⁶ (Baines et al., 2007; Mont, 2002a & 2004). For a well-functioning PSS, companies need customer involvement, thus customers have to be ready for that (Mont, 2002a). Therefore, users have to trust the firm to accept to outsource, and to dedicate involvement to this relationship (Mont, 2004). Moreover, by letting provider entering its business and accessing some information, customers are losing some control on their own processes as well as knowledge. Some customers might be reluctant and would rather keep competencies internally (Mont, 2004). Another barrier suggested by Tukker (2004) is the sacrifices made by users when renting, sharing or pooling systems since they lose in a way tangible value of the asset (they cannot access it 24/7 anymore). To overcome this barrier Tukker (2004) advises provider to design PSS with a high intangible value for users.

On the firm side, cultural and corporate challenges are also dominant (Baines et al. 2007). PSS is more complex than the current offering. Therefore, Tukker (2004) suggests that firms should pay attention to develop concrete performance indicators and control methods (especially for functional PSSs). They might also help to reduce the premium risk linked to increased liability for providers. These indicators have also to be aligned with goals and strategies at all corporate levels, themselves renewed to fit with the new firm orientation (Mont, 2004).

¹⁶ Afresh, this occurs only if ownership is actually not transferred to the user, see Section 1.2.2 for discussions on this issue

Indeed, companies might lack of experience in developing and implementing PSS. They have to change internal structure as well as infrastructure and their network (closer collaboration with supplier, who have to agree on entering the *PPS world* and disclosing more information, and thus with sometimes a need for educating them) (Mont, 2002a). Thus, they have to develop a complete systemic approach, which might frighten manufacturers. Furthermore, full commitment has to be reached from the whole firm, from the top management to the employees, at all levels. This is also emphasised by the case study of IBM made by Ahamed et al. (2013) where *top management sponsorship* and *employee involvement* are considered as the two main factors for successful change.

Providers might also be afraid of supporting risks previously assumed by customers due to retaining ownership and extra services provided after the point-of-sale (as well as the risk of reduced care in use from customers when they do not own the product) (Mont, 2004; Baines et al., 2007). They might also be reluctant of disclosing sensitive information to their suppliers or customers (Mont, 2004).

1.2.9. PSS Design

The main change in designing when speaking about PSS is to move from a product thinking to a system thinking (Beuren et al., 2013; Baines et al., 2007; Ölundh & Ritzén, 2001). Design has to be considered on a systemic level with a close integration of all actors involved, i.e., mainly the firm in a whole as well as the stakeholders and the users in particular. Customers have to be involved from the first development stages in order to achieve a solution meeting perfectly their specific needs (Beuren et al., 2013; Baines et al., 2007). According to Manzini & Vezzoli (2003), in order to design PSS adequately, companies should tend towards a *strategic design*:

“A design activity aiming at an integrated system of products, services and communication [...] developing a strategy linking long term goals with existing trends and based on new systems of value and new market opportunities” (p.856).

In addition to concerning all actors, PSS design has to consider the whole life cycle of the solution (Mont, 2002a; Baines et al., 2007). According to Sundin (2009), life cycle stages are: *manufacturing* (including assembly), *delivery*, *usage* (importance to be able to monitor

product performances), *maintenance* (and other onsite services as well as taking back process), *recycling*, and *remanufacturing*¹⁷.

Lastly, to design PSS, Reim et al. (2015) suggest focusing on two primary aspects: *functionality* and *customisation*. First, the functionality factor requires the PSS to be easy for maintenance, reuse, remanufacturing as well as reliable and durable. Reim et al. (2015, pp.71-72) define it as “*functionality considers how the product or service component should be designed to incorporate an additional component in a way that offers high value to customers*”. Secondly, they define customisation as “(it) *describes how much the products and services are adapted to individual customers’ needs*”.

¹⁷ Sundin & Bras (2005) define remanufacturing as “*Process of rebuilding a product, during which: the product is cleaned, inspected and disassembled; defective components are replaced; and the product is reassembled, tested and inspected again to ensure it meets or exceeds newly manufactured product standards*”. It is not the same as reconditioning or refurbishing: “*restoration of parts to a functional and/or satisfactory condition by surfacing, painting, sleeving, etc.*” where only a few parts are replaced.

1.3. Functional Service Economy

This section aims at providing a comprehensive state of the art of the FSE literature (English and French literature only). It includes the roots of FSE, its emergence in the literature, a typology coupled with its main characteristics, drivers and stakes, etc.

1.3.1. FSE, a concept linked to PSS by Mont (2004)

The distinction between PSS and functional sales is not always that clear. Indeed, Mont (2004) considers functional sales as “*the basic notion of product-service systems*” since it enables a closer link between manufacturing firms and users. It also enables to close the material loop by returning the product to the producer. According to her, PSS and functional sales are interconnected; one cannot go without the other. PSS is the main concept and this concept has a specific way of providing value, by adopting functional sales.

Functional sale is also the foundational concept of *Functional Service Economy*. As it is explained later, Functional Service Economy is a special case of/is part of PSS; therefore, the common components, barriers, challenges and opportunities of PSS also apply to Functional Service Economy. They will not be detailed one more time here.

1.3.2. Functional sales and founder concepts

Mont (2004) also contrasts clearly traditional and functional sales. Like Vargo & Lusch (2006), she sees customers as *value destroyers* in traditional economy (and producers as value creators). In functional sales, roles change completely since producers are value providers while customers are seen as value users. This conception is therefore a bit different from the one of Vargo & Lusch (2006), who see both producers and customers as co-creators of value (the producer being unable to provide value without users, only *offering* a value proposition). Moreover, Mont (2004) perceives goods as *productive assets*, providing functional units.

Functional sale focuses on how to create value to customers through delivering function and by fulfilling their needs (Mont, 2002b). The function is not locked into the product itself but rather extended to products. Ölundh & Ritzén (2001) define functional sales as is

“To offer a functional solution that fulfils a defined customer need. The focus is, with reference to the customer value (defined customer need), to optimise the functional solution from a life cycle perspective. The functional solution can consist of combinations of systems, objects and services” (p.619).

More succinctly, Mont (2004) defines functional sales as “*business models in which a unit of transaction is a function of a product, not the product per se*” (p.17).

Although the term *functional sale* has been clearly defined in early 2000s, the concept itself is not new. Indeed, concepts like *operational leasing* have been used by firms a long time before the third millennium.

1.3.2.1. *Functional sales and remanufacturing*

If firms want to use products for functional sales, product remanufacturing appears to be inescapable (Sundin & Bras, 2005). However, today, products are usually designed for manufacturing ease, not for remanufacturing. That should be modified in order to optimise remanufacturing that appears as an important step in the product life in a functional sale oriented firm.

Among the remanufacturing steps, cleaning and repairing are most critical. In order to ease these steps, product designers are advised to pay more attention to these following product characteristics: *ease of access*, *ease of handling*, *ease of separation*, and *wear resistance* (Sundin & Bras, 2005). It is also important to design product in a way to facilitate their modernisation and upgrading to adapt it to evolving customer needs (Sundin & Bras, 2005).

Ölundh & Ritzén (2001) state that functional sales leave the floor to product innovation. Indeed, it exists various ways of fulfilling customer needs and of bringing value when we are not stuck with a specific product and conventional solutions.

1.3.2.2. *Other linked and grounded concepts*

Another concept similar to functional sales is *leasing*, in the view of the study *Leasing society*, conducted by Fischer et al. (2012) for the European Commission. They emphasise that conventional leasing is well settled in our society, stating “*around €224 billion worth of assets and equipment were leased across Europe in 2010*” (Fischer et al., 2012, p.16). A leasing society goes beyond traditional leasing and they defined it as “*A leasing society is characterised by a new relationship between producers and customers based on (1) new and more service-oriented business models and (2) new ways to define product ownership and responsibility*” (Fischer et al., 2012, p.9).

Other authors, such as Markeset & Kumar (2005), use the concept of *functional product* to speak about the similar idea, described as:

“The customer can buy the performance, instead of the physical product. In such cases, the manufacturer is responsible for operating, maintaining, and supporting the product in addition to designing and making it. Thus, the long-term profit for both user and manufacturer will depend on the product’s designed-in life cycle costs, RAMS (reliability, availability, maintainability and supportability) characteristics, as well as on the effectiveness and efficiency of the product exploitation and support processes.” (Markeset & Kumar, 2005, p.53)

This vision is very similar to the FSE model which is fully described below. Authors also highlight the importance of the product support that enhances performance of a product by preventing losses in case of non-performing product (Markeset & Kumar, 2005).

1.3.3. From Service Economy to Performance Economy, through Functional Service Economy

1.3.3.1. Stahel’s reflection journey

W. Stahel is the main author discussing about Functional Service Economy (FSE), at least in English. His view on that concept has been evolving during past twenty years, but has always been driven by a desire of a more sustainable and resource-saving economy. In 1994, he published a paper about *the utilization-focused service economy* (Stahel, 1994), to evolve over the years to *performance economy* (Stahel, 2008). Many authors consider him as the founder of the functional service economy. Indeed, he has already highlighted the importance of functional sales in late 1980s. This section details his thoughts and helps us to better understand the concept of Functional Service Economy.

As many authors on Servitization-related topics, Stahel makes a clear distinction between Industrial Economy and Service Economy. He defines Service Economy as “*an economy where the majority of value is created by services and the majority of jobs are in service activities*” (Stahel, 1997a, p.1309). Service Economy is focused on performance and real product use (i.e. optimisation of the utilisation, Stahel, 1998) instead of putting value on materiality of products (Stahel, 1994). In his opinion, Service Economy can help us to move towards a sustainable economy, with a long-term societal vision (Stahel, 1997a). This long-term orientation is also opposed to the Industrial Economy where a short-term view prevails, focusing on throughput optimisation for a profit maximisation.

After the concept of Service Economy, he came up with the Functional Economy, defined as an economy “*that optimizes the use (or function) of goods and services and thus the management of existing wealth (goods, knowledge, and nature)*” (Stahel, 1997b, p.91). Therefore, he states that “*the economic objective of the Functional Economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible*” (Stahel, 1997b, p.91). Hence, a shift occurs from a production-oriented Industrial Economy to a Performance Economy (Stahel, 2008).

Thus, came the concept of *Performance Economy* (Stahel, 2008 & 2010), as an umbrella term where *Functional Service Economy*¹⁸ is fully part of this. Stahel (2010) defines Functional Service Economy (FSE) as:

“*a set of innovative business models that integrate products and services into winning solutions to create wealth and jobs with considerably less resource consumption, and provide economic incentives to internalise the costs of risk and waste*” (Stahel, 2010, p.2).

It is interesting to notice that the Performance Economy do not aim at replacing the Manufacturing Economy (or Industrial Economy), and do not pretend to be better than it. Rather, Performance Economy aims at remodelling, orienting manufacturing towards new goals and drivers, focused on sustainability. Those are detailed right below.

Performance Economy, considered as a solution to Industrial Economy shortcomings, rests upon knowledge-based economy and enables to *uncouple wealth creation from resource throughput* (Stahel, 2010). This new economy aims at reaching three goals: *exploiting science* (as driver for uncoupling by smartly using new technologies), *creating job locally* (high-skilled jobs), and *applying extended performance responsibility* (to improve wealth with a full product life cycle consideration) (Stahel, 2010).

1.3.3.2. The French-speaking approach

In the French literature, a concept based on functional sales appeared in the middle of the 2000s, called “*Économie de Fonctionnalité*”. One can translate it by *Functional Service*

¹⁸ One can notice that in 2008 he replaced *functional economy* by *functional service economy*, without any difference in the concept or its definition, before adapting the definition in 2010.

*Economy*¹⁹ or *Functional-based Economy*^{20, 21} This translation into Functional Service Economy already shows that this concept is highly similar to the eponymous concept developed by Stahel.

Bourg & Buclet (2005)²² define it as “*substituting the sale of the use of a good for the sale of the good itself*”. It is the product use that brings the real value to consumer, not the ownership of the product itself (Van Niel, 2007), like in *Stahel’s FSE*. Therefore, products are seen as means, tools rather than purpose of the exchange. Both consider, like Vargo & Lusch among others, the prevalence of value-in-use on value-in-exchange. The concept is also similar in some aspects to the one supported by O. Mont and other PSS authors.

Rousseau et al. (2010) give another definition:

“*Functional Service Economy refers to commercial transaction that both; is about the use of a capital good, not about the sale of the capital good itself, and exerts positive effect in sustainable development, through the drop in material/energy consumption*” (Rousseau et al., 2010, p.8).

They consider FSE as a way of “*moving from an organized obsolescence economy to a functional service economy*”. Besides, Folz et al. (2008) and Rousseau et al. (2010) emphasise three common features of FSE: FSE leads to *maintenance professionalization*, FSE requires *technical characteristics modification*, and FSE is all about *use rationalization*. They also recognise that in order to avoid a *productive dependency*, externalised products/services have to be linked to a non-core activity on the client side.

1.3.4. Ownership and liability in FSE

Consequently to the sale of use rather than the product itself, producers support a bigger liability and have to provide higher quality products and services (Stahel, 1994). Provider’s responsibility now goes beyond the point-of-sale. Moreover, they usually retain ownership of

¹⁹ When translating his abstract in English, Van Niel (2014) used *Functional Service Economy* for *Économie de fonctionnalité*.

²⁰ Term used by Michelin in Michelin performance and responsibility report 2007-2008

²¹ Buclet (2014) translates it by *The economy of functionality*, which is the literal translation.

²² One can notice they translate *Économie de fonctionnalité* by *Service Economy* in their paper. However, the concept of Service Economy (in English literature) is excessively different from Functional Service Economy, in my opinion.

their products, which reinforces this liability. This issue is one of the biggest challenges of the FSE/Performance Economy.

In the Industrial Economy, risks (about quality and utilisation) are externalised to the customers, only the warranty remains on the producer side. The FSE internalises all risks and liability for utilisation and quality by selling system utilisation or customer satisfaction (Stahel, 2010). However, risks might be shared with a *fleet manager* who owns products while user utilisation (Stahel, 2010). This shift in risk supporting brings economic incentives to minimise costs of those risks (such as loss, ‘unusability’, etc.). The same reasoning applies to waste. The internalisation of waste costs leads to economic incentives for waste prevention too (Stahel, 2010).

Stahel (2010) summarises it as: “*selling performance means to internalise all costs for waste and risk over the full lifetime of a product*” (p.91). Mont (2002b) emphasises that it is because the needs can be met through the product performance (and not the product possession) that providers can retain ownership and sell function or performance to the users. Both authors, among others, reckon now that products can be considered as assets by the provider (Stahel, 2010; Mont, 2002b). Hence, they have to be seen as any other asset, managed, optimised, etc.

Retained ownership has several advantages but also challenges/drawbacks as explained earlier (see Section 1.2.2). Stahel (1997a) also suggests that ownership enables provider to ensure the *take-back loop*, needed step for the process of *reuse of goods*, concept dear to Stahel. Retained ownership also generates financial incentive for improving product lifetime. Stahel is even convinced that ownership is the key to long-term income and success (Stahel, 1997b). This new structure comes with many challenges as mentioned previously (internal organisation, design, reverse logistics, etc.).

Nevertheless, Stahel (2010) considers that in *Servitization* or *PSS* concepts, providers do not inherently internalise liability and waste costs since PSS considers products and services as *separated entities* and therefore fails to incorporate performance and liability issues.

Another major drawback of the retained ownership is the new cost structure. If the revenue stream can be better predicted thanks to FSE, it also forces manufacturing companies to make huge investment (Mont, 2002b). They do not receive money directly from their clients (on the contrary to a sale where a transaction occurs close to the transfer of ownership). Therefore, they have to finance their entire assets fleet on own funds (or by making agreement

with financial firm or fleet management firm but, in that case we are not in a pure FSE since the manufacturer do not own the product anymore).

1.3.5. Performance metrics

Performance Economy and FSE also come with new metrics to assess firm success (Stahel, 2008 & 2010). These metrics are based on the three goals (see Figure 4) and they measure “*sustainable competitiveness in the form of absolute decoupling indicators*” (Stahel, 2010). First, ‘*value-per-weight of goods*’ measures wealth creation (economic value) compared to resource consumption. Secondly, the ‘*labour-input-per-weight*’ ratio assesses, via a ‘*man-hour per kg*’, the local skilled jobs creation according to resource consumption. Lastly, the ‘*value-from-renewable-resources*’ ratio measures the degree of internalisation of the total cost of risks and liabilities (through the full product life cycle). It is a metrics on competitiveness²³ based on sustainable profit. (Stahel 2010).

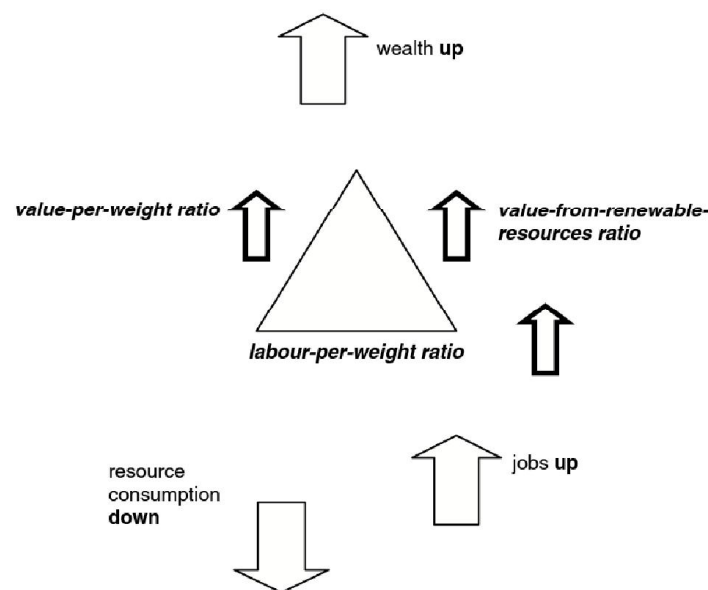


Figure 4 - New metrics of the performance economy (from Stahel, 2010)

1.3.6. Reuse of goods, dematerialisation and decoupling

One of Stahel’s first consideration was on the reuse of goods for better economic and ecologic performance. Extending product-life often goes with a drop in resource consumption as well as in waste (Stahel, 1994). He states that reuse of goods is superior to recycling²⁴ of materials since

²³ Stahel (2010) argues that loss and waste prevention is cheaper than waste elimination and cost of repairs, hence prevention enables to enhance firm competitiveness.

²⁴ Stahel also highlights the fact that the more widespread the less economic is recycling because it causes oversupply of materials dropping prices of both virgin and recycled materials.

it requires less energy and labour to put back the resources on the market (Stahel, 1994). However, reuse of goods is also more complex than recycling of materials, requiring structural changes in the firm (Stahel, 1997b). This superiority of reuse of goods is shown on Figure 5, where each loop is a way to put back the product (or some components) to the market. Smaller loops are more profitable as they require less resource (labour or material) before being reused.

Some ways to perform reuse of goods are e.g. *long-life product design*, *product-life extension services* or *strategies intensifying product use* (Stahel, 1994). According to him, reuse of goods (which is an *extension of the utilisation period*) automatically leads to *utilisation-focused service economy*. Hence, he considers a shift from *linear economy* to *cyclic economy* (cycles closed by the different loops) (Stahel 1997a & 1998).

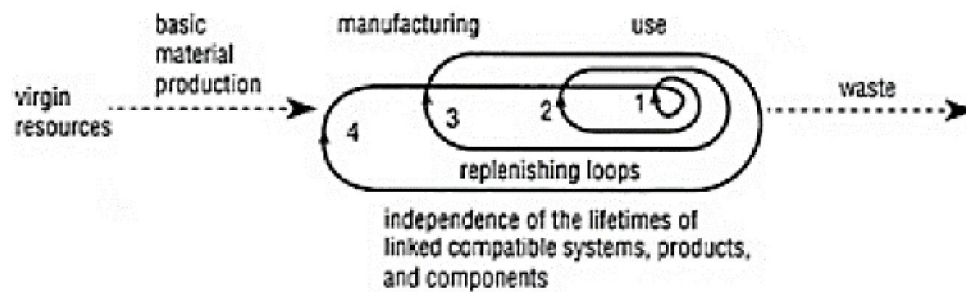


Figure 5 - Loops in the utilization-focused service economy (Stahel, 1994)
(loop 1: reuse of goods. Loop 2: repairs of goods. Loop 3: reconditioning/rebuilding of goods.
Loop 4: recycling of raw materials)

Since profitability is influenced by these loops, Stahel (2010) considers the Performance Economy as a Loop Economy. In order to maximise profit in the Loop Economy, Stahel (2010) advocates a profit maximisation in remanufacturing rather than a cost minimisation in recycling.

This reuse of goods is also a matter of resource productivity when economic success is decoupled from resource throughput. Companies aim at maximising profits via reuse of resources (Stahel, 1997a). Stahel (1997a) sets out four ways to increase resource productivity: *sufficiency solution*, *system solution* (efficiency by dropping resource flow volume and speed), *more intensive use of goods* (dropping volume of goods), and *longer use of goods* (dropping resource flow speed by e.g. remanufacturing). Resource efficiency can be measured as *resource input per unit of use over long periods* (Stahel, 1997b).

Buclet (2005) also sees in FSE both economic and environmental potentials thanks to the decoupling. First, as already mentioned, the economic potential mainly comes from the new profit sources generated by integrated solution (Van Niel, 2007) and by the drop in costs due to the internalisation of risks and liabilities. Now products become *assets* for the provider and it has to manage them like other assets to optimise its profit. Secondly, the environmental potential appears since this model is a way to overcome the programmed obsolescence (Buclet, 2005; Van Niel, 2007 & 2014). It also enables to solve (partially) the issue of growing scarcity of resources, and it enables to reduce material consumption and waste (Buclet, 2005; Van Niel, 2007). Although the environmental benefits are real, Buclet (2005) acknowledges that companies did not (always) think about environmental effects when moving to Functional Service Economy, which confirms the position of Mont (2004) and Tukker (2004) in particular.

In addition, the provider is fully responsible for the strategy to adopt after each '*service-life*'. Therefore, he can optimise his resources productivity by deciding the best next step for each product/component (reusing, remarketing, recycling, remanufacturing²⁵, cascading – using the product in tasks of decreasing importance, cannibalising, etc.) (Stahel, 2010). The manufacturer is now an *asset manager* while being performance provider (Stahel, 2010). The factor *time* becomes source of competitiveness (Stahel, 2010) since profitability of assets is measured throughout their entire life(s). However, when assessing profitability, one should keep in mind that transaction costs occur every time the asset is transferred (between producer and user).

In order to be efficient, the provider has to think about his product as part of a system, of a big master plan. They are not materials anymore but rather technical systems and assets at the same time. Viewing so will ease remanufacturing and maintenance phases (Stahel, 1997b). Product design has to be viewed as sub-component of a global system design. Hence, modularity of all elements (products and services) is highly important. Product components also have to be designed focusing on their *value providing*, but also regarding their ease of remanufacturing and upgrading, being both specific and standardised at the same time.

In addition, since the provider keeps the ownership, it has incentives to design product to protect it against misuse or abuse in order to reduce risks while utilisation (Stahel, 2010). However, since most of companies keep selling while providing functional sales, there might

²⁵ Stahel (2010) states that costs of product remanufacturing is 40 percent cheaper than costs of manufacturing this product afresh.

be some problems in the design and manufacturing phases (Mont, 2002b). Requirement for sold or retained products might not be the same (value capturing is different in both case) and companies have to deal with it.

1.3.7. Value conception in FSE

Value and costs are assessed according to the result in provided use rather than the balance between the exchange value and production cost (Stahel, 1994). Therefore, FSE enlarges the costs evaluation by considering all costs needed for product performance, for its successful use (learning costs, repair and maintenance costs, management and monitoring costs, etc.). This makes sense since clients do not buy a product anymore, rather a *system functioning* or the *functioning of a tool* (Stahel, 1994).

According to Stahel, the dematerialisation of the economy requires to review the value consideration. In FSE, it is *wealth (stock) and its usage value* that matters, not *throughput and its exchange value* of the Industrial Economy anymore (Stahel, 2007a). Economic value is measured as *the value of usage over time* (Stahel, 2007a). The main objective of the FSE is to improve total wealth and welfare. He is convinced that wealth can be achieved *without resource consumption* (Stahel, 2007a). Hence, retaining ownership appears to be needed to reduce that consumption, as Stahel says:

“The key to ‘wealth without resource consumption’ is the service economy: if customers pay an agreed amount per unit of service (and service equals customer satisfaction), service providers have an economic incentive to reduce resource flows, as this will increase their profits doubly: by reducing procurement costs for materials and energy and by reducing waste elimination costs.” (Stahel, 2007a, p.1314)

1.3.8. Profitability and competitiveness

It is never straightforward to assess the success of a project, all the more so a full business model such as FSE. Although big companies (like Xerox, Michelin or Dow Chemical) have developed solution based on FSE, and these solutions are successful and economically positive; it is much more complicated to measure on what extent they have been contributed to the profitability and competitiveness of the company.

Fromant (2010) designed two grids to assess both profitability and competitiveness of FSE companies. The first one lists nine success criteria (Table 7), the second one depicts nine internal gains (Table 8). Firms wanting to shift to a FSE business model can analyse their project

via the two grids (answering yes/no to each item). Hence, the answers can help the company to decide if there is a potential for the project to be profitable and bring competitive edge to the firm.

Success Criteria		
SC 1	Offer coming from a life-cycle assessment	Yes/No
SC 2	True innovation since changing the customer behaviour	Yes/No
SC 3	Innovation combining new products and new services (product performance boosted by the service)	Yes/No
SC 4	Decoupling between use of good and energy and raw material consumptions	Yes/No
SC 5	Classic example of circular economy with production – utilisation – maintenance – repair – reuse – waste management	Yes/No
SC 6	Increased customers mastery	Yes/No
SC 7	Integration of the reseller's added value into manufacturer's one	Yes/No
SC 8	No investment needed on the client side	Yes/No
SC 9	Result guarantee	Yes/No

Table 7 - Success Criteria for a FSE project (adapted from Fromant, 2010)

Internal Gains		
IG 1	Quality improvement	Yes/No
IG 2	Cost reduction	Yes/No
IG 3	New market opening	Yes/No
IG 4	Eco-efficiency strategies	Yes/No
IG 5	Improved labour productivity	Yes/No
IG 6	Reputational capital	Yes/No

IG 7	Mastery of legal and institutional evolutions	Yes/No
IG 8	Influence on new regulation	Yes/No
IG 9	CO ² quotas, energetic certificates, etc.	Yes/No

Table 8 - Internal Gains for a FSE project (adapted from Fromant, 2010)

1.3.9. Corporate strategies and FSE typology

Van Niel (2014) considers that the concept of PSS is much broader than FSE, being any combination of products and services, which only a part is really a model of FSE. PSS have a characteristic of *completeness* but to be a FSE they also need to have a high level of *integration* (Van Niel, 2014). According to him, Product-oriented PSSs are simply models where secondary services are added to product. Hence, they are not FSE models. On the other hand, Use-oriented PSSs and Result-oriented PSSs have a good integration of the solution and more responsibility on the supplier side, which leads him to say they represent FSE.

Then, Van Niel (2014) ends up with a FSE typology, containing three categories. First, ***Sale of use (function)/use-oriented service*** is a long-term contract with a unique client where the provider retains product ownership. It comprises two different sub-categories, *Leasing* and *Functional sales*. *Leasing* is considered mainly for corporate. Van Niel only considers *operational leasing* as a FSE since the ownership is kept by the provider throughout the entire contract life, the user having the option to buy the product, but only at the end of the contract. He excludes *capital leasing* where the option of buying the product can be used at any time, which he considers as a form of bank credit. On the other hand, *Functional sales* is considered as the ‘pure FSE’ where the product function is sold rather than the product itself. Then, the second type is ***Performance contract/result-oriented service***, and is composed of three sub-types: *Energy Management services* or *Energetic performance* (often provided by Energy Services Companies (ESCOs)), *Facilities Management* (externalising non-core activities such as energy management, infrastructure overhaul, real-estate management, security, cleaning, etc.), and *Least cost supply* (such as Chemical Management Services (CMS) or Integrated Pest Management). Lastly, the third type is the ***Collective consumption***, a model working between individuals, which do not appear in PSS typology. It is about sharing utilisation of services, similar to the *sale of use* model but with an emphasis on intensification of use since several consumers can use it successively. Examples of Collective consumption are short time renting,

car sharing, public laundry, etc. In addition to this typology, Van Niel (2014) also highlights the non-commercial potential of FSE (like the *local exchange system*, or ‘private car sharing’).

The concept of FSE, at least for the Sale of use model, is based on ‘*functional unit*’ (Van Niel, 2014 – ‘*unité fonctionnelle*’). Therefore, the user pay according to the amount of functional unit he uses (pay per km, pay per copy, pay per kg, etc.). Mont (2002b) has already set the stage of functional unit by saying that profit centre has moved from a unit of product to a unit of function. Also, Goedkoop et al. (1999) have already used the term functional unit, as “*a standardised quantity of measurable function fulfilled by both PS system and reference system*” (p.19); considering it as the measure unit for their economic case analysis.

On the other hand, Stahel (2010) has suggested five corporate strategies/business models to embrace the performance economy. These are:

- Selling prevention (knowledge-based solutions)
- Manufacturers selling performance, services or results (vertical integrated business model)
- Fleet managers with a loop responsibility (focusing on efficient reverse logistics)
- Fleet managers with maintenance and operation responsibility (e.g. facility managers)
- (Independent) remanufacturers

He also suggests different Functional Service Economy groups (Stahel, 2010), as described in the Figure 6 below.

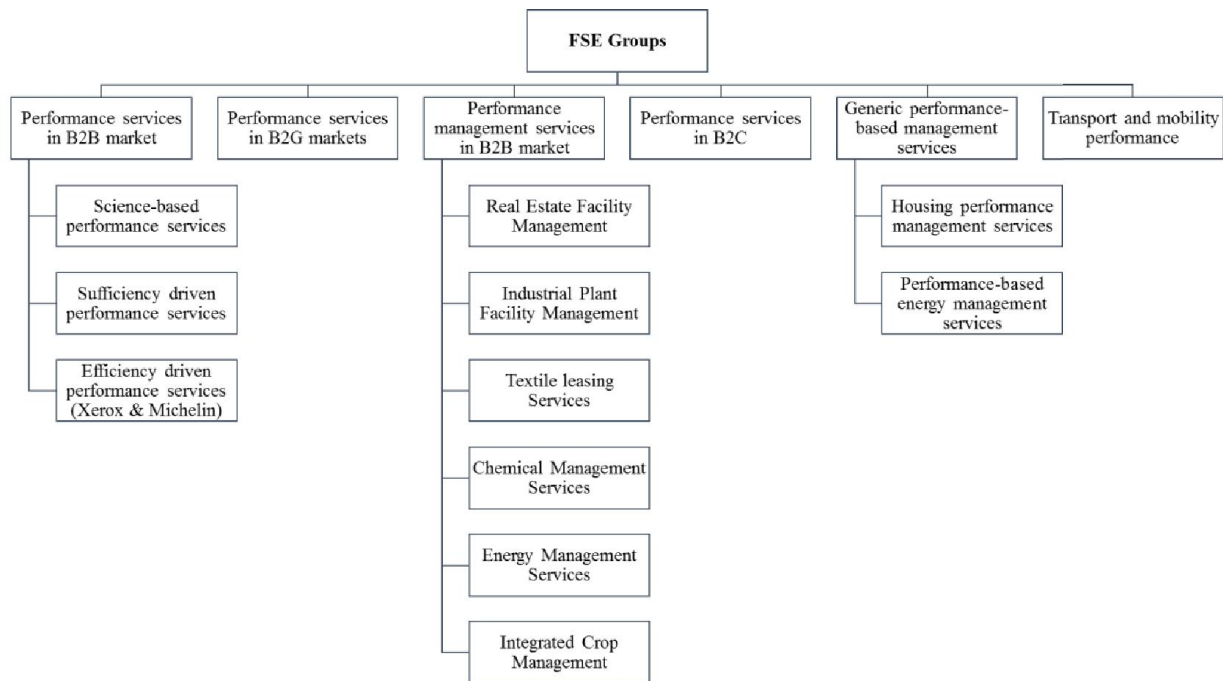


Figure 6 - Functional Service Economy Groups

1.3.10. New labour consideration

Extending product-life often goes with a substitution of *labour for energy*; labour type itself is also modified since *centralised global production units* leave the floor to a *decentralised labour-intensive service workshop* (Stahel, 1994 & 1997a). Hence, in addition to be sustainable, FSE regionalises the economy with closer service centres. In addition, in order to shorten cycles, manufacturing and remanufacturing activities have to be united and located as close as possible to the market (Stahel, 1997b). Having more local facilities means lower volume per facility, but that rise in cost is easily offset by savings in material purchase and disposal costs (Stahel, 1997b).

Work is more specific, technic, less standardised. Therefore, manufacturers need higher-skilled workforce (Stahel, 1997b). They also need new job qualifications (e.g. maintenance engineers and technicians; sales staff becomes customer advisors; etc.). Performance Economy is competitive and sustainable thanks to its capacity to create skilled job while dropping materials and energy consumption (Stahel, 2010).

Obviously, a service/functional/performance economy requires a new appropriate structure, involving many changes in the manufacturing structure. Most of them are similar to

those detailed in previous sections. Corporate strategy has to be aligned with selling performance and principles of this new economy. They are described in the next section.

1.3.11. Drivers for FSE

In addition to the drivers seen for PSS, Mont (2002b) sees in the rapid technical development a driver for functional sales (e.g. in the IT sector). Indeed, it is not easy (and affordable) for consumers to buy always the top-new product/technology to keep up to date. Functional sale enables them to benefit from that technology without having to make huge investment. Besides, providers can integrate new technology on their product without being forced to increase drastically prices since they keep the ownership of the product (often the technologic product are expensive due to their components and materials).

Furthermore, Van Niel, 2014, Folz et al. (2008), and Rousseau et al. (2008) discuss the benefits, drivers and drawbacks of the FSE. Most of them are similar to those highlighted by authors such as Stahel, Mont, Tukker, etc (see previous sections).

Briefly, some of the most often mentioned aspects are: convergence of previously conflicting interest, retained ownership, focus on providing function, modularity, adequate product design, role of the government and new policies, radical behavioural change, environmental issue (drop in consumption and waste, product life), global cost overview, optimised product use, new customer relationship and increasing loyalty, new local jobs potential, change in revenue and cost streams, etc. (From Van Niel, 2014; Buclet, 2005; Folz et al., 2008; Rousseau et al., 2010).

1.3.12. Issue of location and transportation in FSE

Besides other considerations, Buclet (2014) highlights that FSE do not promise anything related to the location of the factories. It means that negative environmental effect of the take-back process (mainly transportation) could overcome the benefits in resource decrease. On a pure strategic move, remanufacturing a product used in Western Europe will be probably more financially interesting in Eastern Europe (or even in Asia) than close to the point-of-use (due to the balance of labour and transportation costs).

Therefore, Buclet (2014) sees the FSE as a strategy to tend to an industrial ecology without automatically leading to positive environmental impacts. The main driver of FSE provider is the profitability, and some actions taken by the FSE firm might lead to eco-design. The eco-design for its environmental performance do not appear *per se* as a driver to embrace

FSE. This finding of Buclet saying that facilities will not be located regionally goes in an opposite view as what stated Mont (2002b). She considered that “*more and more products and materials will circulate, and be refurbished and re-used regionally*” (2002b, p.22).

1.3.13. FSE and innovation

FSE is sometimes criticised as an *innovation killer* due to its principle of long-lasting product life. Rousseau et al. (2010) disagree with that idea. They explain that FSE goal is to reach as much highest quality & longest durability of product as possible. Therefore, providers have to optimise the modularity and the compatibility of components, which leads to a clear interest of innovating. Also, thanks to remanufacturing, firms can upgrade products and innovation can directly benefit to users. They also say that one origin of FSE is the rejection from customers to pay more for innovative products and its related expensive R&D. Thus, FSE appears as a way to innovate without increasing cost for consumers.

1.4. Analysis of similarities and differences between FSE and SDL, Servitization, and PSS

This section represents my own analysis of the connections between the different concepts previously studied, while stressing aspects useful for the FSE conceptualisation.

1.4.1. The concept itself, its objectives and grounded vision

As already explained, we can consider Servitization as the broadest concept and FSE as a specific case of PSS, with functional sales setting the ground to FSE.

Mont (2004) links FSE and PSS via the functional sales she reckons as the basic notion of PSS. Like Stahel states for FSE, she advises that remanufacturing renewal is inescapable to deliver adequate functional sales, and that actors have a completely different roles as well (value users and value providers according to Mont (2004), which is close to the SDL consideration of consumers as value co-creators, Vargo & Lusch (2006)). FSE also modifies drastically the actors' role in the same way. Value cannot be created without the collaboration of both provider and user. Therefore, the view of Vargo & Lusch fits perfectly with the FSE consideration, and a bit better than the one of PSS. Indeed, the conception of value users is too simplistic since users not only use the value but also take fully part in the value creation. The same goes with value providers; the producers cannot deliver or provide value without the contribution of the users.

The aspect of value is prevalent in both SDL and FSE. Numerous of authors discussing about Servitization emphasise that services bring added value to the offer provided. In SDL, the value analysis goes beyond with the concepts of value-in-use vs. value-in-exchange, co-creation of value, and offering a value proposition (rather than a value itself, the value being created by both the user and the provider together). In FSE, value is created mainly by the use of the solution at the point-of-use, and requires the contribution of both parties to exist. That is why the concept of value co-creation (Vargo & Lusch, 2006) perfectly tallies with FSE.

According to Beuren et al. (2013), *“The ultimate PSS objective is to increase a company's competitiveness and profitability, and another of PSS objectives is to reduce the consumption of products”* (p.222). Yet the FSE objective as stated by Stahel (1997b), *“the economic objective of the Functional Economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible”* (p.91). One can easily see the close similarity between FSE and PSS objectives. In addition to

the similar economic objective (detailed in the next paragraph), both highlight the significance of environmental issue by aiming at reducing resource and energy consumption. Although it is not a real driver in practical situations, both concepts attach importance to environmental and sustainable issues. Authors from both streams also reckon that product use highly influences global environmental impact and, therefore, it prevents providers to have a clear overview of the actual global impact (as well as the issue of rebound effect that can be unpredictable in magnitude).

More broadly, FSE objective is also considered as improving total wealth and welfare, which is not strictly mentioned in PSS concept. Stahel highlights that what matters now is wealth and its usage value instead of throughput and exchange value, leading to a drastic fracture with traditional economy. Total wealth is increased by providing a solution that is cheaper to implement for the user and therefore a surplus can be generated by saving expenses without reducing gain of any of the parties. One way of generating surplus is by enhancing the resource productivity (through a more intensive and a longer use of product). This might be one of the *central aspects* of FSE, enabling to link the other dimensions such as decoupling, product considered as asset, focus on functionality and performance, retained ownership, product life cycle consideration (including design, reuse and remanufacturing), etc. Everything starts from an optimal, effective, and efficient use of resources in order to maximise their productivity.

Then, the Foundational Premises, developed by Vargo & Lusch for the SDL concept, describe perfectly the FSE perspective. Considering service as the basis of exchange and goods as tools for service provision, Vargo & Lusch pinpoint *Operant resources* as fundamental source of value. This is typically the FSE conception of the economy. As already stated, they also reckon customers act as required value co-creators and the provider cannot deliver value without their contribution. Alone, the company is able to offer only value proposition. SDL can be seen as the grounded value that has to be added to PSS concept to lead to the FSE fundamental principles. Consequently, FSE could be considered as a PSS since it is a system of product and service (although the product view is still different), but a specific type of PSS based on value-in use, on operant resources, so, in one word, based on SDL principles.

1.4.2. A customised offering

Like the SDL concept suggests, FSE oriented firms provide specialised offers. Although they have standard solutions, companies always adjust the solution to the specific firm/user, invariably focused on functionality. This customisation brings competitive advantage to the

firm/user since the solution better fits to its environment and requirements and therefore enables to optimise the performances. This customisation goes until the pricing system. Indeed, in FSE, companies/users pay per functional unit used, and this rate depends on the specification of the products and services provided (it is contractually defined). This idea of functional unit was already raised by Mont (2002b) and Goedkoop et al. (1999) but not really detailed. It is French authors like Van Niel (2014) who clearly defined the concept of *pay per functional unit*. Consequently to the pay per functional unit and retained ownership, the full cost structure has to be reviewed in a FSE oriented company. Indeed the firm has to find financing for the product since payments come on a regular basis, throughout the full product life.

1.4.3. A new global relationship involving ownership and responsibility reworking

This value co-creation and this new actor's role consideration, tackled above, require a closer relationship between providers and users. They are seen mutually as partners rather than producers and clients, respectively. FSE is well in line with Servitization, SDL and PSS which highlight a better relationship, a customer centricity, customers involved at an early stage as co-creator, and a long-term relation. In FSE, providers deliver solution enabling to outsource a non-core activity. That requires the provider's staff to work closely with users, often on the user's operation site. Since the function and the performance are the core of the solution, trust, loyalty and fidelity are vital to the success of the partnership. The user has to disclose crucial information and the provider has to trust the user to use the goods and services according to the contract, trying to optimise their use without damaging the quality. Contractual clauses might be added to prevent any form of moral hazard. As we will see later, performance guarantee commits the provider to result, which is a highly valuable guarantee for users.

This relationship is also modified by the ownership structure. FSE, like Servitization and PSS suggested it theoretically (but not in practice), develops a retained ownership process. By keeping the product ownership, the provider can focus on optimising his performance and the user is certain to have the optimal product at disposal. The physical product does not matter anymore, the customer expects a need fulfilment regardless the physical product used. As PSS gave a glimpse of it, FSE provides the function of the product rather than the product itself. Therefore, the product ownership is not necessary anymore to meet the needs. Mont (2002b) highlighted that needs are fulfilled by the product performance, not the product possession! On the provider side, the product becomes an asset to manage like any other asset. Providers are

now asset manager and performance provider rather than manufacturer. Both FSE and PSS agree on this consideration shift.

Then, although provider responsibilities are a concern for all the concepts, Stahel judges that Servitization and PSS concepts stay one step back compared to FSE. Indeed, providers do not inherently internalise liability and waste costs (due to the consideration of services and products as separated entities). Hence, they fail to integrate liability and performance consideration to their strategy and therefore do not feel responsible for that. Nevertheless, both PSS and FSE agree on an increased responsibility for the provider due to his extended presence in the transaction, due to performance requirement, due to retained ownership, etc. The provider has now a full life cycle responsibility.

FSE and PSS also agree on the shift of labour for energy, meaning that this increasingly labour intensive economy can enable to reduce energy consumption. It helps to regionalise the workforce as well. Both aspects lead to a more sustainable society. Nevertheless, higher-skilled staff requires a modification of the workforce composition, and leads to new specifications and needed skills. A reorganisation, sometimes linked to lay-offs, appears to be necessary. That might result in adverse social effects. The issue of location and transportation, which is only tackled by French FSE authors, is also ambiguous and important but nevertheless missing from PSS literature.

1.4.4. Decoupling and the new systemic approach

Another similarity between PSS and FSE is the aim of decoupling. The manufacturing strategy evolves to lead to a dematerialization and a decoupling of economic value from material and physical consumption. The strategy involves a life cycle consideration; the whole solution and the entire life of the (reused) product are taken into account for the solution design. In FSE, manufacturing is a new job, requiring new skills to be able to develop a product that matches with the complementary services and the solution in a whole, but that also has to be designed for multi-usage and for an easy upgrading and remanufacturing process. This conception reinforces the decoupling since a single product will be reused, bringing value to the company several times and this value is unlinked to the material consumption (which might be higher for the manufacturing step, but reduced by counting the total product life cycle and amount of uses and value brought).

Hence, both SDL and FSE see goods as tools to deliver a solution, not the basis of the solution. The same goes with the PSS concept where the product (or good) is one of the four PSS elements, the others being the service, the actor network and the infrastructure (but PSS is more ambiguous on that ‘tool’ consideration, perceiving products as important part of the system and a separate entity, giving it more importance than in SDL or FSE).

Moreover, we find all these four elements in FSE too since, in addition to the obvious product and service, the actor network is prominent (cf. the previous section on customer involvement and relationship) as well as the infrastructure (they have to be adapted to the new manufacturing strategy to receive taken-back products in particular, but also to combine product and service and develop the new skills). The network has also to be developed on the downstream side, by collaborating with trustable partners since quality and efficiency are vital to the solution delivering and success in FSE. In addition, as PSS suggested, the integration of all actors is a prerequisite to success, in FSE as well. A network of partners is not enough; they have to be intrinsically integrated, connected and ready to work closely, hand in hand, with the same or aligned objectives.

Besides, PSS theory states a shift from product thinking to system thinking. It is fully applicable to FSE where the solution is prevalent to the service or product alone. However, the system thinking cannot only be considered on an internal point of view; all actors have to be integrated in the reflexion to provide the optimal solution taken into account all the stakeholders (mainly suppliers, partners and ‘clients’/users, who are now another kind of partners). The new system thinking is thus closely related to the new relationship consideration.

1.4.5. Similar but also distinct typologies

The typologies are also quite similar. Mont (2002a) already suggested two concepts of product use: result and use oriented. This typology was expanded to three segments. It is this last typology that is largely recognised as the main PSS typology: product-oriented, result-oriented and use-oriented. Tukker developed a bit deeper this classification by dividing the three main categories into eight sub-categories in total; while Neely added integration-oriented service to the *three categories typology*. If the five strategies developed by Stahel (2010) do not tally with these PSS typologies, the classification designed by Van Niel (2014) perfectly matches with the main recognised PSS typology. It is composed of three types: sale of use/function (use-oriented service), performance contract (result oriented service), and collective consumption. The last one does not represent a B2B strategy; therefore, it makes sense not to find it in the

PSS typology. The product-oriented PSS (and de facto the integration oriented, even less *servitized*) is excessively product focused, the services added to the product are additional services, secondary to the offer. Thus, it does clearly not match with the FSE concept. The two remaining categories, as for them, present close similarities (such as *leasing* considered as example for both use-oriented PSS and sale of use).

Nevertheless, the consideration of the product is more important in PSS than in FSE. In particular, in use-oriented PSS, the product is still considered as central, which is far to be the case in sale of use/function (the sub-category *functional sales* clearly shows the product is overtaken by its function). In addition, PSS still considers products and services as two entities that have to be put together. On the contrary, in FSE, we start from the solution and this solution is composed by products and services, tools to deliver it.

1.4.6. Conclusion of this section

Servitization definitely sets the stage to the more specific concepts, PSS and FSE. Those two last ones are near concepts with some particularities, especially their vision about the position of the product in the system/solution and the value conception. They are both focused on value co-creation, on customisation, etc.; nevertheless FSE has a more fined-tuned approach on the solution offering (customisation of the solution itself, of the pricing structure, of the product and service used, etc.). FSE also emphasises more the close relationship settled on trust, loyalty and fidelity. Like in PSS, FSE is based on a new ownership structure, but it goes further by associating it with new risks, liabilities and performance allocations. Then, both aim at decoupling but FSE goes beyond because of its vision of value, originated from a Service-dominant Logic. Goods are seen as tools, and the systemic approach is strengthened in FSE thanks to a deeper integration of the *four PSS elements* into the solution. PSS and FSE possess similarities but their conception of the product role into the solution differs from each other.

Therefore, we can consider that FSE is a PSS which is settled with value conception and grounded logic from a SDL perspective. The importance of the function of the solution is driven by the aim at generating as much value as possible, combining products and services, like the SDL suggests it.

Chapter 2: Methodology

Thanks to the previous sections, the reader has now a better understanding of the FSE, its roots and links with the near concepts. Also, the section 1.4 sheds a light on similarities and differences among the concepts, while FSE is always the centre of comparison since the objective is to define this model.

To facilitate the FSE understanding, the Chapter 3 consists of case companies' description and analysis. To represent FSE nowadays, three companies have been chosen for their complementarity, i.e. Xerox, Michelin Solutions, and SAFECHEM. Another main reason for choosing them was because they are amongst the most advanced companies in the FSE adoption. Using the Van Niel's typology (2014), Xerox and Michelin Solutions propose a model of *Sale of use/function*, and SAFECHEM is *Performance contract* oriented. These cases show us that FSE is not only a theoretical concept but also a practical orientation for business strategy.

The goal of these cases is to strengthen the theory; it is not a goal of an in-depth analysis. The idea is to support the theory thanks to the case companies. Therefore, we need an overview of the solutions provided by these companies, the changes operated when moving to FSE, as well as the impacts on the value offering and the competitiveness. These information have been collected through a Desk Research. The documents have been gathered from different sources: published documents from companies themselves, scientific papers on FSE, scientific papers on the companies (mainly for remanufacturing at Xerox), companies' websites, other articles and books, etc. Xerox and Michelin Solutions are the most discussed cases in literature, which was also one of the reasons for choosing them as case companies for the thesis.

Desk Research is also known as Secondary Research (Do, 2010) because this research is based on secondary data, previously collected. Other authors use the term Secondary Data Analysis to describe the same method. Johnston defines Secondary Data Analysis as “[the] analysis of data that was collected by someone else for another primary purpose” (Johnston, 2014, p.619). Like Hox & Boeijs (2005) states, any type of data can become secondary data, “By virtue of being achieved and made available, any type of primary data can serve as secondary data” (p.596). This confirms that data collected are valid data for this study.

Heaton (2008) depicts three types of Secondary Analysis: *formal data sharing*, *informal data sharing*, and *self-collected data*. This thesis fits with the first type, formal data sharing. Indeed, Heaton (2008) defines it as studies where “*researchers access datasets deposited in public or institutional archives and re-use them in secondary research*” (p.35). There is no link between primary and secondary researchers, neither direct transfer of data between them, however the primary researcher might be contacted or consulted punctually (Heaton, 2008).

Johnston (2014) emphasises the flexibility and the convenience of this research method, which is composed of three steps: identification and development of the research question and the research context; identification and gathering of the useful set(s) of data; and its/their evaluation based, in particular, on the data quality and relevance for the study (Johnston, 2014). Hox and Boeije (2005) also emphasise the importance of closely checking the data quality in secondary research.

The approach used for this thesis is a bit different since we do not gather numerical dataset, but rather information on the companies and punctual data (such as savings, costs reduction, etc. at a specific point of time). Therefore, the assessment on relevance and quality was conducted differently, through cross-checks of information and strict selection of sources. Indeed, information were qualified as admissible either if they were directly published by the company (but cautiously taken, especially the financial data which were cross-checked when possible), if they came from peer-recognised authors, or if they have been confirmed by other sources.

This method was chosen since it enables to *accelerate the path of research* (Johnston, 2014). In this thesis, the case companies appear to be a support to the theory in order to conceptualise FSE and to answer the research question, not to directly answer it. We do not need a comprehensive analysis of the companies, rather an overview to support and strengthen the concept.

Data and information have been collected in order to meet five analysis criteria. The three companies have been analysed with the same framework. The first aspect is a brief description of the firm to know more about its core business and sector of activities. Then, the second point deals with the reasons for the emergence of the new offering, its roots and drivers. The next analysis criterion is the description of the new solution and its added-value for customers. This criterion is followed by the changes required internally and on the product & services themselves to provide the new solution. Lastly, one explores the concrete impacts on

the firm results (such as profitability, costs reduction, savings, etc.). Hence, cases are analysed on comparable basis to show similarities among them, but also with the theory. This allows strengthening the conceptualisation of the Functional Service Economy. Cases highlight the drivers and challenges suggested in PSS and FSE theories. They also deal with issues such as ownership, decoupling, sources of differentiation and savings, etc. Furthermore, they enable the reader to understand better the FSE typology, especially the distinction between *Sale of use/function* type and *Performance contract* type.

Finally, the Chapter 4 paves the way for future researches on the topic by conceptualising the FSE. Indeed, it combines and synthesises the other chapters to provide a renewed definition of FSE, supported by a description of the main properties and a renewed typology. Obviously, these are different from what has been already done by other academics. It brings a new way of approaching the FSE, and suggests some strategic interests for managers to motivate their choice to embrace FSE. It provides practical evidences to strengthen the theoretical FSE concept.

Chapter 3: Case companies

The choice of those companies has been discussed already in *Methodology* section above. In addition to this justification, one can observe that they are active in three different sectors, all multinationals on the top on their respective market, previously providing simple services with a preponderance of the products. This last point pinpoints the mind shift operated to embrace the FSE. In Appendix V, the interested reader will find additional examples of companies with FSE-oriented strategy; to highlight that FSE is not restricted to three companies, and that other sectors are favourable to FSE as well.

3.1. Case companies description

3.1.1. Xerox

3.1.1.1. The company

They consider themselves as “*leader in document technology and services [...], business process and document management, offering global services*”. They operate with 140,000 employees in 180+ countries and on 4,000+ client sites, for a revenue of \$ 21.4 billion and \$ 1.159 billion of net income in 2013 (Xerox Corporation). More than 12,000 patents secure those profits.

Xerox has huge activities: 4.9b printed pages managed per month on 1m+ devices managed (half of them from competitors)

3.1.1.2. Emergence of a new solution

Since 1960s, Xerox has always been interested in photocopier recovery. In 1987, they launched the Xerox’s asset management programme (or *Asset Recovery Operation*). The idea was already to maximise the profitability of remanufacturing operations and to avoid losing residual value of the products. They were also providing leasing solution for some customers. With these models, even if Xerox do not retain ownership of all the products, it still internalises enough the products to benefit from maximizing use of products while minimizing raw materials used! (Ayres et al. 1997).

However, maximising the remanufacturing profitability was not the only reason for that move. Another commercial goal emerged due to disclosure of several patents that led to

increasing competition. It appeared difficult to keep setting a high price to cover innovation and R&D, although Xerox was famous for that. Hence, they needed to modify customer relationship and find a new revenue structure (Sempels & Hoffmann, 2013). Nevertheless, this change was difficult to implement, they almost drop out the project since the company underestimated costs of ownership and linked to end-of-life management, now internalised but previously supported by the users (Sempels & Hoffmann, 2013). It was while wanting to solve that issue they innovated (again).

A third reason also explains this transition. Some other firms started reconditioning of old equipment inducing two negative effects on Xerox's business. First, those reconditioners were competing with Xerox. Secondly, quality reputation of Xerox slowly became to suffer from these companies business whose services and products did not meet Xerox's requirement and high quality standards (Ayres et al., 1997). That is why they launched, in 1987, the programme called *Asset Recovery Operation*.²⁶

Throughout all these steps, the objective has always been stated clearly: achieving a higher competitiveness (Stahel, 2010).

They have seen a potential in the residual value of the products after their use (or their leasing), they could transform those costs into savings (less recycling cost and drop in new materials need) (Van Niel, 2007). Consequently, in 1991, they came up with a new eco-design thinking to design products and components (such as print and toner cartridge) focused on remanufacturing recycling and reuse (Sempels & Hoffmann, 2013). They developed a complete Product Stewardship implementation.

Mont (2002b), by citing Fischbein, McGarry et al. (2000), summarises clearly what has driven Xerox to embrace FSE model:

“Economics drove the decision to develop the Asset Recycle Management program aimed at avoiding the costs of warehousing and disposal and recapturing the end-of-life value of products. Closing the material loop, through reusing, remanufacturing, and recycling copiers have been very profitable for Xerox. Besides, Xerox linked end-of-life

²⁶ Besides consideration of FSE, Xerox also decided to pursue this program and they keep going to buy sold items back from the country operating companies to incentivise them to pull back those assets (King et al., 2007).

management with product design to increase the residual value that could be recaptured.” (Fischbein, McGarry et al. (2000), cited in Mont (2002b), p.29)

Moving from a pure leasing solution to a global document management solution, nowadays, Xerox offers to its clients to retain ownership of their product. Users are charged a fee per copy, or in most advanced solution, a fee for any managed document. Indeed, Xerox goes beyond the printing business and positions its offer as a global document management solution, sometimes managing the document from its printing/copying to its archiving/deleting. Through that offering, they manage a non-core business activity of their clients, generating savings in administrative and document management activities, thus saving times and finally cents for every copy or document processed. (Xerox Corporation website, and Fischer et al., 2012).

The Functional Service Economy model is a bit specific here. Indeed, they decouple the contract of the machine and the supplies (paper, cartridges, etc.). Regarding the photocopier, customers can either buy it or lease it. Independently of this first choice, they also have to possibility to sign a pay per page contract, including supplies as well as maintenance and other additional services. The *pure* FSE is therefore present if and only if the client *lease* the machine and *pay per copy*.

“The only thing we want to leave with our customer is – THE DOCUMENT” (Xerox Corporation, in Van Niel, 2007).

3.1.1.3. *The solution offering & benefit for users*

Xerox provides different solutions such as sale of machines, leasing solution, managed print services, etc. Among them, one of the Xerox Total Solution Leasing is interesting for FSE: the Cost-per-Copy/Enterprise Pool Plans. Xerox defines it as *“a total cost of ownership plan involving multiple products, multiple sites and volume sharing. Everything you need is included in a single monthly rate – lease, maintenance and supplies”* (Xerox Corporation, 2009, p.2).

This solution provides several advantages for the user: flexible payment option, possibility for upgrading solution, contract duration from 12 to 84 months, several end of term options (upgrade, return, continue, purchase, etc.). In addition, the client does not have to worry about the supplies; Xerox takes care of their management and can estimate his cost since he will pay-per-copy. It prevents him to make investment and it avoids hidden costs (such as supplies ordering, small maintenance, variation in ink coverage, etc.). Now, Xerox is the only

responsible for manufacturing, marketing, maintaining and financing the entire solution. It assumes that this solution enables to drop print & copy expenses by 30 percent. (Xerox Corporation website, and Xerox Corporation, 2010, Fuji Xerox, 2013).

Another interesting solution is the Xerox Partner Print Services. It is a “*single management and support of proactive supplies replenishment, maintenance and repair*” of devices from multiple brands (Fuji Xerox, 2013, and Fuji Xerox website). The solution provides a management of all the devices at a fixed cost per page, aiming at maximising use of existing printers.²⁷

By these solutions, Xerox increases its profit while selling less printers. In addition, they have moved from a photocopier to a document company.

3.1.1.4. Changes

Regarding manufacturing activities, Xerox has adopted completely new production and conception processes (called *Inverse manufacturing* at Fuji Xerox), including design for environment and recycling & remanufacturing of products (asset recovery management). From the design phase the focus is on the optimisation of residual value of end of live (or rather end of contract) products. Printers possess several advantages for valuable remanufacturing, e.g. they are robust & large, as well as easy to disassemble. (See Appendix II, Figures 8, 9, and 10 for closed loop and remanufacturing processes, and Figure 11 for the Integrated Recycling System)

It ensued less amount of components and material variety (10 times less) in each machine, an ease of dismantling, more interchangeable components, the choice of materials is conducted according to their durability and cost, etc. (Van Niel, 2007). In addition, a new cartridge can be filled with up to 20 percent of reprocessed toner (Sempels & Hoffmann, 2013).

However, more time is required during the design phase as well as in the manufacturing phase but this time *lost* is regained in the *after use* phase (which occurs several times for each product, due to its multiple use) (Mont, 2002b).

²⁷ Fuji Xerox is a joint venture between Fuji Photo Film and Xerox Corporation for the Asia-Pacific region. One can notice that Fuji Xerox is on the top of remanufacturing objectives aimed at Xerox with their *Integrated Recycling System* (<http://www.fujixerox.com/eng/company/ecology/cycle/concept/index.html>). The website is full of descriptions and graphics to support the Fuji Xerox Policy.

The internal structure has also been modified, in particular design and dismantling teams started a deeper collaboration, sales team is now connected to remanufacturing team to update prediction of amount of returned products (end of contract), etc. (Van Niel, 2007). It is also the same designers, planners and business teams who assume responsibility of both new products and remanufactured ones. Moreover, remanufactured product are sold through the same channel as new products. Rewards and bonuses are also presents to incentivise sales people (King et al., 2007).

New relationship with suppliers has been developed. Indeed remanufacturing and reuse of spare parts imply a drop in purchase by Xerox. This issue has had to be solved by Xerox in order to maintain good relationship with its providers. They drew up new agreement where suppliers could also benefit partly to the reused parts benefits to balance in a way the reduction of new materials orders (Ayres et al., 1997). In addition, new partnerships have been signed. Among others, TNT (for carrying out returned machines to the adequate facilities) and Covertronic (for dismantling activities) joined the Xerox's network (King et al., 2006).

Now 90 percent of Xerox products are involved at some point in this new model. Almost half of the factories are production sites but also remanufacturing/reprocessing sites (Sempels & Hoffmann, 2013). Nevertheless, Buclet (2014) states that, in 2003, most of assembly chains were in Northern Europe but dismantling chains were located in Southern Europe (cheaper labour cost) which is contradictory. That can be due to the time gap between the two observations.

Kerr & Ryan (2001) explain that photocopiers are sorted into four categories when arriving at remanufacturing facilities (Table 9):

Photocopier category	Description
Test & demonstration models	They are appropriate to refurbishment, including cleaning and replacing some defective or worn components if needed.
Photocopiers with one or two months' average use	They are suitable for reprocessing, including cleaning and replacing all the 'high frequency' service items (like feed rollers) as well as other parts if required.
Photocopiers with a remanufacturing programme	First machine is disassembled, and then subassemblies are cleaned, tested and reconditioned, or replaced if needed.
Other photocopiers	They are either sold overseas, or processed as <i>asset stripping</i> for asset recovery or disposal. These printers are cannibalised and components or subassemblies/modules are used as spare parts for other machines.

Table 9 - Photocopier categories at remanufacturing facilities (from Kerr & Ryan, 2001)

To ensure a *like-new-product* top quality of remanufactured/reprocessed products, Xerox has designed a *Signature* system. A final quality check is operated on each reprocessed machine and they have to possess the same performance specifications (same signature) as new photocopiers (King et al., 2006).

3.1.1.5. Impact

The main impacts are effectiveness benefits and monetary savings, as well as, to a lesser extent, environmental positive impact. Remanufacturing can drop waste generation and resource consumption, especially when products are designed for disassembly and remanufacturing (Kerr & Ryan, 2001).

Thanks to all these changes in manufacturing, design, etc. 70 to 90 percent of components are reused in other machines or supplies (leading to financial benefits & drop in waste and energy consumption). Around 60 percent of all machines in the U.S. are returned to Xerox (and 100 percent for leased machines). In addition, 4.1 million cartridges and other supply items were recycled in 2013, and cartridges can be filled with up to 25 percent of reused toner (Xerox Corporation, 2014). From 2002 to 2006, it also results in a drop in 40 percent in cartridge and toner waste, (6,830 to 3,990 tons). Energy is also saved thanks to these practices; only for the year 2006 175,000 Mwh were avoided (Sempels & Hoffmann, 2013). Xerox states

it saves yearly several hundreds of millions of dollars in raw materials. In addition, their greenhouse gas emissions have dropped from 489 thousands of metric tons in 2003 to 268 thousands of metric tons in 2013. This is due to a huge reduction in resource consumption (mainly fuel and gas) dropping from around 1.5 million MWh to nearly 0.9 million MWh during the same period (Xerox Corporation, 2014). Water consumption also follows this same collapse (See Appendix II, Figure 12 for full numbers).

Remanufacturing operations cost twice the price of new product manufacturing, due to cleaning, dismantling, reassembly, testing, etc. However, these costs are balanced by the drop in raw materials of high value added components (Van Niel, 2007). In 1995, they avoided \$93 million of raw materials and component purchases (Mont, 2002b). Xerox assesses its savings at around \$200 million in 1999 and estimates having reduced waste by 24,000 tons the same year. (Mont, 2002b & Van Niel, 2007). From the Report on Global Citizenship 2014, Xerox estimates having prevented over 38,000 tons of waste in 2013 thanks to all combined returns programmes (machines & consumables) (Xerox Corporation, 2014) (See Figure 13, Appendix II, for graphics and more data. Figure 14 also shows the repartition of resource prevented by management methods, and Figure 15 details results for Fuji Xerox).

Design is therefore a decisive factor in benefits generation. Kerr & Ryan (2001) also state that modular machines are more suitable for better benefit. Table 10 below synthesises their results. One can see that remanufacturing induces interesting savings and it has positive effects on the environment as well. These benefits (especially in materials and energy consumption) can really drive companies to remanufacturing.

	Xerox 5100 copiers (non-modular)		DC 265 copiers (modular)	
	% saving	Reduction by a factor of ...	% saving	Reduction by a factor of ...
Materials consumption (kg)	25	1.3	49	1.9
Energy consumption (MJ)	27	1.4	68	3.1
Water consumption (L)	19	1.2	38	1.6
Landfilled waste (kg)	35	1.5	47	1.9
CO ₂ equivalents (kg)	23	1.3	65	2.9

Table 10 - Savings generated by remanufacturing photocopiers (from Kerr & Ryan 2001)

These savings, associated with good practices and new solution offerings lead to positive financial results. According to Mont (2004), 50 percent of Xerox total revenue came from PSSs in 2000 (Fischbein, McGarry et al., 2000b) and savings might account for up to \$ 250 million per year in the US (Mont, 2004). Those numbers are confirmed in the publication

of the European Parliament, Leasing society, 2012 (Fischer et al., 2012), stating that 50 percent of the revenue comes from renting or leasing (including associated services). These data are fine-tuned in the Xerox Annual Report 2014 (Xerox Corporation, 2015), the share of service revenue rising from 43 percent of total revenue in 2010 to 54% in 2014, reaching \$ 10,584 million in 2014 (See Figure 16, Appendix II).

In addition, new jobs have been created for the asset recovery operations, which leads Ayres et al. (1997) to say, “*Expenditure with materials is being substituted for human labour in this case*” (p.562). It involves a smarter use of labour force to maintain the quality. They conclude by saying that overall Xerox made profit, even with this increase in labour costs (taking the savings of about \$ 65 million in 1996 as a proof).

3.1.2. Michelin Solutions (Michelin Group)

3.1.2.1. The company

Michelin Solutions is a *new* subsidiary of Michelin Group, established in 2012 and dedicated to help fleet managers to perform.

They have today around 500,000 contracted vehicles, in 24 countries, for a total of 1.8 million tyres managed, generating 1.5 million vehicle inspections per year. A staff of 800 people, supported by a network strong of 3,000 specialists, takes advantage of 80 years of Michelin experience in cutting tyres expenditures. (Michelin Solutions, 2013, and Michelin Solutions website)

3.1.2.2. Emergence of a new solution

The creation of *Michelin et Cie* dates back to 1889 and the firm is pleased to say they have always been innovation oriented. They started in 1920s to test new tyres in France and UK, where the goal of retained ownership was to prevent any trouble for customers while interventions occur on tyres.

The launching of Michelin Fleet Solutions arose in 2001 with the goal of “*reinventing our relationship with our customers, optimizing tyre life*” (Michelin, 2009). Stephane Mamelle, Head of Fleet Management Programme explains:

“Michelin Fleet Solutions enables us to promote the competitive edge of our tyres by offering a broader tyre management service. Optimizing product performance and durability is in the interests of all: customers, Michelin and the environment. In this

sense, it genuinely is a model of Sustainable Development” (in Michelin, 2009. Performance and Responsibility 2007-2008, p.62).

In 2012, Michelin Group has settled a new company, Michelin Solutions to integrate expertise of Michelin about their contribution to the business fleets performances (incorporating Michelin Fleet Solution activities). Two main solutions were developed: EFFITIRES and EFFIFUEL²⁸. EFFITIRES is only available in Europe, while Michelin Fleet Solution is still going in the U.S. and China. (Michelin Solution website)

One can wondering why tyres are attractive products for a Functional Service Economy business model. Ayres et al. (1997) consider that, at that time, tyres are one of the most durable products that are produced intensively, in high quantity. Moreover, if the used tyre is reprocessed on time (before being too worn), it is only the *tread* part of the tyre which is lost, accounting for around 10 percent of the total tyre value (Ayres et al., 1997). Therefore, the potential for making savings and profit is huge, especially since the retreading process is less consuming than new product manufacturing (the economies are thus real).

3.1.2.3. *The solution offering & benefits for users*

Michelin Solutions offers a fleet management solution to externalise this non-core activity of its corporate customers. Clients purchase travel mileage, i.e. Michelin Solutions charges them with a per km fee. Companies have to possess a fleet of at least 200 vehicles to be eligible for this solution. (Note: For aviation industry, same concept and pay per landing, incl. supply, management and retreading). By paying for the solutions, users pay the triple function of tyre use: haulage/rolling, guidance and safety (Michelin, 2009).

This strategic move leads the company to switch his view from a volume approach to a performance approach. This is a radical innovation in the manufacturing sector where Michelin makes more profit by selling less tyres while improving the added value to users. Michelin Solutions is contractually committed to results (especially in fuel savings); otherwise, it has to pay the difference to its customers. This is one of the main incentives for clients to embrace the solution; thanks to this commitment, they can fully trust Michelin Solutions and sign a long-

²⁸ EFFIFUEL is a solution offered by Michelin Solutions where they are “*contractually bound to reduce fuel consumption by L/100km*”. EFFITIRES is a Michelin Solutions offering that enables companies to outsource their tyres fleet management and expenditure. (Michelin Solution website)

term contract. Therefore, Michelin Solutions can be more considered as a partner rather than as a supplier. The firm is sitting in the customer's premises to better monitor.

One of the main benefits for users is that costs are now predictable and directly linked to the business activities. Moreover, they avoid fixed cost required by the asset investment. Indeed invoices are based on an agreed rate (according to the vehicle type), charged depending on number of travel mileages. Usually contracts last three to six years. (Michelin Solutions website)

Michelin Solutions states that it avoids fleet manager to dedicate too much time and resources on: selecting best tyres, inspecting them, checking pressure and wear, trying to reduce fuel spending, managing supply and stocks, etc. (Michelin Solutions website). These aspects are met while achieving expected goals of the fleet manager, i.e. optimizing life span, improving safety and ensuring regulatory compliance. Both combined lead Michelin Solutions to assert EFFITIRES Solution can improve resources by 10 to 20 percent of users' margin (Michelin Solutions website). That represents around 200 to 350 euros yearly per truck according to their brochure; their simulation is a bit more balanced, assessing a yearly saving of around €110 per truck for a fleet of 200 trucks (See Appendix III, Figure 17 for the full simulation).

EFFITIRES Solution includes tyres (selection and supply), optimised maintenance (including replacement and end-of-life management), regular pressure check, *retreading & regrooving*, etc. They take care of everything, manage the reporting and coordination among the customer's bases, and prevent their clients with doing administrative work linked to tyres. In one word, it prevents users to worry about their tyres fleet.

Nevertheless, clients have to dispose of telematics on their trucks (at least 70 percent of the fleet) to enable Michelin Solution to monitor the fleet. It is a prerequisite to sign the contract.

Note: Michelin Solution signed, in 2006, a Performance-based Logistics contract with the US Armed Forces. Michelin committed to supply, maintain and repair tyres worldwide. The payment structure was established as a pay-per-service-unit. (Stahel, 2010). This example shows us that B2B is not the only juicy market and that FSE solution can have different contract forms and specificities.

3.1.2.4. *Changes*

To develop a competitive solution, Michelin Solutions has established new partnerships to enlarge its network (see Appendix III, Figure 18 for a schema of the network). The four main new partnerships are with Accenture (for the contracts and administrative management), Wordline (for the telematics platform, measuring parameters on vehicles), Tyrecheck (providing vehicle inspection and tyre's data management tools) and Michelin (providing tyres among other) (Michelin Solution website). Considering Michelin as a partner clearly states that the only point-of-contact is Michelin Solutions, who takes care of all the aspect of the tyres fleet. (Michelin Solution website)

The maintenance provided by Michelin Solutions is the key to make savings, to reduce costs and externalities. Its better knowledge (thanks to a continuous reporting) also enables Michelin (i.e. Michelin and Michelin Solutions) to innovate, to develop new tyres with higher-performance, but also to better master the optimisation of pressure/inflating.

In addition to a continuous innovation bringing new tyres on the market, the main changes on the product itself are its regrooving after 100,000 km (mobile workshop) and its retreading after 125,000 km (Michelin plants), using a remix integrating used rubber (Stahel, 2010). Regrooving & retreading are processed in China (Folz et al., 2008), at least for some parts, therefore huge transportation costs might offset environmental benefits of such remanufacturing process. Also, if it is economically interesting for Michelin to send tyres to China, it means that revenues are potentially huge (to overcome transportation costs and still generate profit).

3.1.2.5. *Impact*

The tyre life can be multiplied by 2.5 and the shell of the tyre (70 percent of the final product) is managed in circular flux (Sempels & Hoffmann, 2013), thanks to the professionalised maintenance, the regrooving and retreading, and the new tyre generation. This multiplier brings 36 percent of savings compared to a direct replacement with new tyres. Michelin Solutions can use only 20 tyres instead of 64 previously for a typical scenario (Buclet, 2005). Fromant (2010) states that decoupling has led to a drop in resource consumption by 69 percent.

In its Performance & Responsibility Report 2007-2008 (Michelin, 2009), Michelin details an example where services, especially retreading, yearly led to saving of 126 litres of fuel and to a drop of 330 kg of CO₂ emissions per bus.

3.1.3. SAFECHEM (Dow Chemical)

3.1.3.1. *The company*

SAFECHEM Europe GmbH is a subsidiary of The Dow Chemical Company. The firm was settled in 1992 and accounted for around 40 employees in 2011 for both Europe and North America.

The company provides *Industrial Surface Cleaning Solutions*, instead of selling chlorinated solvents for metal cleaning, considering themselves as “*provider of services and solutions related to the safe and sustainable use of solvents in industrial cleaning*”. They provide services to around 7500 clients. (SAFECHEM website, and SAFECHEM, 2011a)

3.1.3.2. *Emergence of a new solution*

Chlorinated solvent market is highly controlled and regulated. SAFECHEM decided to go ahead and stop being constrained by integrating legislation requirement to their basic standard. They have stopped selling chlorinated solvents (highly toxic) and now offer a *grease removing solution*. Chlorinated solvents are highly risk products since they can penetrate into the ground and produce a high level of emission. Closing the loop of storage, use and transportation became a must to go. (See Appendix IV, Figure 19 for solvent efficiency numbers). In 1992, they started selling a complete solution, integrating safe containers to transfer the solvents (Fischer et al., 2012). The solution comprises a full product stewardship coupled with a closed-loop service system (UNEP, 2014), taking the full process into account to ease the customer concern.

Clearly, they were driven by stricter and stricter legislation²⁹ as well as a market reinforcement (see Figure 20, Appendix IV, to have an insight of the *legislation threat*). Both strengths became difficult to manage and counter without a drastic reworking of their business model and business processes. It was more interesting to adjust the strategy than to suffer from regulation and competition. Now they can face the more and more competitive market (by securing the market share and expending it), and are also well prepared to deal with new even more stringent regulation.

For 15 years, SAFECHEM has been the only one on the market to be ahead of European regulation. It brought to them an increasing demand coming from companies wishing a safer

²⁹ Such as the obligation for suppliers to take back used chlorinated solvents [German HKW-AbfV, 1989], and the solvent emissions directive [1999/13/EC] (Fischer et al., 2012)

and more sustainable solvent use. When, in 2007, the specific renewed directive on Volatile Organic Compound was implemented, the competitive advantage was even more emphasised (UNEP, 2014).

3.1.3.3. *The solution offering and benefits for users*

COMPLEASE, the solution, is a Chemical Leasing model, aiming at innovating in chlorinated solvent industry. Safechem describes its solution: “*The COMPLEASE™ model enables our customers to lease the complete cleaning process including state-of-the-art equipment, Dow branded high quality solvents, SAFECHM services and extensive CHEMAWARE™ expert know-how*” (SAFECHM, 2011a, p.2). Customers pay for the cleaning performance of a full solution package. For that purpose, SAFECHM provides the customer with two SAFE-TAINER™, one for fresh solvent and the other for used solvent, as well with a cleaning equipment in order to optimise the cleaning performance. (cf. Figure 7)

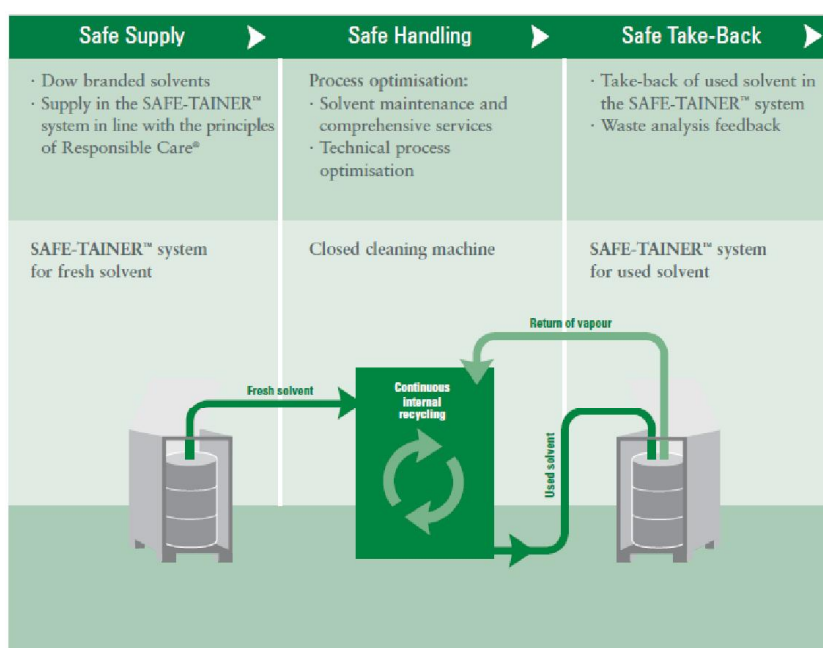


Figure 7 - The COMPLEASE™ Model, an enclosed system (Source: SAFECHM, 2011a)

The take-back service clearly adds value to the solution for users. They do not sell solvent anymore but rather a bundle of know-how, equipment and solvents. This brings a transparency in cost for user, coupled with savings (no hidden cost related to administrative and managerial operation linked to cleaning process, plus supply quantity is exactly what they need, no need to prevent short falling).

SAFECEM considers COMPLEASE as a *safe solution* on three aspects: safe supply, safe handling, and safe take-back. There is virtually no chemical risk for the user anymore. They also states this solution enables an increased cleaning efficiency with a top high quality result.

3.1.3.4. *Changes*

SAFECEM is now driven by the wish to improve the entire solution via the highest quality and economic efficiency (SAFECEM, 2011a). Hence, user's and SAFECEM's goals are now aligned since both aim at reaching a high quality cleaning result at lowest cost with the lowest level of solvent consumed (see Figure 21, Appendix IV).

They created a specific process, comprising delivery, testing, waste management, documentation, consultancy and HSE (Health, Safety, and Environment) compliance (SAFECEM, 2011a). Clients are trained for a correct use, safer and more sustainable, leading to a virtual no risk of emission or spills when used. The pricing strategy has also moved from a volume-based payment to a fee per cleaned part or per month, including the full solution and based on cleaning performance (SAFECEM, 2011a, SAFECEM, 2011b, and SAFECEM, 2008).

Changes have also been operated on the product itself. A new container was designed with pump and vacuum. SAFECEM has worked with clients and machine manufacturers to develop the optimal steel container (UNEP, 2014). Solvents themselves are under continuous innovation, but are used both for leasing solutions and for sales. Nevertheless, with cleaning leasing solutions, the solvent can now be reused several times.

3.1.3.5. *Impact*

Without altering chemical properties, around 65 percent of virgin solvent can be recovered in the metal-cleaning industry (Ayres et al. 1997). Thanks to the COMPLEASE solution, the firm managed to drastically reduce product used as well as externalities (Sempels & Hoffmann, 2013). Before that, 754 kg of solvent were used for 100 kg of processed grease, inducing 233 kg of waste and 520 kg of emission. Now, 4 kg of solvent are enough, generating 3 kg of waste and 1 kg of emission (meaning a reduction by around 98 percent for each factor) (SAFECEM, 2011b; see Appendix IV, Figure 19 for full data). In addition to this drop of 98 percent of solvent consumption for customers, the solvent can be reused up to four years if properly monitored

(reused and recycled around 100 times!), which is interesting for SAFECEM too (UNEP, 2014).

By simply training staff and providing consulting and monitoring, a 10 percent drop in solvent consumption can be reached (SAFECEM, 2011b). The machine utilisation rate is also increased up to 99 percent, which represents a huge interest for customers. For the particular example of Aircelle (world leader in nacelle integration), they managed to reduce the annual solvent consumption by 92.9 percent! (SAFECEM website)

3.2. Common findings

Here are listed the main findings from the cases. Some ideas have already been suggested in the Chapter 1, and will not be discussed here again. In addition, the elements found in the cases description, and only them, are exposed here.

3.2.1. Drivers

The drivers are maybe the biggest similarities amongst the three companies: reinforcing the competitive edge, strengthening their market position (and expanding it), and being ahead of regulation (which is more restricting for SAFECHEM, but appears in each case). Competitiveness is improved by a better resource use (inducing a profitability rise), but also by a more suitable solution portfolio aiming at improving the customer satisfaction. The main regulation aspects companies face or want to anticipate are increasingly strict legislation in waste, energy consumption, provider responsibility, chemical risks, environmental impact, etc.

3.2.2. Changes

The relationship with clients has completely changed. It is a long lasting process rather than a sale transaction. Contracts are signed on a long-term basis and including not only the product but also all the services. This solution is seen by the three firms as *cost preventers* for customers and as *optimiser* of customer processes. Xerox provides solution starting from 12 months (until 84 months) renewable and offers vast flexibility of options. Michelin Solution directly starts with a minimum of three years and a full service solution. One reason might be that time is required to really benefit for the longer-lasting tyres. SAFECHEM also provides a complete solution, including traditional services and other more specific such as staff training.

Companies are now focused on performance and offer some performance guarantee to the users. Xerox commits to perform some savings and promises to pay the difference if objectives are not reached. Michelin Solution has adopted the same practice by guaranteeing a drop in fuel consumption, and accepts to pay the difference if occurring. This performance contract, coupled with the supply management and the coverage of initial investment expose the providing companies to strengthened risks. One way of controlling those risks is to act as asset manager, developing a full product stewardship to react as fast as possible from any happening.

To develop these new solutions, the three companies have developed new partnership: Xerox with TNT and Covertronic, SAFECHEM with its clients and other partners to design the new container, and Michelin Solution with Accenture, Worldline, Tyrecheck and Michelin.

The payment method has changed in all firms. SAFECHEM has a pay per cleaned machine or per month pricing strategy, Xerox charges a fee per copy and Michelin Solution a fee per km (or mileage). Therefore, the fee is based on a functional unit rather than on product volume.

To optimise performance and manage the products, which have become real assets for both parties, providing companies operate with on-site management. Michelin Solution sends full-time staff on client site; SAFECHEM and Xerox run with skilled employees moving from one client to another. That enables a better monitoring, resulting in improving and customizing the solution. Customers are more involved in the relationship, sometimes at early development stage like at Xerox.

Changes have been operated both in the internal structure and on the product itself. Xerox has reworked the machine design (components, dismantling, etc.) but also modified processes to tally with the new business model (in particular the take-back loop and remanufacturing processes). SAFECHEM also completely modifies its delivery-reuse process as well as renewing the containers and constantly innovating for its solvents. Finally, Michelin Solution was established to move out the solution from the initial companies, and tyres are perpetually optimised.

From antagonist incentives, FSE has enabled companies to align their incentive with those of their customers, become partners. Indeed, all parties have interest on using less product as possible, reducing resources consumption. In addition, products have to be manufactured with premium quality in order to maintain a full availability while reducing maintenance (and therefore service cost for the provider). In particular, Michelin Solution and Xerox are now able to plan the maintenance and remanufacturing of their product and thus can guarantee a high level of product availability. Obviously, it also kills programmed obsolescence since firms do not have any interest to replace their product anticipatively.

3.2.3. Impacts for consumers

Several changes on the provider side are also reflected on the customer side, such as longer-term contract, aligned incentives, less risk and no need of initial investment, etc. Moreover,

clients pay now according to the level of their activity, with a clear and predictable cost structure. Thus, that prevents hidden costs and enables to budget for this post.

By optimising processes and removing the non-core activity from the client side, providers generate savings they share, partially with users. Michelin Solutions explains their services make savings for users around €200 to €350 per year and per truck (when including EFFITIRE and EFFIFUEL savings together, around €110 for EFFITIRE only). The two other firms declare savings for customers as well. That is why they can afford to be contractually committed to performances.

3.2.4. Benefits for the providers

First of all, the drivers can be considered as benefits since companies have developed a FSE business model to benefit from advantages (or counter the disadvantages) detailed in the drivers section. Secondly, firms agree on two important benefits as for reduction in resource use and optimisation of product use. Together they generate savings that on their turn influence the profitability and competitiveness. For example, Xerox saves hundreds of million dollars in raw materials yearly and now 50 percent of revenue comes from renting and leasing activities. The company also gained in competitiveness when they realised and took advantage of the potential in residual value of product after use. SAFECHEM, on its side, states that a huge drop in resources used enabled them to make savings.

The three cases have also been assessed on their profitability and competitiveness thanks to the Fromant's grids. Results can be found in Appendix I (see Section 1.3.8 for details and explanations about these grids).

Chapter 4: Findings and conclusion

Thanks to the literature review and the previous analysis on literature similarities, gaps, as well as cases analysis; it is now possible to rework the different FSE definitions and approaches to the concept in order to combine the previous works on the topic as well as to add a personal contribution. Thus, it will lead to a new conceptualisation of the Functional Service Economy. This contribution is based notably on the case companies and a service business approach of the theoretical concept.

4.1. A renewed FSE definition

Functional Service Economy is, first and foremost, an economy that is based on functional solutions integrating services and products to optimise their use and function. It aims at contractualising usage performance based on an integration of products and services. Thus, FSE is also an approach companies can adopt to modify their business models and to position their long-term strategy, moving from a volume orientation to a usage orientation. Therefore, it represents a strategy, a guideline for managers to design and provide solutions in alignment with the FSE principles. A proper definition could be:

FSE is a shift in business models, integrating products and services into complex adaptive system (the solution), that aims at providing functional use of products while optimising processes and maximising value creation, wealth, and resource productivity.

Practically speaking, company provides functional unit, i.e. delivers a solution comprising services and products at disposal to the user. The payment structure is based on a fee per functional unit used (such as a fee per mileage, or a fee per operated unit). Hence, the providing company has substituted the sale of the good by the sale of the use of this good. Contracts are now based on a level of performances with contractual commitment to results.

By moving into FSE, the firm is adopting a complete reverse logic. Now, instead of trying to sell as many products as possible, the company has an incentive to deliver as few products as possible to meet the contract agreement. The volume costs have moved to the provider side. Production and manufacturing objectives are completely opposed to the ones of an industrial economy: higher product quality, with a longer life expectancy, better modularity,

etc. That highlights the fact that objectives and processes of all company's units have to be adapted to the new strategy.

FSE is all about the global system, comprising products, services, partners and infrastructure. The global solution is designed thanks to an integration of these components, keeping in mind a system thinking and a wish to fulfil customers' needs by optimised, effective, efficient, and productive processes. The provided solution has to be linked to a non-core activity (on the customer side) in order to avoid a productive dependency.

Therefore, this global system enables the firm to provide a customised solution for each client. Nowadays, it is not the client who fits to the machine, but rather the machine that is adapted to the client. FSE follows clearly this view since the solution is adapted to each customer. Furthermore, with this reverse logic (functional orientation rather than volume production orientation), customer and provider have aligned objectives; both aim at optimising performances with this specific offering.

4.1.1. Main characteristics of FSE

However, FSE is much more than a definition, hopefully. This section comprises the main characteristics of the FSE concept, enabling to strengthen this new conceptualisation as well as answering the research question (i.e. the competitiveness and value offering that the FSE brings to companies).

4.1.1.1. Value consideration

Companies that have adopted a FSE business model lose, de facto, the monopoly of value creation. Indeed, now, they offer tools to create value; value itself is created only when the customer uses the solution. Therefore, value is co-created and is measured by calculating the *provided use* throughout the full product life-cycle and the total process of use.

The economic value represents the usage value over time (considering the multiple use of products and resources and the added value of services). The value *in use*, not *in ownership* or *in consumption*, is responsible for the wealth generation, reinforcing the quote of Stahel (2007a) "*Wealth without resource consumption*". The focus is on the added value created by the solution. Now, it is the product performance, the successfulness of use, that defines the costs. These are composed of the entire process costs, also including costs such as access, transaction, learning, monitoring, repair and maintenance, take-back, etc.

FSE comes into companies with a new function for goods, they are considered as delivery tools for value, as assets enabling the service provision. Thus, they represent a mean rather than the end itself, on the contrary to services (or operant resource) that are the key to competitive edge.

To summarise the FSE value consideration, one can remember that SDL value conception can be considered as the grounded principles for FSE, and the reader can go back to the section 1.1.2.2 for a deeper analysis of SDL conception of value.

4.1.1.2. Decoupling & resource productivity

FSE is based on resource productivity and products are considered as assets for both provider and user. Therefore, the provider acts as an asset manager, deciding after each use the optimal next step of his product. Productivity is reached by reusing the resources and thus lengthening their use (as products or as components for other products), but also by intensifying resource use. Resource efficiency becomes crucial to monitor, and it can be computed as the resource input per unit of use, considering a long period of time.

Resource productivity and cost-effectiveness truly happen only if decoupling (separating value creation and economic success from resource throughput). Products keep a residual value, even after use; hence, providers have to take advantage from this value (to capture it), generating profits without adding extra resources. Thus, FSE induces a resource use rationalisation. It vanishes resource overconsumption and transforms it into value. To maximise the resource use, expert in maintenance is vital to maintain a top quality and working product. Therefore, FSE sets the stage to maintenance professionalization. FSE, via this need for decoupling and the required process changes, calls for a deep structural change in the company, which is not easy to implement but vital to the FSE success.

In that context, this Stahel's consideration makes even more sense: *"The economic objective of the Functional [Service] Economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible"* (Stahel, 1997b, p.91). One can remember the above discussion stating that resource productivity as surplus generator might be a central concept for FSE. An optimal use of resources enables to maximise productivity and thus represents the starting point to profitability and competitiveness.

4.1.1.3. *Profitability and competitiveness*

Thus, the increased resource productivity detailed above can lead to a better profitability and competitiveness from providers. Nevertheless, it does not represent the only factor of improvement. Indeed, FSE brings another way of profitability and competitiveness enhancement. Since provider is trying to optimise value of his assets, he will retain their ownership. Through this operation, he internalises all risks and waste costs (which are also risen by the extended responsibilities linked to performance contract and beyond point-of-sales responsibilities). Consequently, economic incentives appear to minimise costs and to optimise all the processes and the product use. By integrating the processes under a comprehensive solution, the provider generates new source of profit, resulting in better profitability and competitiveness.

These costs minimisation and process optimisation go with a new manufacturing approach. Since FSE promotes reuse of physical assets, these assets have to be designed and manufactured for reusing and for longer life. Design has to fit with a full life-cycle optimisation (including reuse, remanufacturing, recycling, etc.). Furthermore, modularity, modernisation and upgrading have to be facilitated by the new product design. Therefore, FSE asks for a product characteristics modification as well as an internal structure modernisation to tally with the new business model and strategy.

One way of analysing the profitability and competitiveness is to go through the two Fromant's grids depicted in Section 1.3.8 and Appendix I. They can be useful for a first consideration. Stahel (2010) has also created metrics that can be interesting tools to assess the potential of a solution on a FSE basis (see Section 1.3.5 for the metrics).

4.1.1.4. *A way to answer today's concerns*

FSE can be considered as the *Economy of the future*, or at least an economy solving some of current concerns and drawbacks of today's economy.

Firstly, FSE is an innovation catalyser. Numerous of firms complain about the refusal of their customers to pay for innovation. With FSE, providers can keep going to innovate and, since they retain product ownership, can reflect smoothly the price on the users. Furthermore, providers have now a direct interest to innovate. Indeed, when an innovation enables them to provide the function at lower costs, it generates immediate profit for the providing company. In

a second move, this firm can decide which share of the savings it wants to give to the user, striking a balance between profitability and competitiveness.

Secondly, FSE is a way of extending responsibilities for providers. These responsibilities relate to the product itself, the performances, but also externalities generated by the firm, wastes, risks, etc. It facilitates the company to be more sustainable, more societally responsible (including the environmental issue, but not only). It also enables to be more transparent and to get closer to the company's partners (in particular the clients and the suppliers).

Thirdly, some consider companies have to be societally responsible by enhancing local economy. FSE also answers this concern by creating non-offshoring jobs (not all of the new jobs, but at least a fair part of them). Actually, jobs have to be located closer to the client sites to be able to operate on-site. It prevents them to decentralise jobs abroad and it promotes the jobs regionalisation. Moreover, FSE requires high-skilled workforce and replaces labour for energy. Thus, the Western staffs do not suffer so much from the cheap workforce from emerging countries (as they suffer from them in traditional manufacturing activities). People are the new added value and Western economies are well recognised for their staff quality and staff expertise.

Lastly, FSE modifies financial consideration. FSE companies are less driven by short-term financial performance. Since contracts are based on a long-term relationship and on performance, managers have incentive to optimise the long-term profitability. If they take actions to optimise the current results without having a global and (at least) medium-term vision, the company will go bankrupt, inevitably. This new vision will lead to a better stability as well as more responsible decisions and actions.

4.2. A new FSE typology

Van Niel (2014) has already set the stage to a FSE typology. Nevertheless, he also integrated B2C and C2C activities into the concept but these are out of the scope of this thesis. Thus, a renewed typology appears to be needed, enlightened by the reflection conducted during the previous chapters.

To be eligible for a FSE type, a business model has to have a specific product involved in the transaction; and therefore, it cannot be based only on services. This product is the typical product of the company (part of the usual core business), or a substitute developed in order to

optimally provide the solution (and therefore, it cannot be bought to another firm and “*leased*” further away). Product has to be considered as a global term, including energy and consumption resources (electricity, gas, fuel, water, etc.), chemical products (such as solvents, catalyser, fertiliser, etc.), etc.

Here is the new typology³⁰, comprising two main categories *Sale of use (function)/Use-oriented service*, and *Performance contract/Result-oriented service*:

- ***Sale of use (function)/Use-oriented service***: long-term contract where the firm provides the function of a product in a comprehensive solution comprising a wide range of services too. The provider commits to a certain level of performance. The typical example is the Functional sale:
 - *Functional sales*: pay per functional unit used, including the product at disposal and all the services. Xerox and Michelin Solution are the two main illustrations.
- ***Performance contract/Result-oriented service***: long-term contract where the firm provides a guarantee on a level of performance for a solution including a consumption good. The pricing method is also a *pay per functional unit* system, the consumption good and services being included. The main sub-categories are:
 - *Energy Management services* (or *Energetic performance*): providing a level of comfort (heating and cooling system) instead of fuel. The payment is calculated according to the temperature for example.
 - *Least cost supply*: such as Chemical Management Services (CMS) or Integrated Pest Management. SAFECHEM is part of this category.
 - *Textile leasing Service*: if the company is also the textile producer or works closely with this firm. It could be a carpet manufacturer providing the service of *carpet cleaner* as already offered by other companies (when both activities are split into two different companies, it does not tally with FSE principle anymore). The payment system could be a pay per hour of carpet use.

This typology is based on the Van Niel’s proposition (2014). Nevertheless, the distinction of Stahel (2010, cf. Figure 6) and his corporate strategies fit with this categorisation as well. Indeed *Sale of use* tallies with his *Performance service* type and *Performance contract* with his *Performance management* type. This highlights the fact that both FSE types are based

³⁰ The types and sub-types name are inspired or taken from Van Niel (2014) and Stahel (2010)

on performance provided by the *selling* company, which is important for the corporate strategy. Indeed a new strategy consideration is required. A mind shift is operated to focus now on performance throughout the entire company. Like the reverse logic occurs on the production side (use and functional orientation rather than volume orientation), the strategy has to be oriented on a long-term profitability and competitiveness and based on performance. This applies from the bottom to the top of the hierarchy.

Appendix V describes a few more examples of FSE oriented companies and business models.

4.3. What is not FSE

Specifically, some business models do not fit with FSE concept although they have some similarities. Most of the time, those examples can be considered as PSS, or are simply pure services companies. In general, a FSE company has to be a manufacturing firm or to be closely associated with the firm. If the service provider buys the product to another company, a huge part of the concept disappears (resource productivity, remanufacturing optimisation, etc.) and the business model cannot be considered as a FSE business model.

Therefore, are considered out of the scope of the FSE concept as explored in this thesis (non-exhaustive list):

Business types	Justification
Car sharing	No systematic contract, no retained ownership from the manufacturer, no payment per functional unit (per driven hour, per kilometre, etc.), mainly a C2C market.
Washing centre	No long-term relationship, not a manufacturer providing the service, mainly a B2C market.
Car renting	Not a manufacturer (except Mu by Peugeot but they do not have long-term relationship, neither based on performance), no payment per functional unit (you pay per hour, no matter the kilometres driven). One exception: Daimler's Car2Go, see Appendix V.
Accommodation renting (AirBnb, Hotel, etc.)	No long-term relationship, not based on performance.
Catering on-site	It is a service provided, no product associated.

Facilities management	It is a service provided, quite similar to the Performance-based logistic case (see right next sub-section).
Etc.	

Table 11 - Non-FSE business models

4.3.1. The case of Performance-based logistics

Many companies provide performance services based on after-sale contract. Kim et al. (2007) provide a clear definition of that model:

”Performance-based contracting is reshaping service support supply chains in capital-intensive industries such as aerospace and defense. Known as “power by the hour” in the private sector and as “performance-based logistics” (PBL) in defense contracting, it aims to replace traditionally used fixed-price and cost-plus contracts to improve product availability and reduce the cost of ownership by tying a supplier’s compensation to the output value of the product generated by the customer (buyer).” (Kim et al., 2007, p.1843)

KONE is a typical example. They offer performance contract for the maintenance and the monitoring of their assets, but the product itself is sold separately beforehand. Another example is the *Power-by-the-hour* of Rolls-Royce. It is a service offered to airline companies to provide performance contract for engine maintenance and in-flight monitoring. It is not a FSE since the engine is sold, beforehand, and those services can also manage non-Rolls-Royce engines. The performance contract only occurs after the sale of the product, not to *replace the sale*.

Kim et al. consider that the U.S Department of Defense is one of the pioneer in that sector (at least for a *public* organisation). Indeed, guidelines for performance-based contract are stated in *Defense Acquisition University 2005a*, §5.3:

“The essence of Performance Based Logistics is buying performance outcomes, not the individual parts and repair actions ... Instead of buying set levels of spares, repairs, tools, and data, the new focus is on buying a predetermined level of availability to meet the [customer’s] objectives.” (Kim et al., 2007, pp.1843-1844)

To conclude, the concept is very similar to FSE, it aims at reaching close goals, but only in the after-sale part of the product life. FSE is more comprehensive since it takes the product

life in a whole, integrating the design and manufacturing phase, taking more risks and responsibilities by retained ownership, committing on performance in a larger extent, etc.

4.4. FSE, a strategic interest for companies

Here are a few considerations that might motivate managers to embrace FSE model.

In 1980's, Vandermerwe & Rada have already stated clearly the main advantages of Servitization. They are quite pragmatic but apply fully to FSE as well: lock in customers, lock out competitors and increase the level of differentiation (Vandermerwe & Rada, 1988). By providing more and more services and fulfilling more needs, the provider makes itself essential to its customer. The provider enters so deeply into customer's business that the client cannot do these steps anymore. Customer retention is improved by FSE. Moreover, it increases switching costs (highly increased by the ownerless consumption where switching will lead to huge investment), blocking even more the customers and preventing the competitors to attack the market. The expertise gained by the experience reinforces the level of differentiation and erects new barriers to entry, turning back competitors. Supporting more risks and responsibilities, and offering integrated solution also contribute to the rising differentiation. In addition, by creating innovative partnership and by reinterpreting customer demands, the firm reinforces the gap with the other companies.

Another good reason to move into FSE is the intrinsic potential of services. First of all, manufacturing firms now face the installed product base issue, their own product leading to a reduction of market potential. This issue can be transformed into a juicy opportunity by catching residual value of previous sales.³¹ Indeed, the maintenance and extra-service markets are highly profitable and launching a FSE solution will automatically integrate this market into the initial solution provided. One can also consider a possibility to include sold products into a new FSE based contract. Moreover, by providing those services, you avoid someone else catching this business. In addition to that aspect, services can bring higher margin than traditional product, they also stabilise revenue splitting them through several years.

Linked to the previous point, FSE enables to price the true value for services (payment for all services provided). It makes customers fully aware of every single service price (those offered by the provider, but also those previously internally operated). The goals of both parties

³¹ Kim et al. (2007) states: "*Support and maintenance services continue to constitute a significant part of the U.S. economy, often generating twice as much profit as do sales of original products*". (p.1843)

are aligned on performance. Therefore, it is a way to clarify the actual cost structure. Providers can also capture value of additional services offered into the global solution, extending the service portfolio. Sometimes those services are already required by customers who demand it to competitors or do it internally. FSE is therefore a way to better fulfil customers' needs and expectations.

Needs and expectations are also better met since incentives are aligned. Indeed, the reverse logic vanishes the goal of selling as much as possible on the firm side, and replaces it by a wish to produce/consume as few as possible. Therefore, relationship with customers is enhanced; clients do not perceive the sales representative as someone who wants to sell them as much as possible anymore. Trust is present and help to build a sincere collaboration. Being committed to results is also a guarantee for users and is required for such long-term contracts. Clients agree to commit to a long-term contract because of this commitment security. Nevertheless, by contracting a long-term commitment, clients also become linked to the provider, which might reduce their move possibilities (due to switching costs, sharing knowledge, etc.). That is why the performance commitment is vital for customers.

Moreover, this alignment and reinforced needs fulfilment are also due to customised offer. Clients are more and more demanding and FSE solutions can easily be adapted to each expectation, offering tailor-made solutions (product they need, services they need, support they need; nothing less, nothing more). The offering is not stuck to a product anymore, but is provided through an optimised functional solution. In addition, FSE solutions prove to be easier for clients since they facilitate the long-term management of product. Indeed, the customers do not have to worry about the replacement of products, their re-investment provisions when the product become obsolete, etc.

Like Xerox and Michelin Solution have explained clearly, FSE has enabled them to get around the client refusal for innovation when this innovation is linked to a rise in prices. Included in the FSE solution, clients are now ready to pay for this continuous innovation. Consequently, it gives incentive to the companies to continue to innovate, which allows them to stay at the top of their activity sector by maintaining or increasing the differentiation level (boosting their competitiveness). Moreover, thanks to FSE the firm will have a better knowledge about their clients and how they use the solution, which enables them to open new ways of innovation.

More globally, FSE prevents competitors and regulation to overcome the company. The provider always stays one step ahead and acts as a pioneer. By acting proactively, the firm can benefit from the *first mover advantages*. Moreover, the company is not constrained and limited by regulation anymore, giving them more freedom to develop their business.

FSE also prevents to suffer from resource scarcity and volatility of material prices. This is an increasing and ongoing phenomenon. FSE brings a structural answer to it by reducing resource consumption and providing tools to optimise resource use. The level of activity can be maintained while reducing resources, which is highly interesting for managers.

Moreover, as already stated, Western companies cannot compete on a cost basis only, facing fierce competition from emerging countries in particular. Thus, traditional manufacturing are devoted to go bankrupt or to react and change drastically their strategy. Focusing on services and using high-skilled staff are ways to compete against firms from emerging countries. Hence, FSE is an interesting strategy for Western companies, which will also reinforce the local presence of their workforce. This last point is highly valuable by authorities.

Lastly, business model and strategies in traditional economy have been based on an expansionist market. Companies were convinced about the possibility to always find new market and expand their market share. Unfortunately, in numerous of sectors, markets are saturated and it is mainly the replacement market that drives the economic growth. Therefore companies will be forced to change their business model and strategy one day or another. Managers can anticipate it by implementing a FSE-oriented strategy.

Consequently, all these aspects can clearly lead to a better resource productivity and an improved structural productivity, resulting in enhanced profitability and competitiveness (*can lead*, since it is not automatic, but FSE, if well implemented, has the potential to lead to them).

Nevertheless, FSE also comes with barriers managers have to overcome for a successful implementation. Managers have to be aware of them to tackle them appropriately. The most critical are discussed below.

FSE requires a mindset shift, functionally oriented. It is not specific to FSE, this barrier often occurs when companies want to move out from the business as usual. FSE is grounded on new goals, a complete renewed strategy, new processes, new responsibilities, new sources

of power and power allocation, etc. People have to familiarise with it, to accept and to adopt the new system. The reverse logic has to happen in their mind too. Therefore, managers have to take action in order to motivate staff to shift their mind, and to support this change.

Aligned with the first point, one can face reluctance to change from both side (inside the company but also from the client side). For example, some customers might be reluctant to the *ownerless consumption* (because they cannot use it as they wish, or do not possess it anymore – these are characteristics that would rather fit to individuals; but they can also appear with corporate). This averseness has to be anticipated and tackled adequately.

Also, to fully benefit from FSE, a completely rebranded and renewed strategy has to be implemented. This long-term plan has positive aspects but also sticks the firm to this long-term strategy.

The cost structure is very different in FSE from traditional manufacturing activities. FSE requires high capital to invest and higher transactional and contractual costs. Managers also have to anticipate it, plan the financial structure, and, if necessary, find the required fund. The advantage is that erects a barrier against competitors, increasing the gap (cf. lock out competition). Obviously, the revenue streams are also different and FSE cannibalise the *old replacement market*. It has to be taken into account, although on a long-term perspective the firm should earn at least as much as before thanks to the full solution provided. Thus, it is a shift in revenue stream rather than a loss of a revenue stream, which needs to be understood by managers and sales staff.

Hence, the workforce has to be revised as well. New skills are required in maintenance, remanufacturing, service provision, etc. On the other hand, one can expect that manufacturing operations will require less staff (since less product to manufacture). Globally, a higher-skilled staff prevails and modifications in location and allocation are needed. Moreover, this new business model goes with a call for new way to incentivise sales staff. Bonuses have to be modified to incite to provide a global solution and work on long term basis, rather than selling products and making short-term profits.

In addition, this is not a barrier rather an aspect to keep in mind, cases show us that success is not automatic for companies adopting FSE. Also, some markets are easier to approach with that model (B2B are more successful than B2C cases). Managers have to remind that and to plan well in advance the move to a functional business model. Besides, as a service market, the functional sale market requires critical mass to be profitable (cf. the U-shape of the

profit curve, the *dead valley* is quickly reached and has to be overcome); therefore, the firm has to be prepared (especially financially) not to be profitable before this *breakeven point*.

To conclude this section, managers can find many reasons to embrace FSE, some advice are given here as well as some warnings to remind the managers to be cautious when starting the change. In one word, FSE requires agile behaviour from managers, open-minded and challenge driven people to succeed in this new strategy implementation.

4.5. Final consideration

From many years, the economic world has evolved, driven by an increasing servitization of all sectors. This evolution is also coupled with a rework of the value conception. In this environment, *Functional Service Economy* appears as the completion of a thinking trend, combining the PSS thinking and a Service-dominant Logic. FSE belongs to the PSS typology since it is a system of product and service, although the product view is still different; but a specific type of PSS based on value-in-use and intrinsic function of solution, settled with Service-dominant Logic.

Companies shifting their strategy into FSE are adopting a complete reverse logic, focusing on function and performance rather than on volume. They aim at contractualising usage performance based on functional solution. In this thesis, we conceptualised this new economic model by recounting its evolution and surrounded concepts, and by providing its definition, main characteristics, as well as strategic stakes. It enabled us to answer the initial research question; What can the Functional Service Economy bring to the value offering and to the competitiveness of companies?

The central concept of FSE is the functional use. This functional use leads to optimised resource productivity, thus generating surplus. This wealth generation provides aligned and distributed incentives, for all parties, to contribute to the well-functioning of the long-term partnership.

The study of the theory coupled with case companies enabled us to highlight the value potential for companies to move into FSE. This value can be linked to the value offering, the productivity, the profitability, the competitiveness, etc. Besides, functional orientation opens new perspective for the firm on service offering, on innovation, on new jobs specification and skills, etc. This is promising for the corporate world, but also for the society in general since it

can lead to a more sustainable management and economy; thanks to decoupling, resources and processes efficiency, long-term and closer partnership, etc.

Nevertheless, we are fully aware that FSE is not automatically successful when implemented. Indeed, nowadays only few firms have effectively performed by embracing FSE. However, three of these firms (that have succeeded for several years now) are major actors in their respective sector (Xerox, Michelin-Michelin Solutions, and Dow Chemical-SAFECHEM). These positive results are promising for the future and they show us that FSE is neither a niche concept, nor a theoretical myth. It is true that this transition comes with some challenges. However they do not appear as insuperable and, when overcome, they can strengthen the company's positioning.

Furthermore, this study contains some limits. Indeed, we decided to focus only on B2B market for this thesis. To be exhaustive, one should consider other markets such as B2C or B2G, and therefore one should analyse the different implications on the FSE concept itself, also on its adoption, drivers, barriers, etc. In addition, a choice was made to study the state-of-the-art on FSE and surrounding concept. Hence, the thesis is *de facto* a theoretical research, where case companies are there to illustrate the theoretical concept. Consequently, there is a potential for further researches in analysing FSE companies with in-depth researches, on a case-by-case approach.

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