

POLITECNICO DI MILANO
Facoltà di Ingegneria dei Sistemi



POLO REGIONALE DI COMO

**Master of Science in
Management, Economics and Industrial Engineering**

**DEVELOPMENT OF A FRAMEWORK TO
ASSESS THE VALUE-IN-USE OF PRODUCT
SERVICE SYSTEM IN THE BUSINESS-TO-
BUSINESS SECTOR**

Supervisor: Ing. DONATELLA CORTI

Master Graduation Thesis by:

AHMED SAYEM

ID No. 737677

Academic Year: 2009/2010

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EXECUTIVE SUMMARY

During the last ten years with the increase in world-wide competition, reduction in tariff and improvements in communication, European manufacturers has faced competitive pressures from low-wage economics. Earlier these threats were primarily based on the common practice of imitating products of competitors from developed, industrialized nations. These imitations exacerbate the amortization of investments in research and development and can even render them impossible. Highly dynamic markets pose the additional challenge of having to generate sustainable competitive advantages under changing conditions (Rese, Karger, Strotmann; 2009).

Focusing on providing products does not suffice to create a viable economic basis for company success (Prahalad, C.K., Ramaswamy, V., 2003, pp 12-18). This impels manufacturers of developed economies should have to compete on the basis of innovative products and services. The boundary between products and services is becoming blurred. Manufacturers are continuously introducing new services that support and add value to their products. In fact the boundaries between manufacturing and services firms are breaking down across the globe. Firms are moving from selling products to selling whole package solutions of products plus services- Product Services Systems (PSS). One example is Rolls Royce which offers an integrated solution: Power by the Hour. The client exclusively pays for the use of the engine whilst Rolls Royce performs every necessary activity to guarantee the engine is kept in optimal conditions (maintenance, overhaul and spare parts). This study is focused on the increasing importance of these services in order to generate a sustainable competitive edge and prevent out-suppliers from penetrating the customer-supplier relationship.

Product-service system (PSS) is considered to be a high potential business model (Mont,2001; Williams, 2005). In PSS products and service are combined and sold as solutions. Research into PSS has increased dramatically over the last decade, but it is still considered a new area of research needing further exploration. Since this term was first coined servitization has been studied by a range of authors who have specifically sought to understand the methods and implications of service-led

competitive strategies for manufacturers. In addition, and somewhat independently, during this same period there has been a growth in research on the related topics of Product-Service Systems (PSS), Service-Science (SS) and Integrated Vehicle Health Management (IVHM). This increasing body of research indicates a growing interest in this topic by academia, business and government. One reason for this is the belief that a move towards servitized manufacture is a means to create additional value adding capabilities for traditional manufactures. Furthermore, that such service is distinctive, long-lived, and easier to defend from competition based in lower cost economies. The literature on PSS has focused on its advantages in competitiveness and sustainability through the transfer of responsibility from the customer to the supplier.

PSS is a unique business model. It departs from the usual treating of products and services as needing separate and different business models. This thesis deal with PSS in a general Business-to-Business sense rather than study a specific case, and the aim is to contribute to the understanding of value derived from the PSS developing a framework useful to support manufacturing companies in the B2B sector in assessing the value-in-use in order to be able to define a proper and sustainable offer.

In order to achieve the thesis's aim, the following procedure has been followed:

- Understand the concept of Product Service System (PSS)
- Construction of a value-in-use assessment framework which represents the best linkage between contributing elements.
- Explores significance of various components of these elements.
- Testing of the framework with an industry expert

The literature review forms the backbone upon which this thesis is based. It covers various areas of prior research that together formulate an understanding of the research topic. These are:

- definition of the concept of Product Service System,
- drivers of Product Service System,
- classification of Product Service System, definition of value,
- value-in-use and value creation systems and
- a review of current literature related to Product-Service Systems (PSS).

Then, a value-in-use assessment theoretical framework has been developed based on assumptions designed starting from findings from literature, and defining and explaining the essential contributing elements to value in use (including sub-elements).

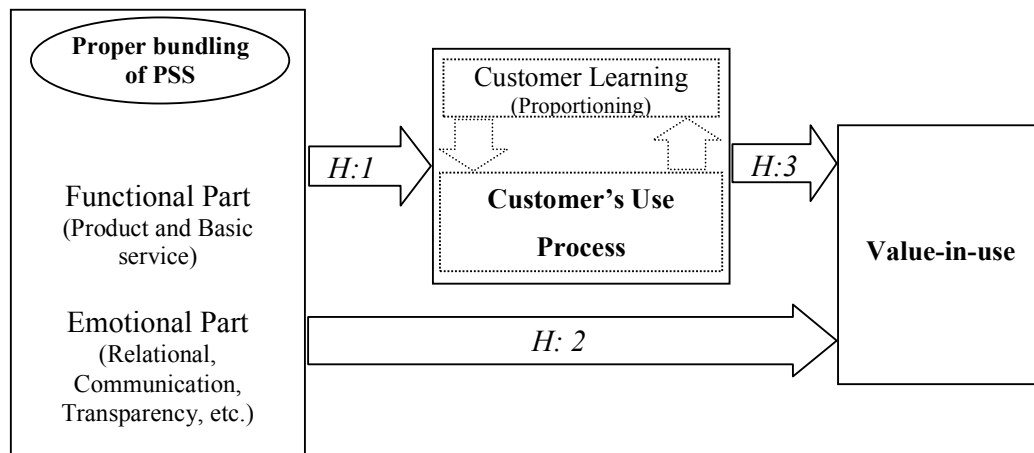
The reference hypotheses are:

Hypothesis 1: Customer and supplier co-create value and the value-in-use is not one-off perceptual phenomenon rather processual.

Hypothesis 2: A change in the product support strategy & bundling of PSS results in the change in value-in-use.

Hypothesis 3: Value-in-use is determined relative to use context and the changes in the customers' usage process results in the changes of the value-in-use.

Then, depending upon the hypothesis, the proposed scheme that shows which are the reference components for assessing value in use and shows their interactions is depicted below



Proposed Value-in-use assessment scheme

Starting from it, the elements influencing on value-in-use of product-service system, has been defined in detail, answering to the question: *How the factors determine whether a PSS business model creates value-in-use in the best way?*

Elements behind the hypothesis *one and three* in combination determines the influence of customer oriented components on value-in-use; and the influence of supplier driven arrangement are determined from the *second* hypothesis point of view. More in detail, considering the arrangement of customer oriented components to value-in-use outcome, the developed framework scores the bundling of nine customer oriented components (which are responsible for the authentication of hypothesis *one and three*), against the value-in-use elements/outcomes

Effect of customer oriented components on value-in-use outcome

Customer oriented components*	Value in use element/outcome						
	Focus on core business	Improvement in machine availability (i.e. reduction in machine downtime)	Efficient use of resources	Environmental burden reduction / recycle	Customer gets better services every time	Enter into the supplier network	Value proposition relates to customer's lives, objectives and aspirations
Knowledge, Skill and Competence of customer							
Learning from product performances							
Dialog between parties							
Increase in the level of customer participation or involvement							
Intangibles valued by the customer							
Technology content of the service delivery							
Consumer predisposition (e.g., personality, attitude & values)							
Existence of emotional value proposition							
Customer learning (learning from the practice involving a supplier)							

* in the next section a brief description of each of this component are given.

Key:

- ++ : Significant effect
- + : Has effect
- 0 : Indifferent
- : Low
- : Lower effect
- ? : No judgment possible

While, considering the **arrangement of PSS bundling (different service choices) to value-in-use outcome**, the developed framework, scores the bundling of eight generic types of PSS (which are arranged depending upon second hypothesis), against the value-in-use elements/outcomes.

Effect of the bundling of PSS in the value-in-use elements

	PSS Model	List of Services*	Value in use element/outcome					
			Efficiency in the use of Material and Human Resources (customer's organization)	Need to develop infrastructure (in customer premise)	Need to bear capital cost (Initial investment Vs Periodical investment)	Transfer of risk	Green Environment (environmental burden reduction)	Flexibility to change the business process (customer)
Product content	Product oriented	Product-related service ¹						
		Advice and consultancy ²						
Service content	Use oriented	Product lease ³						
		Product renting or sharing ⁴						
		Product pooling ⁵						
	Result oriented	Activity management/ outsourcing ⁶						
		Pay per service unit ⁷						
		Functional result ⁸						

(*List of services obtained from the paper: 'Eight types of product-service system: Eight ways to sustainability', 2004)

¹⁻⁸ : A brief description of different types of PSS are depicted next.

Key:

- ++ : Higher / Improved
- + : High
- 0 : Indifferent
- : Low
- : Lower Impact
- ? : No judgment possible

Finally, the previously defined framework has been tested, exploring the components influencing value-in-use thanks to the judgment of an industry expert.

The results obtained are depicted in the following figure that shows the influence of each of the customer oriented component (figure A) and the influence of the different services (figure B) on the value in use elements, is added one after another (scoring arranged from 0 to 25, with an increment of 5 for each of the higher influence and the total is grounded on 100 percent scale)

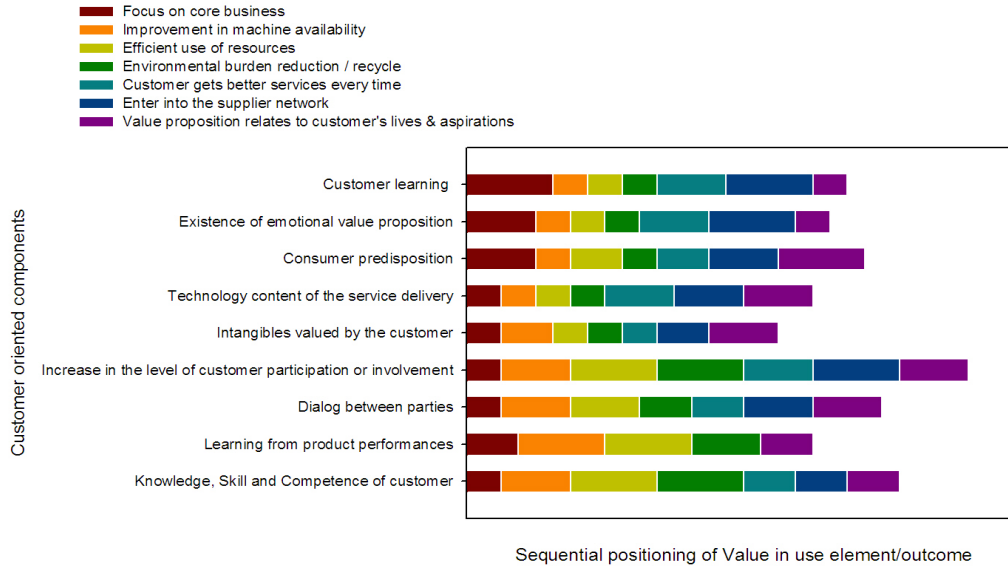


Figure A

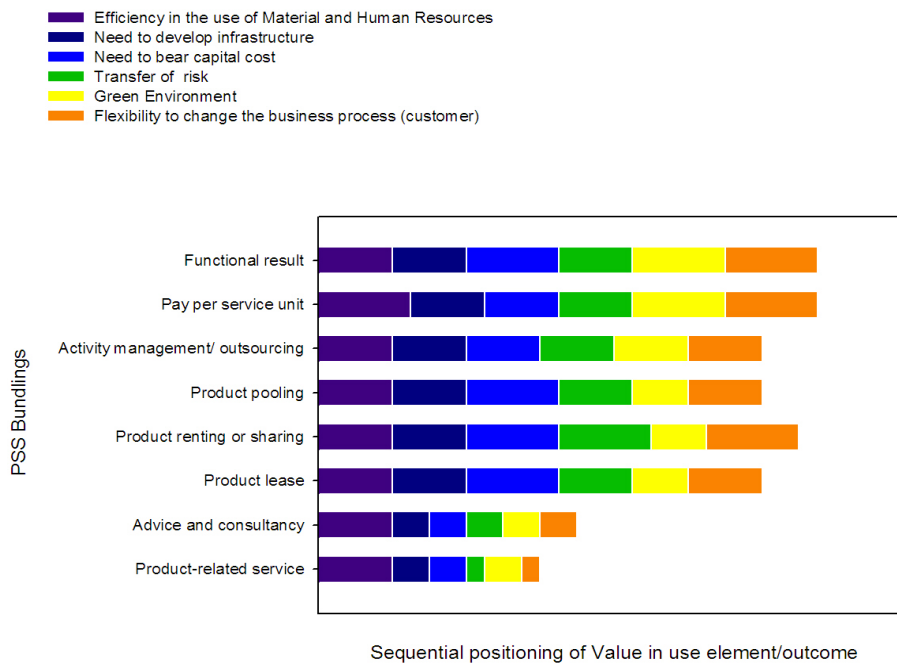


Figure B

COMMENT AND CONCLUSION

PSS is unique due to its combining of products and services. An initial overview may produce the impression that PSS is only a combination of these two offerings, but in reality it is not. PSS is the result of an evolution of business models. Whilst older business models seek profit or quality, new concepts PSS seeks value. PSS provide routes for companies to move up the value chain and exploit higher value business activities. Meanwhile, in the most developed economies, service demand is steadily increasing whereas product demand tends to remain constant. These both elements (servitization of the manufacturing sector and the increase of service demand) create a propitious environment to implement successful PSS business solutions. This product and service mix has to be supported by infrastructures and networks that will allow bringing the product and services to the customers when they are required. The problem with any value-based concept is the subjectivity of measuring value, as its appreciation differs between people. To ensure a higher level of value, companies must establish a close relationship with their customers. This is the third dimension to PSS, in addition to products and services. A PSS is not promoted as a simple service, as it is more strategic than operational, and must establish long-term partnerships.

During this thesis the researcher conducted a study to explore the outcomes of the existing literature. Then the researcher explored the literature behind PSS, to form the basis of a list of components and elements influencing the value area of PSS. After exploring a significant number of literatures, by hypothesizing three main linkages the author proposed a theoretical framework for value-in-use assessment of PSS in Business-to-Business sector aimed at filling the literature gap; and arranged the influencing components and value-in-use outcome/elements in a systematic way. The list of these components were explored and/or validated by interview with an industry expert/consultant. The findings of the research were the validation of the three hypotheses behind the proposed framework, and the validated components and a proposed value-in-use assessment framework.

INTRODUCTION

With the increase in world-wide competition, reduction in tariff and improvements in communication, manufacturer of developed nations has faced competitive pressures from low-wage economics. These economies are boosting technology capabilities whilst maintaining the advantage of lower cost. This increasing pressure on European manufacturing firms, impelling them to rethink their business strategies.

This impels manufacturers of developed economies should have to compete on the basis of innovative products and services. Firms are moving from selling products to selling whole package solutions of products plus services- Product Services Systems (PSS). PSS delivery involves the exploitation of synergies between products and services in a unique configuration as the basis of a new business proposition.

As a shift towards ‘servitization’ it concerns itself primarily with the ‘sale of use’ rather than the ‘sale of product, from here the importance to explore the value in use. Over the past two centuries several economic and marketing thinkers including Alderson (1957) and Drucker (1958) proposed an alternative view that value emerges during consumption. One such protester was Levitt (1983) who observed that only customers can assess the value in goods and services. However, no substantial progress was made in terms of defining value-in-use of PSS and the embedded-value perspective continued to dominate. Value of PSS has been always a fuzzy area because it deals with situational element and perceptions.

In this context, the aim of this thesis is to understand what are the elements behind the value-in-use assessment of PSS and how they are interacting. The main obstacle with PSS value assessment lies in the perceptions and attitudes towards it. This means that PSS, as a new concept, must face the issues what any new concept faces, including initial rejection and skepticisms.

In particular, this thesis deal with PSS in general Business-to-Business sense rather than study a specific case, and the aim is to contribute to the understanding of value derived from the PSS in the business to business sector. This work explores the prime

contributing elements for value assessment of PSS and categorizes them as the basis for a value-in-use assessment theoretical framework.

It defines the research problem through a literature review identifying the customer oriented components and the proper bundling of PSS are the basic influencing elements value-in-use outcome. Then explores these issues through interview with industry expert. In other words, the author tried to build a metrics in order to identify and analyze the value-in-use of PSS. This thesis will therefore take the approach of first understanding the elements contributing the value of PSS and defining them in a way that can be used in a value-in-use assessment metrics.

Figure -1, below shows the general steps of the work

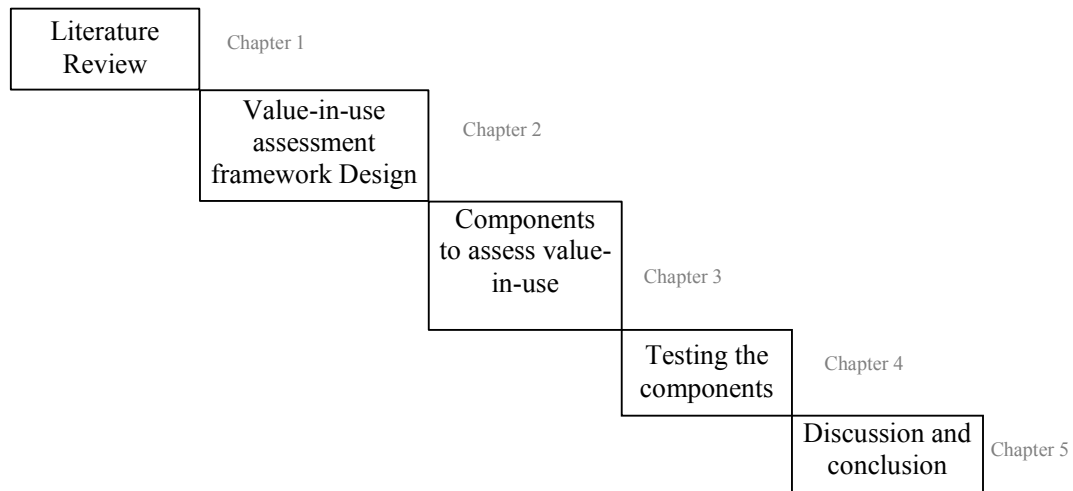


Figure 1: Outline of the thesis work

Chapter 1 presents the literature review, forms the backbone upon which this thesis is based. It covers various areas of prior research that together formulate an understanding of the research topic. Chapter 2 proposes a value-in-use assessment theoretical framework mentioning the underlying assumptions, also clarifies the essential elements (including sub-elements). Chapter 3 presents the components to assess value-in-use, which shows the arrangement of components and value-in-use outcome/elements. Chapter 4 contains the testing of the components influencing value-in-use, based on the response of industry expert. The final chapter presents a summary of the research and findings, and the presentation of recommendations for future research.

CHAPTER ONE

LITERATURE REVIEW

1.1 Concept of Product Service System

A product may be defined as an item that can be bought or sold, the item being either a good or a service. In practice, however, this definition is insufficiently accurate. People tend to classify purchases based on their tangibility, separating them into tangible products and intangible services (Parasuraman, 1985; Goedkoop, 1999). The traditional focus on products, which primarily associates growth with developing innovative products and views services only as an add-on, does no longer serve to achieve sustainable competitive advantages. For example, about 60% of the turnover is generated after the vehicle is sold (Meier, H., Sadek, K., 2009). Until recently products and services were separate, but with increasing competition manufacturers have begun to attach services to their products in order to add value to them (Kanda & Nakagami, 2006). Servitization – the process of moving towards a product-service system- is a widespread phenomenon. Fifty-eight percent of US manufacturers operate a combined service manufacturing model, and this approach is growing across other Western nations (Neely, 2007). In the evolution of servitization, many manufacturing companies have moved dramatically into services and so caused the boundaries between products and services to become blurred. PSS can be considered as a special case of servitization. PSS aspires to exploit the existing synergies between one product and the services associated with it. One important characteristic of PSS is that, it is not necessary to physically own a product to enjoy its functionalities. In PSS the ownership of the product is retained by the producer, a characteristic which generates multiple advantages such as ‘increasing the rate of utilization’ or ‘enhancing the design of the product’ - because producers have access to the product during the utilization stage which allows them to have a better understanding about the product’s performances.

There is no unique definition shared by all the experts. Because it is a relatively new concept, researchers have proposed several definitions for it, depending on each

researcher's point of view. Goedkoop (1999, p.18) defined PSS as "a set of products and services that if marketed jointly are capable satisfying a customer's need". Mont (2001, p.9) defined it as "a system consisting of products and services along with the supporting networks and infrastructure that is designed to be: competitive, fulfill user's needs and have a lower environmental impact than conventional business models". Tukker (2004, p.246) defined it as "tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs". American researchers, such as White et al., (1999) and Rothenberg (2007), defined this type of solution as an initiative rather than as a system and they call it "servicizing" which the Boston-based Tellus Institute (1999, p.2) defined as "the movement towards product based services that blurs the classic distinction between manufactured products and provided services". While all of these definitions converge, they vary with their level of comprehensiveness and whether they hold PSS to be an environmental or business-focused business model. However the majority regard PSS as a combination of products and services to satisfy the functional necessities of the customer, normally in a way that decreases the environmental impacts. The definition adopted in this thesis as: Product Service System is a bundle of products, services, relationship, communications and supporting infrastructure that satisfies customer's need, and is competitive and deliver value-in-use. It offers dematerialized solutions that minimize the environmental impact of consumption (Baines, 2007).

The term 'servitization' coined by Vandermerwe and Rada (1988), is now widely recognized as the process of creating value by adding services to products. Since the late 1980s its adoption as a competitive manufacturing strategy has been studied by a range of authors (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Slack, 2005) who have specifically sought to understand the development and implications of this concept. Its growth is driven by a saturated installed base, increasing global competition, and commoditization in product markets. Servitization is occurring across many business sectors and has implications across all organizational functions. For instance, in marketing this change has been heralded by an increased focus on services marketing, relationship marketing and experience marketing, and has seen a shift from the supplier perspective and the means of production - to a customer perspective and a focus on utilization (Gummesson, 1995). Fifty-eight percent of US

manufacturers operate a combined service manufacturing model, and this approach is growing across other Western nations (Neely, 2007).

At present there are some applications of PSS. Many of them have been working during a long time. Followings are the classical examples of PSS.

Rolls Royce: ‘Power by the Hour’ (Source: Howells, 2000)

Rolls Royce’s “power by the hour” is an example of a successful PSS offering, accounting for over 50% of Rolls Royce’s aerospace revenue (Baines et al., 2007). ‘Power by the Hour’ programs are available on several Rolls Royce engines. Instead of selling aircraft engines, Rolls Royce sells airline operators a guaranteed number of flying hours. It provides Rolls Royce’s customers a fixed engine maintenance cost while Rolls Royce covers the expense of inspecting, repairing and maintaining the engine and all the accessories. These services are provided by a world wide network of Authorized Maintenance Centers. The costs are directly linked to the number of operating hours.

Xerox: ‘Pay per copy’ (Source: Mont, 2001)

Xerox calls itself ‘the Document Company’ since 1994. This motto represents perfectly the move toward functional sales from traditional sales that Xerox started during the earliest 1990s when its products were becoming a commodity (printing machines). Currently Xerox offers a comprehensive package solution to satisfy the necessity of printing documents of its customers. Xerox performs every required activity to provide its customer the capacity of printing; from the physical product (such as the printer and consumables) to the support services (such as maintenance, overhaul and even help to increase the efficiency in the document printing process). The customers pay for the use (amount of printed document) rather than for the number of printers sold.

1.2 Drivers of Product Service System

Based on the concept of Sandra Rothenberg (2007) ‘In an increasingly environmentally conscious and cost-conscious world, suppliers can make their business both more sustainable and more profitable by focusing on services that

extend the efficiency and value of their products’, here I identified three main PSS drivers: *economic drivers* (increasing global competition and service demand), *marketing drivers* (customer relationships and product differentiation) and *socio-economic* (environmental pressures).

Increase in Global Competition - globalization and deregulation have sensibly increased the competition in the global manufacturing companies, impelling companies to rethink their business strategies.

Increase in Services Demand- Figure 2.1 illustrates how the services demand is increasing while product demand is decreasing among the Japanese consumers. This trend is not exclusive to Japan or the single consumer sector, but it is a general trend in every highly industrialized economy. This increase of the services demand can not be ignored by the manufacturing firms.

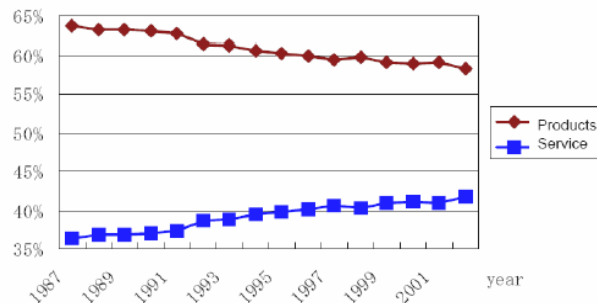


Figure 1.1: Expenditures of Consumers (singles) in Japan

(Source: 25/01/2007 Tomohiko Sakao PhD)

Customer relationships and product differentiation- Marketing opportunities are generally understood as the use of services for selling more products (Mathe and Shapiro, 1993; Gebauer et al., 2006; Gebauer and Fleisch, 2007). The service component is well known to influence the purchasing decision and assessing its importance has been a lasting tradition in marketing literature (Mathieu, 2001b; Gebauer and Fleisch, 2007). This is especially true in B2B or industrial markets where customers are described as increasingly demanding for services (Vandermerwe and Rada, 1988; Oliva and Kallenberg, 2003; Auramo and Ala-Risku, 2005; Slack, 2005). Reasons for these are pressures to create more flexible firms, narrower definitions of core competences and higher technological complexity, and these often lead to increasing pressures to outsource services (Lewis et al., 2004; Auramo and

Ala-Risku, 2005; Slack, 2005). Services are also claimed to create customer loyalty (Vandermerwe and Rada, 1988; Correa et al., 2007) to the point where the customer can become dependent on the supplier. Services tend to induce repeat-sale and, by intensifying contact opportunities with the customer, can put the supplier in the right position to offer other products or services (Mathieu, 2001b; Malleret, 2006).

Increase in Environment Issues Concern- There is a world-wide growing concern about the environmental issues. This increases the pressure on companies to be more 'green'. It is normally brought in by increasingly restrictive environmental regulation by the different governments and administrations.

1.3 Classification of Product Service System

There are several categories of PSS in the literature. At one end of this dimension, PSS consists mostly of a product with a small addition of services, while at the other end the value is more in the service than the product. Tukker's (2004) typology includes the following broad categories: (a) *product-oriented PSSs*, where a product category is augmented with some services such as a maintenance contract or consultancy; (b) *use-oriented PSSs*, where a traditional product still plays a central role, but the business model sees the supplier retain ownership of the product which is made use of in a different form, examples include a supplier who provides printers and printer maintenance to a business; and (c) *result-oriented PSSs*, where the customer and supplier agree on a result and no predetermined product is involved. Each has its own set of challenges for the servitizing manufacturer. The paradox for many manufacturers is that while servitization is perceived as providing greater marketplace security, it can also lead to greater risk of failure (Brax, 2005; Gebaur, Fleisch and Friedli, 2005; Reinartz and Ulaga, 2008). For instance, combined manufacturing-service organizations are over-represented amongst manufacturer bankruptcies (Neely, 2007).

The Dutch PSS manual (Tukker & van Halen, 2003) elaborated on this typology by sub-categorizing each category. This resulted in eight types of PSS. Product-oriented PSS includes the sub-categories of (i) *product-related services* and (ii) *advice and consultancy*. With product-related services the provider sells the product and offers

such additional services as a financing scheme, a maintenance contract, or a take-back agreement at the end of the product's life. With advice and consultancy the provider sells advice and technical support, one of the most efficient uses of the product. Use-oriented PSS includes the sub-categories of (iii) *product leasing*, (iv) *product renting or sharing*, and (v) *product pooling*. With product leasing the provider owns the product and has the ownership and responsibility of maintaining and repairing it, while the lessee has unlimited access to it. With product renting or sharing, the product is also owned by the provider, who retains all the responsibilities, but the customer's access to it is limited. Product pooling largely resembles product renting, the only difference being that the product is used simultaneously by several users. Result-oriented PSS includes the sub-categories of (vi) *activity management outsourcing*, (vii) *pay per service unit*, and (viii) *functional result*. Activity management outsourcing involves contracting a part of an activity that the provider does to someone else. With pay per service unit the clients no longer pay for the product but for its result; the most common example is most copier producers who charge clients per print rather than selling them the printer, the toner, and the paper. With functional result the client and the provider agree on the delivery of a result regardless of the means. In principle, the provider is free to use any legal means to deliver it.

1.4 Value, Value-in-Use and Value creation systems

In the PSS there is an additional customer insight element which is not captured in traditional value measures, and this includes those where the service component is not sold but offered free with a product (Brax, 2005). Traditional manufacturer tends to take a linear view of product production which is then sold (a transaction) to the customer for their use (consumption). However, when PSS deliver an integrated product and service there tends to be a series of 'touch points' between the supplier and customer. For example, monitoring of the asset in use; this may lead to servicing of the product by the supplier; and finally the supplier may take-back the product at end-of-life. While the product itself may still be sold to the customer the associated services are more closely associated with a relationship business model. Hence, servitization tends to combine both transactional and relationship business models and, most importantly, revenue, profits and cash flow arise mainly from the

relationship aspects of this model. This raises the question of the nature of customer value and how it can be assessed.

Value has several meanings in the management literature. The nature of value has been discussed and debated since Aristotle. Part of its elusiveness stems from the oblique – if not orthogonal – meanings of value that have been embedded in the foundations of economics and the study of market exchange. In general, value represents a tradeoff of the salient give and get components. That is, it is the overall assessment of what is received and what is given, though what is received varies across consumers (i.e. some may want volume, others high quality, others convenience) and what is given varies (i.e. some are concerned only with money expended, others with time and effort). Zeithaml, (1988, p14) termed value as “Perceived value is the consumer’s overall assessment of the utility of a product based on perceptions of what is given and what is received”.

Specifically, two general meanings of value, “value-in-exchange” and “value-in-use”, reflect different ways of thinking about value and value creation. The traditional view is referred to as goods-dominant (G-D) logic and is based on the value-in-exchange meaning of value. In G-D logic, value is created (manufactured) by the firm and distributed in the market, usually through exchange of goods and money (Vargo and Lusch, 2004; Vargo and Morgan, 2005). From this perspective the roles of “producers” and “consumers” are distinct, and value creation is often thought of as a series of activities performed by the firm. Consider an automobile. A manufacturing firm constructs an automobile out of metal, plastic, rubber and other parts, arranges them precisely, and packages them together. In their raw form, the metal and other components cannot be used as transportation. According to G-D logic, the firm’s production process creates value for customers through the manufacturing and delivery of an automobile. That is, the automobile manufacturing firm embeds value in the automobile by transforming raw materials into something that customers want. In this sense, value is created by the firm in the form of a good, and this valuable good is exchanged in the marketplace for money (or possibly other goods). Value is measured by this exchange transaction. Over the past two centuries several economic and marketing thinkers including Alderson (1957) and Drucker (1958) proposed an alternative view that value emerges during consumption. The alternative view,

service-dominant (S-D) logic, is tied to the value-in-use meaning of value (Vargo and Lusch, 2008a). In S-D logic, the roles of producers and consumers are not distinct, meaning that value is always co-created, jointly and reciprocally, in interactions among providers and beneficiaries through the integration of resources and application of competences.

Woodruff (1997) developed a conceptualization of value which encompassed both embedded-value and value-in-use perspectives: “Customer value is a customer’s perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer’s goals and purposes in use situations” (Woodruff, 1997, p142). The embedded-value view shows up in his inclusion of “product attributes” and “attribute performances”, however his consideration of value-in-use shows up in his inclusion of the statement that consumers evaluate “consequences arising from use” and refers to the “customer’s goals...in use situations”. Vargo and Lusch’s (2004) “new service dominant logic for marketing” brought to the fore the importance of assessing customer value not just from the customer’s perspective, but also at the point of consumption rather than the moment of delivery. Vargo and Lusch’s ‘foundational premises’ FP 6 and FP7 are, respectively, “*The customer is always a co-producer*”, and “*The enterprise can only make value propositions*”. Building on Vargo and Lusch (2004) as well as Woodruff (1997) and Woodruff and Flint (2007), Emma, Veronica and Hugh (2009) defines Value-in-use as a customer’s functional outcome, purpose or objective that is directly served through the product/service consumption. As part of this view Vandermerve, (1996) acknowledged that “value emerges in the customer’s space, rather than in the producer’s space”.

1.5 Approaching the PSS concept from different perspectives

Literature review includes a review of current literature related to Product-Service Systems (PSS). Although the literature review findings are exposed all along this chapter, this last subchapter aims to summarize them in a comprehensive list. The search contains a wide range of keywords in order to include every paper that could refer to PSS ideas whether contains explicitly PSS terms or not.

Research of T. Baines and H Lightfoot, (2009) aimed to gain a deeper understanding of the issues that arise when a servitization strategy is followed in real-life. They investigated a servitized organization case that designs, builds and delivers integrated packages. Their multi-disciplinary case-study showed how servitization necessitates companies to make modifications ranging from language they use to interact with the customers, through to their organization design. They opines that, (i) Traditionally product designs are conceptualized remotely, prototyped and refined, and then put into practice. With services, prototyping tends to take place through application. Here, one danger for engineers to attempt to apply conventional product design processes. Understanding more about how these processes differ is a considerable future challenge. (ii) As with the product designs, the organizational design required to support the value proposition also change. Along with the traditional uni-directional material flow there is also super-imposed a complex service delivery system that monitors and supports the asset in use. (iii) The metrics used to define value offered to the customer vary to reflect the changing business model, here, a future challenge is to precisely define, distinguish and communicate the key performance measures.

Mario Rese, Markus Karger, and Wolf-Christian Strotmann, (2009), analyzed Industrial Product Systems (IPS²) concept aimed to develop a method to determine quantified value of an IPS² for an individual customer over its entire life-cycle. After discussing the features of IPS², they propose a combination of the Net Present Value Approach and the Real Options Approach as a means for determining the quantified value of an IPS² in order to understand which IPS² configuration the customer will pursue. The proposed method is helpful for the supplier to differentiate between different IPS²s of its own; but it would be complicated to differentiate between different supplier's IPS² at a time period, may be because it would be difficult to consider all the possibilities along with their corresponding weights.

Baines et al. (2007) by reviewing PSS literature defined product-service system as an integrated product and service offering that delivers value-in-use, embraces a service-led competitive strategy, environmental sustainability, and the basis to differentiate from competitors who simply offer lower priced products. Authors opine the barriers as: consumers may not be enthusiastic about ownerless consumption, and the manufacturers may be concerned with pricing, absorbing risks, and shifts in the

organization, which require time and money to facilitate. A successful PSS needs to be designed at the systemic level from the client perspective and requires early involvement with the customer and changes in the organizational structures of the provider. Authors proposed an in-depth and rigorous research is needed to develop models, methods, and theories, for better understanding of PSS practices, of methods to assess value, and of organizational transitions.

An article by Andy Neely (2007) analyzed servitization with the help of data drawn from the OSIRIS database on 10,078 firms incorporated in 23 different countries. The investigation suggests three things, are: there are significant differences between countries in terms of the extent to which manufacturing has servitized – servitization is most prevalent in the US and least prevalent in China; there are twelve different forms of service offering that manufacturing firms adopt; and there is evidence that larger firms, measured both in terms of number of employees and turnover, are more likely to servitize. The author recognizes the need to explore the servitization of manufacturing at multiple levels, as: how are servitized organizations and product-service systems built and delivered? how are servitized organizations and product-service systems sustained by the network? how can the value-in-use delivered by product-service systems be assessed? how can “traditional” manufacturing firms make the transition to servitized organizations?

Reinartz and Ulaga (2008) looked service offering may seek to differentiate companies --a potentially profitable strategy. They conducted in-depth studies of 18 leading companies in a broad variety of product markets to learn what distinguished the successes from the rest. They discovered four steps to developing a profitable services capability- (i)recognize that you already have a service company; (ii)industrialize the back office; (iii)create a service-savvy sales force; and (iv)focus on customers’ processes and the opportunities they afford for new service offerings: companies may need to acquire new capabilities to take advantage of those opportunities: The industrial coatings specialist PPG had to learn how painting robots function after it offered to take over Fiat's Torino paint shop. Services can both lock in customers and help acquire new accounts. They should be developed with care and attention. Authors found that, servitized industrial companies appear to divide into two distinct groups: those that thrive under a servitization model with services

margins up to eight times those in product sales, and those who are struggling to break even because they are unable to convince customers to pay for their services. They concluded that, unfortunately, companies often stumble in the effort. The paradox for many manufacturers is that while servitization is perceived as providing greater marketplace security, it can also lead to greater risk of failure.

A conceptual article by Sara Sandstrom, Bo Edvardsson, Per Kristensson and Peter Magnusson (2008), suggested a new theoretical framework describing value in use through service experience, which dimensions influence the service experience, and how it is linked to value. The framework is placed in a context of technology-based services. They conceptualized that, “Value in use is the evaluation of the service experience, i.e. the individual judgment of the sum total of all the functional and emotional experience outcomes. Value cannot be predefined by the service provider, but is defined by the user of a service during the user consumption”. According to this article, the service experience is unique to every individual customer and the service consumption situation. And value-in-use is the cognitive evaluation of the service experience. The study is limiting only on the technology-based services, and empirical studies are needed for concerning service experiences in different kinds of service contexts.

Stephen L. Vargo, Paul P. Maglio and Melissa Archpru Akaka, (2008), emphasized on value and value-creation based on the perspective of intersection between two growing streams of thought- service science and service-dominant (S-D) logic. They argued that value is fundamentally derived and determined in *use*- the integration and application of resources in a specific context – rather than in *exchange* – embedded in firm output and captured by price. They named the value-creation configurations as service science. Service science is the study of service systems and of the co-creation of value within complex constellations of integrated resources (Spohrer et al., 2007, 2008). Service systems interact through mutual service exchange relationships, improving the adaptability and survivability of all service systems engaged in exchange, by allowing integration of resources that are mutually beneficial. They represented this interaction to express value co-creation which can be viewed as a relationship among value-in-exchange, value-in-use and value co-creation. Authors

did not discuss about the level of integration which also involved a multidisciplinary activities.

Saara Brax (2005), in her article first discusses how manufacturers becoming a service provider, next, a qualitative single-case study is reported, in which a troublesome business concept was surveyed through 35 thematic focus group interviews. The analysis revealed a set of challenges (marketing, production, delivery, product-design, communication, and relationship) that were compared to arrive at a conclusion, the paradox. She suggested that many challenges stemmed from the manufacturing-oriented way of doing business. One important is - The old transaction-focused incentive systems do not support service business. It is critical that all parties understand the concept of the service. Services require motivating the customer to the service co-production. In general, the implicit transaction-oriented business philosophy of the manufacturer does not support service offerings. In order to become a service-focused total offering, services cannot be merely added on top of the original goods-dominated total offering, but a more radical approach is necessary to question the implicit view of the world in which the company operates. Her findings further indicates that the common implicit view, that manufacturers can shift to service provision steadily, by adding service offerings to their total offering one by one, may actually be hazardous.

Oliva R. and Kallenberg R, (2003), discussed on the issues - to what extent services should be integrated, how this integration should be carried out, or in detailing the challenges inherent in the transition to services. Based on the study of 11 capital equipment manufacturers developing service offerings for their products, they tried to identify the dimensions considered when creating a service organization in the context of a manufacturing firm, and successful strategies to navigate the transition. Analysis of qualitative data suggested that the transition involves a deliberate developmental process to build capabilities as firms shift the nature of the relationship with the product end-users and the focus of the service offering. Authors identified implications of their findings for further research and practitioners.

Vargo and Lusch (2004) have inspired much recent discussion on significance of services on marketing, proposing in particular an emphasis on value-in-use, but they

neither define this term nor develop an argument as to how it can be assessed. Some see PSS as the next step in manufacturing development (White et al. 1999); others see it as an eco-friendly solution (Mont, 2001).

The above discussion indicates that, many literatures has publications referring to PSS ideas without mentioning the PSS term. Some see it as the next step in manufacturing development (White et al. 1999); others see it as an eco-friendly solution (Mont, 2001). This has also resulted in a wide range of classifications. PSS is a raw concept and these classifications have been taken from different applications of PSS. Summarizing them in a comprehensive list as, (i) PSS is a relative young term-around ten years old. Its first publication was in 1999, (ii) the term PSS has a modest penetration in the academic environment and almost no penetration at all in the industrial environment, (iii) the ideas that support PSS are numerous covered in the literature, although using a different terminology, (iv) PSS is still an emerging area of research and some disputes remain on how it should be defined and analyzed, (v) the introduction of PSS is most likely to affect purchasing partnerships, due to changes of ownership, increases in the level of dependency, or both. Although customers often see this effect as a negative one (Michelle, 1995), PSS supporters could argue that PSS is likely to increase the focus on a firm's core operations.

CHAPTER TWO

THEORETICAL FRAMEWORK TO ASSES VALUE IN USE

Economic consequences of product-service systems have to be anticipated as best as possible by the supplier and this are taken into account when offering a PSS. In the following sections, after hypothesizing the main linkages I tried to establish a framework.

2.1 UNDERLYING HYPOTHESIS

As the concept of PSS grows, challenge in assessing value-in-use also grows due to the complexity and variability of the product service arrangements, and blurring of the line between customer and supplier processes. For businesses that operate a PSS model, value-in-use metrics may prove particularly valuable for assessing customer value. Before presenting the metrics, it is essential to discuss about the underlying hypothesis.

2.1.1 Value-in-use is a processual, not perceptual phenomenon

Companies can no longer act autonomously, designing products, developing production processes, crafting marketing messages, and controlling sales channels with little or no interference from consumers. In the conventional value creation process, companies and consumers had distinct roles of production and consumption, value creation occurred outside the markets. But in the co-creation this distinction disappears. Increasingly, consumers engage in the processes of both defining and creating value.

The consumer uses the supplier's outputs as a means of satisfying their ends and the value is created/co-created and emerges as the consumer uses the offering. In business-to-business markets, co-creation occurs because suppliers need ever deeper information from customers to create value, and customers find that they need deeper information from suppliers in order to ensure supplier agility and responsiveness to their changing demands. For Rolls Royce to be able to provide the engine

maintenance and repair service it guarantees as part of its PSS, it needs to be fully immersed in its customer's business to the extent of knowing precisely its patterns of usage at any point in time anywhere around the world. In this case, the value it provides is not only the highly technical engine products that it produces, but the value-in-use of its engines which allow the aircraft operator to keep its aircraft flying safely and on time.

The traditional focus of marketing was on producing tangible goods and moving them around. The mode of engagement between the supplier and customer was via transactions where possession utility of a good filled with embedded-value was handed over from the firm to the buyer. A relational approach allows a set of interactions to take place between the customer and the supplier (including its products and processes) over a period of time. A related notion is that, customers assess perceived value over time as opposed to developing a one-off perception of the value of a particular good or service. The marketing literature has tended to over-emphasize customer value as a perceptual state and under-emphasize its process nature (Woodruff and Flint, 2006). An integrationist perspective recognizes that value creation cannot occur unless the customer appreciates the characteristics of some object (Holbrook, 1999). Significantly, a relational approach makes it important for a supplier to manage the flow of processes in order to facilitate customers' perception of value in their consumption or usage processes.

Hypothesis 1: Customer and supplier co-create value and the value-in-use is not one-off perceptual phenomenon rather processual.

2.1.2 Value-in-use is dependent upon the proper bundling of PSS and on the product support strategy

By adding something new or changing a standard product, by customizing it to fit a customer's demands, wants, and desires, one also introduces various new possibilities of product/service failure. The providers should therefore carefully design the strategy for supporting product use, to avoid errors in use and reduced reliability and quality. Product support strategy should not only be focused around product, or its operating

characteristics, but also on assisting customers with services that enhance product use and add additional value to their business processes (Tore. M, and Uday. K, 2003).

The co-creation experience of the consumer becomes the very basis of value. (C.K. Prahalad and V. Ramaswamy, 2004). If one accepts Vargo and Lusch's 'foundational premises' FP7, "The enterprise can only make value propositions", then the role of the organization is "to make value propositions to potential customers who need the benefit of the firm's competencies" (Vargo and Lusch, 2006). A firm has control over the design and development of attributes of its products or services; however, "value is not created in a factory or in the back office of a service firm" (Gronroos, 2000, p140). The majority of product and service quality measures assess product attributes and delivery systems as designed by the supplier (Emma K. Macdonald et al., 2009).

Hypothesis 2: A change in the product support strategy & bundling of PSS results in the change in value-in-use.

2.1.3 Value is use process dependent

The relativistic nature of value has been previously recognized (Holbrook, 1999, Woodruff, 2006). Value occurs relative to a consumption context (for example, the value I derive from a rental car on holiday is different to the value derived when I hire a car to attend an important meeting). The assessment of value-in-use may hence depend on the nature of the customer's use.

According to *Andreas Hinterhuber, (2008)* assessment of value-in-use is: Customers can be observed and interviewed when they are actually using new offerings to obtain estimates of customer value. Such value-in-use assessments enable assessment of customer satisfaction and customer dissatisfaction (in terms of product and service dimensions) as customers experience them in their daily use. Such assessments are useful for uncovering unmet customer needs or problems that customers would not voice in laboratory tests or in response to direct questioning. According to *E. K. Macdonald, V. Martinez and H. Wilson (2008I)*, value-in-use assessment contrasts with typical customer satisfaction surveys which focus only on – 'the components of what the company delivers in products and services – while leaving entirely implicit

what the customer’s goals are and the extent to which these are met.’ PSS providers can learn from successful pure service firms who manage their processes where customer-supplier interactions take place so that they facilitate customers in managing their own processes in a value-creating manner (Gronroos, 2006). In the example of Rolls Royce, the value created by their “power by the hour” PSS is assessed not only at each point of interaction between Rolls Royce and its customer, but also at each point in the customer’s use process - each time a plane takes off and lands safely, each time engine maintenance is completed on time, and each time an emergency repair is conducted. In addition, because Rolls Royce owns the engine but not the entire plane, they need to ensure that the aircraft operator does their part correctly in terms of correct usage and maintenance of the parts. Thus not only do suppliers need to manage their own processes, but they need to make it easy for the customer to deploy their own operant and operand resources to the creation of value-in-use.

Hypothesis 3: Value-in-use is determined relative to use context and the changes in the customers’ usage process results in the changes of the value-in-use.

2.2 DEVELOPMENT OF VALUE-IN-USE METRICS

Depending upon the hypothesis derived on article 3.1, in the figure-3.1 it is proposed the theoretical framework that shows interactions of components for assessing value-in-use.

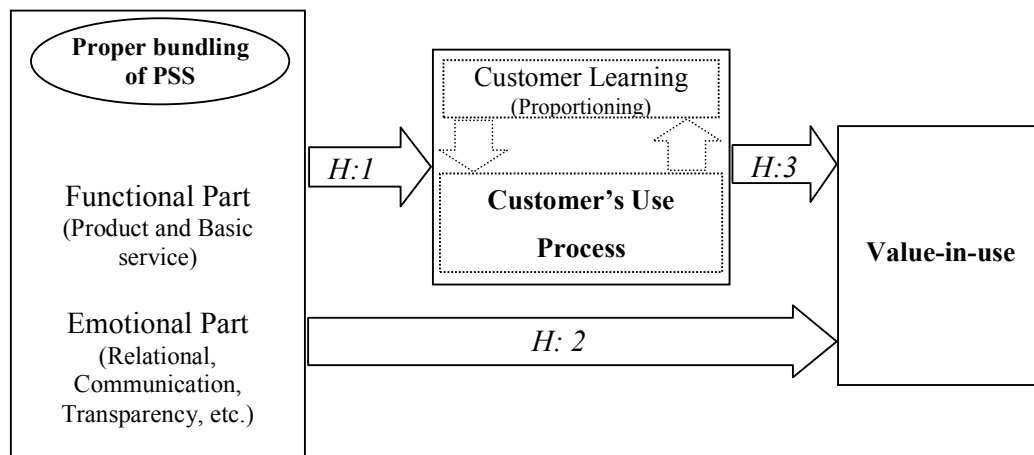


Figure 2.1: Proposed Value-in-use assessment framework

2.2.1 PSS Development

It is easy to understand that designing any product that fully matches the customers' needs, requires thorough understanding of the customers' business, processes, circumstances and environment. Through understanding how the customers create value, services that support the customers' own value creation can be offered. It is important to note that customers may not be able to perceive their needs or translate them into requirements. It is important to involve competent and demanding customers in the process, to understand their needs and wishes properly (Edvardsson et al. 1996).

Functional Part: includes what is possible to do using this; that is, it serves as a foundation for the actual value propositions made to the customer. It consists of the product/machine and the basic services like – presale, installation, commissioning, etc. With functional products, the user company focuses on core business processes (e.g. production) and need not worry about service/maintenance. In such an approach, both parties (supplier and customer) share the business risks (Tore. M, and Uday. K, 2003).

Emotional Part: The emotional value proposition is used to engineer the intended, favorable service experience and is viewed as an expression of corporate culture and strategy (Sara et al., 2008). The emotional value proposition provides the non-physical features and may also include mental images, brand reputation, and themes (Bitner, 1992; Normann, 2001; Rafaeli and Ilnai-Yavetz, 2004). It is argued that the emotional proposition is important for the service experience and user value (Hirschman and Holbrook, 1982). This symbolic meaning of the customer offering has long been practiced in advertising, consists of relationship, communication and transparency components; as an example- SLA (Service Level Agreement). Usually supplier set price initially and the customer agreed with this, but they don't know the quality of the product and/or services, e.g., what happen when the toner of the printer is out, or what happen when the cooling system of the machine doesn't operate. That is how quickly supplier will replace/repair this, e.g., average waiting time. These types of service level conditions are maintained by SLA. SLA should be measurable and quantifiable. SLA is an indicator of service and quality. Depending upon the

agreement, this will impact on value-in-use outcomes to a higher to moderate to low level.

Product support strategy: Over the past decade the scope of product support strategy has widened from installation, commissioning to documentation, logistics, software, telephone support, etc. (Wilson et al., 1999). Product support needs are dependent on product characteristics, customer's skills and capabilities, and the environment in which the product is going to be used. As customer satisfaction is crucial to business success; these strategies should be aligned to customers' needs. For the company to stay competitive it is necessary to deliver products with documented and predictable quality, reliability, supportability, and maintainability. Services intended to support the customer, are related to improving the customer's accessibility to product function, efficient and effective use of it, and retrieval of performance attributes.

Lack of user understanding of product capabilities, and a difficult user interface, reduces the user's capability to utilize the product fully. The result can be a very dissatisfied customer. Incorrect use can also lead to increased maintenance, faster degradation, wear and tear, increased warranty costs for the manufacturer. In the worst case, it can lead to accidents, reduced safety, and damage to health and environment. Training of users and operators improves their ability to correctly apply/use and maintain the products and, not least, increase user satisfaction. The ability to take full advantage of product capabilities and capacities, and to obtain maximum product value, also increases.

2.2.2 Customers' Use Process

Throughout the total life cycle of the product suppliers offers potential services. The importance of recognizing customer processes rests with the need to develop a full understanding of where a supplier's offering fits within the customer's overall activities. Customer value creating processes should not be viewed in the traditional 'engineering' sense, but as dynamic, interactive, non-linear, and often unconscious processes. (Payne, et al., 2008). Korkman (2006) suggests that the customer engages in practices; building on the ideas of Reckwitz (2002) and Schatzki (2001), he defines practice as a set of routinized actions which consist of tools, know-how, images,

physical space, and an active player who is willing to carry out and carry on the practice. Korkman argues that value is embedded in customers' practices and that this value can be enhanced through positive interventions or further development.

From the supplier's perspective, creating value for the customer begins with an understanding of the customer's use processes. Storbacka and Lehtinen (2001) argue that customers produce value independently, but with the support of the supplier. According to Payne, Storbacka & Frow; (2008) this process involves: a review of co-creation opportunities; planning, testing and prototyping value co-creation opportunities with customers; implementing customer solutions and managing customer encounters; and developing metrics to assess whether the enterprise is making appropriate value propositions. A recursive process of organizational learning and knowledge management places continual emphasis on knowledge as the fundamental source of competitive advantage. Payne, Storbacka & Frow; (2008) consider that this represents a substantial advance on the traditional perspective of customer orientation, at least as practiced by many large organizations.

Planning, implementation and metrics: In traditional business strategy models, suppliers make decisions and choices about which core business or product category they should be operating in. The view is clearly *inside-out*, as it is based largely on the understanding of current organizational competencies. In S-D logic, business strategy starts by understanding the customer's value creating processes and selecting which of these processes the supplier wishes to support. The positioning within the customer's processes defines the support and thus the scope of the value proposition. Planning for co-creation is

outside-in as it starts from an understanding of the customer's value-creating processes, and aims at providing support for better co-creation of value. Value co-creation demands a change in the dominant logic for marketing from "making, selling and servicing" to "listening, customizing and co-creating".

S-D logic emphasizes knowledge as a key operant resource. Mokyr (2002) has suggested that knowledge is composed of two parts: propositional knowledge, which is abstract and generalized; and prescriptive knowledge, "...which is often referred to as techniques." These 'techniques' "...are the skills and competences that entities can

use to gain competitive advantage” (Vargo and Lusch 2004a, p. 9). Knowledge about customers’ value-creating processes should not be based solely on hard data such as customer satisfaction measures, but should incorporate a deep understanding of customer experiences and processes. Organizations might be well advised to design their knowledge management activities and infrastructure around identified value co-creation processes, rather than around information technology capabilities. Payne, Storbacka & Frow; (2008) suggest a restructuring of knowledge management architecture with systems built around customer processes and experiences rather than products.

Several techniques for mapping customer use processes have been suggested by researchers; these draw on concepts from industrial engineering, flowcharting and business process re-engineering. They include: process mapping, customer activity cycles, service-blueprinting, activity mapping, and customer–firm touch point analysis (e.g., Shostack 1984; Kingman-Brundage 1989; Grönroos 2003; Sawhney et al. 2004). The purpose of these techniques is to highlight opportunities, identify failure points, improve service enhancement, re-engineer processes, and support differentiation. Investigations into value co-creation in business-to-business contexts suggest that mapping customer processes is more complex in such markets—although customers here may be more knowledgeable about their own value-creating processes. The supplier’s motivation should be to improve customer practices in order to build value for the customer and a more valuable role for itself in the customer’s activities.

2.2.3 Influencing Factors of Customer’s Use Process

Customer’s use process is influenced by the following issues. That is, the firm should take into account these points, to model the customer’s use process.

(i) Knowledge, Skill and Competence:

According to Senker (1995), knowledge implies “understanding”, whereas skill means “knowing how to make something happen”. Competence, in turn, differs from

skill in that it requires “the use of situation-specific information”, whereas skills do not (Kirschner et al., 1997).

One key aspect of the customer’s ability to create value is the amount of information, knowledge, skills and other operant resources that they can access and use (Normann, 2001).

The quality and applicability of equipment has utmost importance to the customers for knowledge development, as both have a strong influence on how smoothly they can run their operations without process failures. Emphasis should be placed on the development of customer knowledge among the R&D personnel who are in a position to influence the customers’ perception of equipment quality through design of user interfaces, operating procedures, parts and components. (Paloheimo et al., 2004)

Knowledge management: Knowledge management is how easily they can be developed, when needed. Customer knowledge is acquired by supplier organizations through customer-visits by development, marketing and sales staff; through customer visits to supplier site; through induction programs and training and through self-study. Acquisition, development and dissemination of customer knowledge should be encouraged and the management should reward individuals for excelling in this.

Knowledge, skills and competence of customers are not only about the offered component/product, but about the whole system and process. Supplier task should be to create an environment for continuous development of these attributes of the customers.

(ii) Learning from product performance:

Product performance influences the customer’s process in such a way that the customer is able to utilize available resources more efficiently and effectively.

How can suppliers’ company manage this: Customer Usage Profiling (CUP) is a data acquisition and analysis methodology used to define the performance of products while in the hands of the customers. CUP captures unbiased, real-world data while the product is in service, e.g., if the supplier can set sensor in the dashboard or in the engine- they can get real data during use and/or at some specified time. This process provides a true picture of product performance outside the confines of a traditional

laboratory environment. Profiling activities involving direct measurements and statistical analysis can take the guesswork out of product development.

This analysis is widely used by the product development team and they are more conscious about the product features. Data from a CUP program, coupled with the appropriate analysis, can be used to answer many questions regarding a product's performance. This type data can be used for the analysis of customer usages, e.g. level of understandings about the product, their expectations, etc.

(iii) Dialog:

In G-D logic, customers are usually viewed as operand resources to be acted upon—that is, to be segmented, targeted and penetrated through promotion. In S-D logic, the customer is an operant resource and someone with whom the firm can co-create value. When the customer and the supplier co-create the service solution, effective dialogue between parties is a prerequisite for successful cooperation. Ballantyne and Varey (2006) persuasively argue for a dialogical orientation so that value is co-created via dialog and learning.

A productive dialogue is marked by factors such as

- Careful listening,
- Responsiveness to what the other party says,
- Attempts to make assumptions explicit, and
- Eagerness to learn from the other (Jaworski and Kohli 2006, 112-3).

Customer's use process is positively affected by the development of a dialog between supplier and customers; that is founded on trust, learning together, and adaptation to each other.

(iv) Level of participation or involvement:

The level of customer participation required in a service experience varies across services as shown in Table 1. In pure service and customer care service, customer participation is usually low; e.g., providing plant and flower by interior landscaping services. Once the service has been ordered, little is required from the user other than

to open its doors or provide access to the service provider to move plants in and out. In other cases, customer inputs are required to aid the service organization in creating the service --moderate level of participation. Inputs may include information, effort or physical possessions.

Table 2.1: Level of customer participation across different services

	Low	Moderate	High
Nature of service	standardized	Customized	customized
Provision of service	Purchase not required	purchase required	purchase required + active participation
Requirements	Payments	payments + inputs	payments + inputs + co-production

Source: Adapted from Bitner et al. (1997)

In some situations, customers can actually be involved in co-creating the service -- high level of participation. For such services, customers have essential production roles that, if not fulfilled, will affect the nature of the service outcome. All forms of education, training and health maintenance fit this profile. Unless the customer does something the service provider cannot effectively deliver the service outcome (e.g. studies, exercises). In a business-to-business context, examples of services that require little participation are less common. (Bitner, et al., 1997)

Similarly, an organization seeking training services for its employees will need to help define the nature of the training, identify the right employees for the training, provide incentives for them to learn and facilitate their use of the training on the job. If the organization does not do this, it and the employees involved will not receive the full benefits of the service.

The effectiveness of customer involvement at all of the levels will impact organizational productivity and ultimately quality and customer satisfaction.

Customers' roles: *Customers as contributors to quality, satisfaction and value.*

Effective customer participation can increase the likelihood that needs are met and that the benefits the customer is seeking are actually attained. Customer is an integral part of the service and unless he/she performs his/her role effectively, the desired service outcome is not possible. This is true for an organizational customer seeking consulting services. Unless the organization uses or implements the advice it has received, it cannot expect to get the full value of the service. Recognizing this, many

management consultants now get involved in teaching customers to use the information they provide.

In addition to contributing to their own satisfaction by improving the quality of service delivered to them, some customers simply enjoy participating in service delivery. These customers find the act of participating to be intrinsically attractive (Bateson, 1983, 1985; Dabholkar, 1996).

(v) Types of service provided and Target of the service:

In Schmenner (1986), services are categorized with the amount of labor intensity in addition to interaction and customization, which can be seen similar to customer specificity of the service. According to Schmenner, services are divided to *Service Factories* with low customer interaction and low labor intensity, *Service Shops* with high interaction and customization but low labor intensity, *Mass Services* with low interaction and high labor intensity, and finally *Professional Services* with both high interaction and labor levels. Most long-term B2B service, such as repair, maintenance and operating service contracts, fall into either *Service Shop* or *Professional Service* category. In both of these, the level of customization and the importance of a single customer are important. Some industrial services, e.g. complex repair and testing services can be better understood as *Service Shops*, that is, they are more capital than labor-intensive, while other service activities, such as plant optimization or consultation require higher levels of labor interaction in the delivery and are therefore closer to *Professional Service* definition.

According to Paloheimo et al. (2004) industrial services are directed at -

1. *Equipment*: Proper and economical use of the delivered equipment.
2. *Process*: Optimal operation of the process that the delivered equipment is part of.
3. *Business*: The customer's ability to conduct business optimally.

As the target of industrial services varies, it will affect customer's use process differently. That is, equipment oriented services are different from process oriented services; and the equipment and the process influences customer's use process differently.

(vi) Intangibles valued by the customers:

Some factors are critical to the customer, e.g. time, perceived respect for the customer, attitude of service provider. Such critical components can represent a significant portion of service value. Example: a customer may enjoy unhurried shopping in a shop. He/she may have spent an hour of personal time looking, studying, and selecting items. In this phase for the customer, time was not critical. At the cash register, he/she waits what seems like endless minutes while the cashier replaces the tape, calls for cheque approval, or waits for change. The total time at the register is very short relative to the shopping time. However, it is critical time, since the customer did not select or welcome that use of time. Likewise, in the B2B services, response time is very important for a customer as well as a supplier.

(vii) Technology content of the service delivery:

Technology continues to change the delivery function of companies and to affect customers' usage decisions. Understanding how customers react to the technology-content of service channels and decide how to use the delivery channels of the firm is a key asset for achieving profitability and differentiation. Despite the development of new technology-based service delivery, there is limited knowledge about how customers react to choose and use these channels.

The context in which decisions are taken is changing, as technology developments increasingly allow for remote service provisions. The replacement of human service by a technology usually requires both the development of new knowledge and behavior associated with the service, and also increased customer participation and responsibility in the production of the service. How customers react to this 'technology infusion' (Bitner et al., 2000) is something that needs to be understood so that firms may benefit from the technological element in their service provision.

(Branca, A.S., 2007) proposed a model to explain consumer decisions on usage of technology-based channels. It is assumed that consumer behavior is driven by affective and cognitive factors.

Affective Determinants

Enjoyment with technology: Dabholkar (1996) found a positive relationship between expected enjoyment from using a technology-based self-service option and expected service quality. A consumer's enjoyment with technology will influence the likelihood of that consumer using more frequently technology-based service deliveries.

Enjoyment with participation: A consumer's enjoyment with participation will influence the likelihood of that consumer using more frequently technology-based service deliveries.

Cognitive Determinants

Perceived ease of use: If an innovation is perceived as complex to use, that will undermine its likelihood to be adopted. Similarly, if an innovation is perceived as easy to use, that will enhance its adoption (Davis, 1989; Rogers, 1995). Te'eni (1989) also concluded that perceived complexity affects the decision maker's actions and performance.

Perceived service quality: Service quality is considered to be a cognitive evaluative element that influences the usage decision for both interpersonal and technology-based encounters (Gronroos, 1988; Berry and Parasuraman, 1991). The dimensions of service quality modeled are the ones considered in Parasuraman, Zeithaml, and Berry's research (1988), that is, reliability, responsiveness, assurance, empathy and tangibles. A consumer's perception of service quality will influence the likelihood of that consumer using more frequently the delivery channels of the firm.

(viii) Consumer predisposition: (e.g. personality, attitudes, and values)

Consumer predisposition may be difficult to change, the service provider must recognize these factors and how they could be managed.

2.2.4 Contribution of Customer Learning

This is the most significant factor as the results of the customer learning process are manifested in changes within the customer's attitudes and preferences. For example, if a supplier's superior value proposition leads to its acquisition of a customer, and as a result of 'value-in-use' the customer has better experiences than with other

suppliers, the customer will typically develop a preference for that supplier and engage in repeat purchase (Adrian, et al., 2008).

S-D logic suggests relevant meanings are created by the experiences a customer has over time. The customer's experience of a supplier and its products is a culmination of the customer's cognitions, emotions and behavior during the relationship over life-cycle. These elements are interdependent and involve the customer in thinking, feeling and doing as an integral part of their role in value co-creation. Importantly, the relationship experience leads to customer learning. By understanding the customer cognition, emotion and behavior in this broader experiential sense, the supplier can shift the focus of marketing communications from attention seeking to dialog with customers in support of their experiences and learning processes. The supplier can support customer learning by developing processes which take into account the customer's capability to learn.

Customer learning can take place at differing levels of process complexity. Payne, Storbacka & Frow, (2008) distinguished customer learning as: *remembering*, *internalization* and *proportioning*.

Remembering: This is a simple form of learning and it is about customer attention rather than a competence to process emotions and information. Traditionally, marketing communication has focused on remembering.

Internalization: The second level of customer learning is internalization. During this process customers interpret and assimilate messages and experiences. The customer is usually prompted to take some kind of stand, which is often based on the emotions they experience in relation to the message. Internalization is common in traditional brand-building activities which aim to build consistent and memorable customer associations with a product or brand identity.

Proportioning: Argyris and Schön (1978) termed the third and more complex form of customer learning- 'proportioning'. Proportioning is a form of 'double-loop learning'. It involves the customer taking 'one step backward' to reflect on their own processes and how they engage in practices involving a supplier. Such reflection may cause

them to change their behavior by performing new activities or disengaging from existing practices, and to use resources in new ways. This usually results in customers not only fully understanding the supplier's value proposition and being attracted to it, but also engaging in new types of behavior in terms of how the value proposition relates to their lives, objectives and aspirations. Thus, this category of learning plays an important role in customers' use process.

2.2.5 Value-in-use Goal/Outcomes

The followings are the most significant value-in-use outcomes. Supplier should have to quantify the extent to which these are met, as the changes in customer's goals indicate changes in the value-in-use.

(i) *Focus on core business* – In the Product-Service System the suppliers take much more responsibility for the day-to-day running of the delivered product (e.g. printer or machine). The purchase of PSS solution freed their users of performing many activities associated with the ownership of a product, for example: maintenance. A customer who purchases PSS solution does not develop the infrastructure necessary to perform these activities internally. So that user/customers can give more time on their core business.

(ii) *Improvement in the machine/product availability*: Reduction of machine downtime results in the improvement of availability.

(iii) *Periodical payment to buy the performance*: As PSS doesn't seek total investment for the product and/or service at the very beginning; customers have the opportunity to pay periodically for the performances they received. And they can invest freed capital to other sectors of the business.

(iv) *Risk shearing* (Investment risk, downtime reduction, etc): PSS ensures transferring of risk from the customers' side to the supplier side.

(v) *Efficient use of resources*: Long lasting relationship allows the improvement of efficiency of use since the supplier is able to provide advanced training and he knows

the customer business. Experienced customers tend to make fewer mistakes in their operation of the service. So productivity is improved and operating costs are reduced.

(vi) *Environmental burden reduction/recycle*: PSS's repair and maintenance activities prolong the useful life time of products, and take-back and recycling services impose a new life to certain materials and products, which will help the customer to keep environment green.

(vii) *Customer gets better service every time*: As the supplier maintains direct access to the asset they can collect data on product performance and use. Knowledge of the previous maintenance improves efficiency of service provision. Such data can then enable the improvement of performance parameters to improve machine/product efficiency.

(viii) *Enter in contact with supplier network*: As part of PSS, suppliers ensures different facilities to the customers. To maintain this, supplier establishes a supporting service suppliers network. It would be easier for the customer to remodel/improve their process and plant in future, as they are in a family of suppliers.

CHAPTER THREE

DETAILING THE THEORETICAL FRAMEWORK

This section deals with the analysis of the elements influencing on value-in-use of product-service system exploring which are the elements that represents the customer oriented components (determined by the hypothesis *one and three*) and the elements of supplier driven arrangement (determined from the *second* hypothesis point of view).

3.1 Arrangement of customer oriented components to value-in-use outcome

Table 3.1 scores the bundling of nine customer oriented components (which are responsible for the authentication of hypothesis *one and three*), against the value-in-use elements/outcomes as described in chapter three.

Table 3.1: Effect of customer oriented components on value-in-use outcome

Customer oriented components*	Value in use element/outcome						
	Focus on core business	Improvement in machine availability (i.e. reduction in machine downtime)	Efficient use of resources	Environmental burden reduction / recycle	Customer gets better services every time	Enter into the supplier network	Value proposition relates to customer's lives, objectives and aspirations
Knowledge, Skill and Competence of customer							
Learning from product performances							
Dialog between parties							
Increase in the level of customer participation or involvement							
Intangibles valued by the customer							
Technology content of the service delivery							

Consumer predisposition (e.g., personality, attitude & values)							
Existence of emotional value proposition							
Customer learning (learning from the practice involving a supplier)							

* in the next section a brief description of each of this component are given.

Key:

- ++ : Significant effect
- + : Has effect
- 0 : Indifferent
- : Low
- : Lower effect
- ? : No judgment possible

Brief descriptions for customer oriented components are given below:

Knowledge, Skill and Competence of customer: customer’s ability to create value is the amount of information, knowledge, skills and other operant resources that they can access and use. Knowledge, skills and competence of customers are not only about the offered component/product, but about the whole system and process.

Learning from product performances: Product performance influences the customer’s process in such a way that the customer is able to utilize available resources more efficiently and effectively.

Dialog between parties: When the customer and the supplier co-create the value, effective dialogue between parties is a prerequisite for successful cooperation, ultimately that will influence on the value of the customer.

Increase in the level of customer participation or involvement: In a business-to-business context, examples of services that require little participation are less common. (Bitner, et al.,1997). High level of participation customer actually is involved in co-creating the service. For such services, customers have essential production roles that will affect the nature of the value outcome.

Intangibles valued by the customer: Some factors are critical to the customer, e.g. time, perceived respect for the customer, attitude of service provider. In the B2B

services, response time is very important for a customer, which will affect on his value outcome.

Technology content of the service delivery: Technology continues to change the delivery function of companies and to affect customers' usage decisions. The replacement of human service by a technology usually requires both the development of new knowledge and behavior associated with the service, and also increased customer participation and responsibility in the co-creation of the service.

Consumer predisposition: personality, attitude & values of customer will impact on the value. Consumer predisposition may be difficult to change.

Existence of emotional value proposition: The emotional value proposition provides the non-physical features and may also include mental images, themes, brand reputation, etc. It is argued that the emotional proposition is important for the service experience and user value (Hirschman and Holbrook, 1982).

Customer learning (learning from the practice involving a supplier): The relationship experience leads to customer learning. Customer's experience of a supplier and its products is a culmination of the customer's cognitions, emotions and behavior during the relationship over life-cycle. These elements are interdependent and involve the customer in thinking, feeling and doing as an integral part of their role in value co-creation. It involves the customer taking 'one step backward' to reflect on their own processes and how they engage in practices involving a supplier. Such reflection may cause them to change their behavior by performing new activities or disengaging from existing practices, and to use resources in new ways, ultimately plays an important rule in value-in-use.

3.2 Arrangement of PSS bundling (different service choices) to value-in-use outcome

Table 3.2 below, scores the bundling of eight generic types of PSS (which are arranged depending upon second hypothesis), against the value-in-use

elements/outcomes as described in chapter three. Of course, for individual PSS's a tailored and quantitative evaluation is necessary to find out whether it is profitable business.

Table 3.2: Effect of the bundling of PSS in the value-in-use elements

	PSS Model	List of Services*	Value in use element/outcome					
			Efficiency in the use of Material and Human Resources (customer's organization)	Need to develop infrastructure (in customer premise)	Need to bear capital cost (Initial investment Vs Periodical investment)	Transfer of risk	Green Environment (environmental burden reduction)	Flexibility to change the business process (customer)
Product content	Product oriented	Product-related service ¹						
		Advice and consultancy ²						
Service content	Use oriented	Product lease ³						
		Product renting or sharing ⁴						
		Product pooling ⁵						
	Result oriented	Activity management/ outsourcing ⁶						
		Pay per service unit ⁷						
		Functional result ⁸						

(*List of services obtained from the paper: 'Eight types of product-service system: Eight ways to sustainability', 2004)

¹⁻⁸ : A brief description of different types of PSS are depicted next.

Key:

- ++ : Higher / Improved
- + : High
- 0 : Indifferent
- : Low
- : Lower Impact
- ? : No judgment possible

Open question: Please give your opinion on- what is the influence of *quality of interaction and relationship experience* on customer satisfaction and customer value

¹ *Product related*: Producer or supplier provides services such as, a maintenance contract, a financing scheme or the supply of consumables during the use phase of the product; but also a take-back agreement when the product reaches its end of life. That is functional part is prominent in this type of PSS.

² *Advice and consultancy*: Service provider gives user the knowledge to use more efficiently the product. This can include, for example, advice on the organizational structure of the team using the product, or optimizing the logistics in a factory where the product is used as a production unit. In this type there is an introduction of emotional part with the functional one.

³ *Leasing*: The product does not shift in ownership. The provider holds the ownership, and is also often responsible for maintenance, repair and control. The lessee pays a regular fee for the use of the product; in this case users have unlimited and individual access to the leased product. From this type of PSS (to the type 8) there is a gradual increase of emotional part with the functional part.

⁴ *Product Renting or Sharing*: Here also, the product in general is owned by the provider, who is also responsible for maintenance, repair and control. The user pays for the use of the product that can be own by a third company (renting) or the collective of users (sharing). The same product can not be used simultaneously but sequentially.

⁵ *Product Pooling*: This greatly resembles product renting or sharing. However, here several users can use simultaneously the product.

⁶ *Activity management/ outsourcing*: Part of an activity of a company is outsourced. Since most of the outsourcing contracts include performance indicators to control the quality of the outsourced service, they are grouped under result oriented services. One traditional example is to outsource the cleaning service.

⁷ *Pay per service unit*: The user no longer buys the product, only the *output* of the product according to the level of use. Well known examples in this category include

the pay per-print formulas now adopted by most copier producers. Following this formula, the producer takes over all the activities that are needed to keep a copying function in an office available (i.e. paper and toner supply, maintenance, repair and replacement of the copier when appropriate).

⁸ *Functional result*: Provider has to provide a specific result. The provider is free to choose the most appropriate approach to deliver the result. The payment is not linked with number of service provide, its quality or the resource consumed but with the performance of the result. In this type of PSS emotional part is prominent.

CHAPTER FOUR

VALIDATION OF THE THEORETICAL FRAMEWORK

In this stage the author tried to determine whether the customer oriented components and the service elements for bundling the PSS presented in chapter 2 and chapter 3 are applicable or acceptable in PSS value-in-use assessment, by submitting the developed detailed theoretical framework through an interview with industry expert. The participant was industry consultant and PSS researcher. The significance of choosing/selecting the consultant for this study was, this person has cumulated knowledge about how the companies/industries look at PSS. This study conducted with a structured interview and the duration was two and half hours.

In the next sections, the author briefly explained each area in order to provide a better understanding of these findings.

4.1 Analysis of key customer oriented components influencing on value-in-use outcome

Each of the customer oriented component was presented in the questionnaire and discussed with the participants in regard to which degree it is applicable. The interview outcome is presented in the table below.

Table 4.1: Plot of scores of customer oriented components on value-in-use outcome

Customer oriented components*	Value in use element/outcome						
	Focus on core business	Improvement in machine availability (i.e. reduction in machine downtime)	Efficient use of resources	Environmental burden reduction / recycle	Customer gets better services every time	Enter into the supplier network	Value proposition relates to customer's lives, objectives and aspirations
Knowledge, Skill and Competence of customer	-	+	++	++	0	0	0
Learning from product performances	0	++	++	+	?	?	0

Dialog between parties	-	+	+	0	0	+	+
Increase in the level of customer participation or involvement	-	+	++	++	+	++	+
Intangibles valued by the customer	-	0	-	-	-	0	+
Technology content of the service delivery	-	-	-	-	+	+	+
Consumer predisposition (e.g., personality, attitude & values)	+	-	0	-	0	+	++
Existence of emotional value proposition	+	-	-	-	0	+	++
Customer learning (learning from the practice involving a supplier)	++	-	-	-	+	++	-

* in the next section a brief description of each of this component are given.

Key:

- ++ : Significant effect
- + : Has effect
- 0 : Indifferent
- : Low
- : Lower effect
- ? : No judgment possible

The following list presents details of each of the components and its level of effect/influence as shown by the questionnaires' response.

A. Knowledge, Skill and Competence of customer: has significant influence on efficient use of resources and environmental burden reduction; a moderate effect on the improvement in machine availability. For other value-in-use element/outcome this customer oriented component has indifferent influence. During the designing of development program for this issue, suppliers should focus on the most significant elements.

B. Learning from product performance: according to the expert opinion this component has significant influence on- improvement in machine availability, efficient use of resources; moderate influence on only in the environmental burden reduction; and for other outcomes influence is indifferent and/or not possible to judge clearly. This highlights that, customer tries to get better services or use the resources in as much better way as possible learning from the product performance; supplier task should be to create environment for this.

C. Dialog between parties: has moderate influence on four elements of value-in-use outcome, these are, improvement in machine availability, efficient use of resources, enter into the supplier network, and value proposition relates to customer's aspirations; has a low influence in- focus on core business of customers'. Arranging or designing of dialog should focus on improvement (or, how to better manage) of the above mentioned four elements.

D. Increase in the level of customer participation: has significant effect on three elements as, efficient use of resources, environmental burden reduction, and enter into the supplier network. And has moderate effect on three elements as, improvement in machine availability, customer gets better services every time, and value proposition relates to customer's lives and aspirations. In general, this component influences on the value-in-use outcome elements at a balanced order than other customer oriented components.

E. Intangibles valued by the customer: has moderate influence only on the element: value proposition relates to customers' lives and aspirations. For most other element of value-in-use this component has low influence. Though this factor influences at a low level to most on the elements, by definition this component is directly related to the service part of the PSS; and its main function is to evaluate directly or indirectly the lives, objectives and aspirations of customer.

F. Technology content of the service delivery: has moderate influence on three value-in-use elements- customer gets better services every time, enter into the supplier network, and value proposition relates to customer's lives and aspirations; for all other outcome elements it has low influence. This issue/component is mainly dependent on particular user/customer type.

G. Consumer predisposition: has strong positive effect in the element- value proposition relates to customer's lives and aspirations; moderate influence on two of the elements as, focus on core business (of the customer), and entering into the supplier network; for other four outcome elements this component has low and indifferent influence. By nature consumer predisposition may be difficult to change,

but, as this has significant and moderate influences on some important outcomes, supplier/provider should include some steps to modify the consumer predisposition.

H. Existence of emotional value proposition: has strong positive effect in the element-value proposition relates to customer's lives and aspirations; moderate influence on two of the elements as, focus on core business (of the customer), and entering into the supplier network; for other four outcome elements this component has mostly low influence. This component's influence relation is similar with the customer predisposition. By nature these are the basic part of PSS and that's why they made stronger influence on customer aspirations, lives and objectives.

I. Customer learning: has strong positive influence on two outcome elements, as, focus on core business and enter into the supplier network; has moderate influence on- customer gets better services every time; and low influence on the remaining of four value-in-use outcome/elements. In this regard, suppliers' task should be to create environment for the customer to get this.

Overall the key issue with these customer oriented component is the difficulty of selecting considering good performance criteria and the prediction. Though it is easier for three or four components to choose, but for others it would be tough to make the trade-off.

Figure 4.1 below shows the overall influence level of customer oriented components on the value-in-use outcome/elements, based on the interview with industry expert. Scoring arranged from 0 to 25, with an increment of 5 for each of the higher influence. And the total is grounded on 100 percent scale. This figure shows the overall scenario only; when anyone is interested on the specific one, he/she has to look on Figure 4.2, the details of that particular customer oriented component. In this figure influence of each of the customer oriented component is added one after another.



Figure 4.1: Overall influence level of customer oriented components

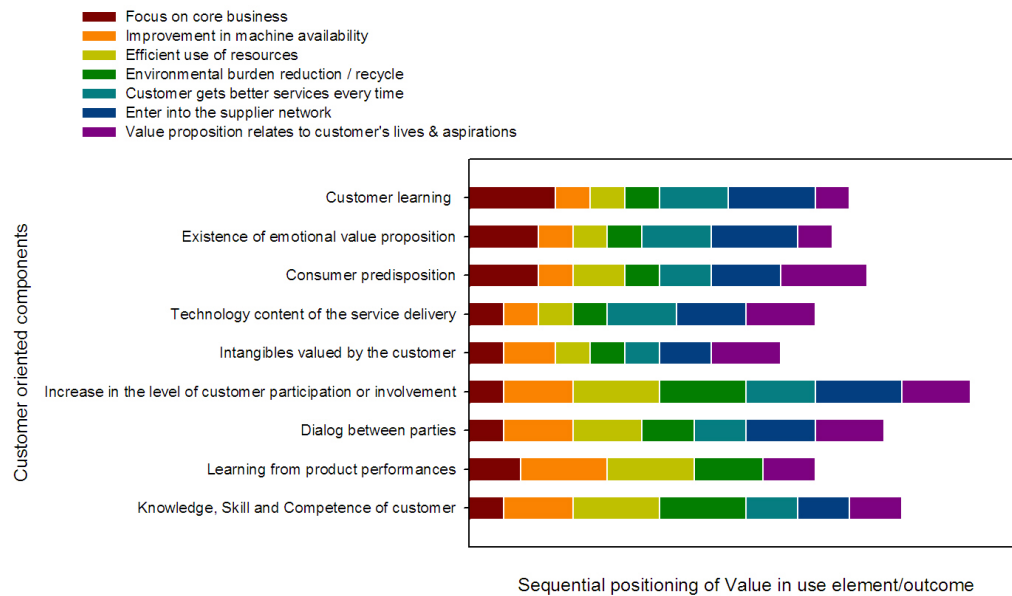


Figure 4.2: Influence level of customer oriented components by parts

4.2 Analysis of the influence of key service elements that bundles PSS

Table 3.2 presented in chapter 3, were presented as questionnaires to the industry expert in order point out the effect of the bundling of PSS in the value-in-use elements. The author briefly explained each of them in order to provide a better understanding of the elements. Table 4.2 below, scores the eight generic types of PSS against six value-in-use outcomes.

Table 4.2: Plot of scores of the bundling of PSS on the value-in-use elements

	PSS Model	List of Services*	Value in use element/outcome					
			Efficiency in the use of Material and Human Resources (customer's organization)	Need to develop infrastructure (in customer premise)	Need to bear capital cost (Initial investment Vs Periodical investment)	Transfer of risk	Green Environment (environmental burden reduction)	Flexibility to change the business process (customer)
Product content	Product oriented	Product-related service	+	-	-	--	-	-
		Advice and consultancy	+	-	-	-	-	-
	Use oriented	Product lease	+	+	++	+	0	+
		Product renting or sharing	+	+	++	++	0	++
		Product pooling	+	+	++	+	0	+
Service content	Result oriented	Activity management/ outsourcing	+	+	+	+	+	+
		Pay per service unit	++	+	+	+	++	++
		Functional result	+	+	++	+	++	++

(*List of services obtained from the paper: 'Eight types of product-service system: Eight ways to sustainability', 2004)

Key:

- ++ : Higher / Improved
- + : High
- 0 : Indifferent
- : Low
- : Lower Impact
- ? : No judgment possible

The following list presents details of each of the components and its level of effect/influence as shown by the above response. Of course, for individual PSSs a tailored and quantitative evaluation is necessary to find out whether it is profitable business.

Product related service (1) and *Advice & consultancy(2)*: both of them have high positive impact on -efficiency in the use of material and human resources of

customer's organization. For other value-in-use elements, these services are not so prominent. Thus, they provide some tangible value for the user by a more efficient use of materials and human resources.

Product lease (3) and Product pooling (5): both of this two has strong positive impact on the capital cost sharing, and positive influences on other four elements – efficiency in the use of material and human resources of customers' organization, the requirement of infrastructure development in customer premise, magnitude of the transfer of risk, and the flexibility to change the customers' business process.

Product lease has some tangible value for the user, since various costs and activities are shifted to the provider. User loyalty might improve (as the product plus maintenance, etc. is provided).

Product renting or sharing (4): has strong positive impact on the responsibility of capital cost, magnitude of the transfer of risk, and the flexibility to change the customers' business process. And positive influences on other two elements – efficiency in the use of material and human resources of customers' organization and the requirement of infrastructure development in customer premise.

In general product renting or sharing demands a tangible sacrifice by the user. He/she now has to put time and effort into getting access to the material artifact. Compensation can come from the fact that the customer no longer needs to bear the capital cost of the product.

Activity management/outsourcing (6): has equal high impact on all the six value-in-use elements. Activity management shifts personnel and material costs from the user to the provider, who has to make gains by organizing the outsourced tasks more efficiently by specialized knowledge.

Pay per service unit (7): has higher positive impact on three of the elements of value-in-use outcomes, namely, efficiency in the use of material and human resources, flexibility to change the business process (customer's), and helpful to keep environment green. For other three elements (need to develop infrastructure, need to bear capital cost and the transfer of risk) the impact is high positive.

There is a clear tangible value for the user since various activities (e.g. maintenance) are outsourced to the provider. Since the product stays in ownership of the provider, additional cost the provider is needed, vice-versa lower for the customer to bear.

Functional result (8): has higher positive impact on three of the elements of value-in-use outcomes, namely, need to bear capital cost, flexibility to change the business process (customer's), and helpful to keep environment green. For other three elements (efficiency in the use of material and human resources, need to develop infrastructure, and the transfer of risk) the impact is high positive.

Since the same function is offered, in principle the user could give it the same tangible value. Intangible value is another matter though, and cannot be judged without defining the specific system. In principle, the provider could try to provide a solution with much lower input of human resources and materials, especially in comparison with the *pay per service* unit.

Overall the key issue with these PSS bundling is the difficulty of agreeing with the user a set of good performance criteria, and the prediction of, or influence on, the behavior of the user within reasonable margins. This risk element is particularly relevant for the functional result type of PSS, since the provider takes the overall liabilities that in a product-based system were with the user.

Figure 4.3 below shows the overall influence level of different PSS type, from the interview with industry expert. Scoring arranged from 0 to 25, with an increment of 5 for each of the higher influence. And the total is grounded on 100 percent scale. This figure shows the overall picture only; when anyone is interested on the specific one, he or she has to look on the details of this type of PSS bundling. Figure 4.4 shows the details of each particular PSS bundle's influence on value-in-use outcome/elements. In this figure influence of each of the service component is added one after another.

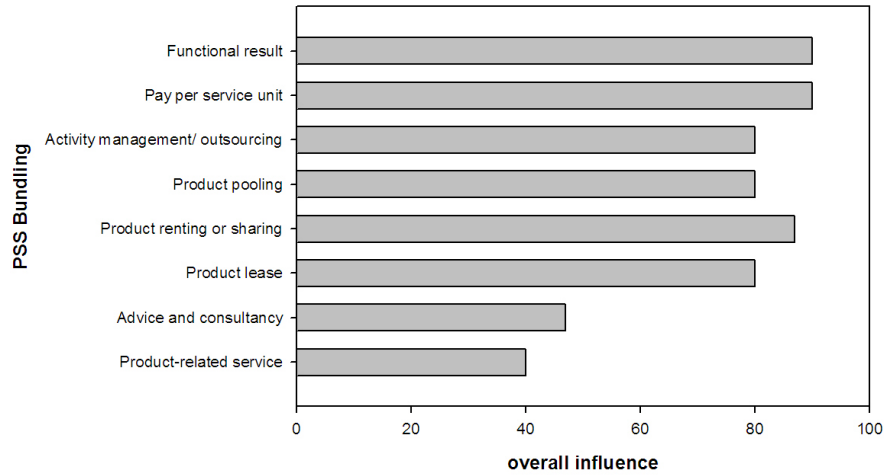
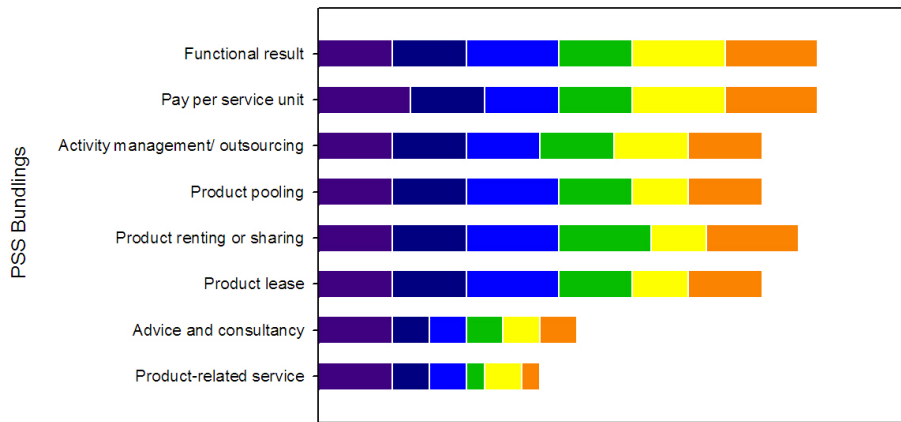


Figure 4.3: Overall influence level of different PSS type

- Efficiency in the use of Material and Human Resources
- Need to develop infrastructure
- Need to bear capital cost
- Transfer of risk
- Green Environment
- Flexibility to change the business process (customer)



Sequential positioning of Value in use element/outcome

Figure 4.4: Influence level of different services on value-in-use outcome by parts

The intangibility of services always has a risk factor associated with it. This intangibility creates difficulty in evaluating product performance. It also contributes to difficulties in market forecasting. Furthermore, customers' expectations in services are always more than what is offered, as the intangibility makes it easy to raise the bar.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Author's Perspective

During the last ten years the increasing global competition is steadily increasing the pressure on the manufacturing sector. Lower-wage economies manufacturers are catching up the European market while maintaining their competitive advantage of lower wages. Innovative manufacturing firms could adopt a Product Service System (PSS) approach to gain competitive advantage. PSS defenses that frequently a pure product market approach is not the best way of satisfying the necessities and expectations of the customers. Usually a mix of products and services (combined together in a package solution) is a more effective approach.

PSS is unique due to its combining of products and services. An initial overview may produce the impression that PSS is only a combination of these two offerings, but in reality it is not. PSS is the result of an evolution of business models. Whilst older business models seek profit or quality, new concepts PSS seeks value. PSS provide routes for companies to move up the value chain and exploit higher value business activities. Meanwhile, in the most developed economies, service demand is steadily increasing whereas product demand tends to remain constant. These both elements (servitization of the manufacturing sector and the increase of service demand) create a propitious environment to implement successful PSS business solutions. This product and service mix has to be supported by infrastructures and networks that will allow bringing the product and services to the customers when they are required.

The problem with any value-based concept is the subjectivity of measuring value, as its appreciation differs between people. To ensure a higher level of value, companies must establish a close relationship with their customers. This is the third dimension to PSS, in addition to products and services. A PSS is not promoted as a simple service, as it is more strategic than operational, and must establish long-term partnerships.

5.2 Summary of Findings

During this thesis the researcher conducted a study to explore the outcomes of the literature. The literature clearly represented the gap, that is, no substantial progress was made in terms of defining value-in-use of PSS and the embedded-value perspective continued to dominate. From that point of view the author aimed to understand, what are the elements behind the value-in-use assessment of PSS and how they are interacting. Then the researcher explored the literature behind PSS, to form the basis of a list of components and elements influencing the value area of PSS. After exploring a significant number of literatures, by hypothesizing three main linkages the author proposed a theoretical framework of value-in-use assessment of PSS in Business-to-Business sector aimed at filling the literature gap; and arranged the influencing components and value-in-use outcome/elements in a systematic way.

The list of these components was explored and/or validated by interview with an industry expert/consultant. The findings of the research were the validation of the three hypotheses behind the proposed framework, and the validated components and a proposed value-in-use assessment framework.

5.3 Critique

The main critique of this thesis is related to the limited empirical validation. For the framework to have more accurate depth, it should have been analyzed to a number of case studies. The framework should also have been validated through the discussion with the research sample including PSS researchers and industry personnel.

5.4 Recommendations for Future Work

This research provided an overview of PSS's value-in-use assessment.

- It is recommended that extended empirical validation is needed for the accuracy of the framework and the interacting components.
- It also recommends that future research regarding the PSS's value should examine the more significant components for specific type of PSS. A research

study could also be more specific by studying a single type of PSS with a single type of product or industry to form a framework, for a case study of a PSS provider.

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APPENDIX

APPENDIX 1: OUTCOME OF INTERVIEW WITH INDUSTRY EXPERT

Your Personal Information*

Participant Name:

Participant Position:

Participant Company**:

* Individual information will not be revealed. There will be no reference to a specific company or person name in the final report.

** The company/institution's name might be mentioned as in example for participant sector only.

Background and aim of this questionnaire:

This questionnaire is part of a thesis conducted by Ahmed Sayem as part of an Master of Science in Management, Economics & Industrial Engineering, at Politecnico di Milano. The topic of this research is “Assessing Value-in-use of Product Service System (PSS). There has been a raising interest in the topic of PSS in the later years. From the beginning of this century Services along with the Product, that is service throughout the life-cycle of the product becomes very much important to the customers (also in the B2B sector) - this is named by experts as PSS (product service system). In this approach supplier/producer shares more risks than earlier approach of only maintenance type service. Suppliers' task is to arrange the appropriate combination of Product & Service, and show/highlight the value for the customers for this offering. However most of the research focused on how to build a PSS, no extensive research was done in value assessing activities. And that's where this research comes in. In my current work I tried to develop a theoretical model for assessing value of PSS. This questionnaire will focus on the elements that are associated with PSS value.

What's in it for you? PSS is an emerging research area and your contribution will be to a contribution to the knowledge in that area. The thesis author will in part send a copy of the final report to all participants so that all benefit from this research.

A format of answers from industry expert, scoring the effect of customer oriented components on value-in-use outcome, is presented below:

Customer oriented components*	Value in use element/outcome						
	Focus on core business	Improvement in machine availability (i.e. reduction in machine downtime)	Efficient use of resources	Environmental burden reduction / recycle	Customer gets better services every time	Enter into the supplier network	Value proposition relates to customer's lives, objectives and aspirations
Knowledge, Skill and Competence of customer	-	+	++	++	0	0	0
Learning from product performances	0	++	++	+	?	?	0
Dialog between parties	-	+	+	0	0	+	+
Increase in the level of customer participation or involvement	-	+	++	++	+	++	+
Intangibles valued by the customer	-	0	-	-	-	0	+
Technology content of the service delivery	-	-	-	-	+	+	+
Consumer predisposition (e.g., personality, attitude & values)	+	-	0	-	0	+	++
Existence of emotional value proposition	+	-	-	-	0	+	++
Customer learning (learning from the practice involving a supplier)	++	-	-	-	+	++	-

* in the next section a brief description of each of this component are given.

Key:

- ++ : Significant effect
- + : Has effect
- 0 : Indifferent
- : Low
- : Lower effect
- ? : No judgment possible

A format of answers from industry expert, scoring the effect of the bundling of PSS components on value-in-use outcome, is presented below:

	PSS Model	List of Services*	Value in use element/outcome					
			Efficiency in the use of Material and Human Resources (customer's organization)	Need to develop infrastructure (in customer premise)	Need to bear capital cost (Initial investment Vs Periodical investment)	Transfer of risk	Green Environment (environmental burden reduction)	Flexibility to change the business process (customer)
Product content	Product oriented	Product-related service	+	-	-	--	-	-
		Advice and consultancy	+	-	-	-	-	-
	Use oriented	Product lease	+	+	++	+	0	+
		Product renting or sharing	+	+	++	++	0	++
		Product pooling	+	+	++	+	0	+
Service content	Result oriented	Activity management/ outsourcing	+	+	+	+	+	+
		Pay per service unit	++	+	+	+	++	++
		Functional result	+	+	++	+	++	++

(*List of services obtained from the paper: 'Eight types of product-service system: Eight ways to sustainability', 2004)

Key:

- ++ : Higher / Improved
- + : High
- 0 : Indifferent
- : Low
- : Lower Impact
- ? : No judgment possible

Thank you very much for your co-operation and time.

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