# People, Product and Process Perspectives on Product/Service-System Development

**Åsa M. Ericson and Tobias C. Larsson**

**Abstract**
The adaptation of Product/Service-System calls for new development models. On one side this businesses give the manufacturing firm possibilities to redesign, upgrade and replace the discrete device that provides the performance their customers are asking for. On the other side, this new situation has to address aspects that are normally not addressed in early product development, i.e., services. In this chapter, we will elaborate on product and service development processes models, as well as system models to propose a frame of reference for multiple perspectives on PSS development. These perspectives are people, product and process. Also, this chapter puts forward implications for the development of PSS models.

Keywords: Product-Service System, innovation, engineering design, development models, service perspective

## 1 Product/Service-Systems

When selling products, services are important for the customer to be able to use the device or for the device to perform well, e.g., cars need the services at gas stations and the engine needs maintenance. And, vice versa, to provide services tangible support is needed, e.g., rooms and furniture for the hotel business and phones for the telecommunication company. Thus, the integration of products and services to meet the customers' requirements is well known, but, depending on a perspective, it seems that development processes favor one of them at the expense of the other. Service literature emphasize that the discrete device is one of several elements in strategic relationships (Grönroos 2000), hence putting the customer relationship first. This is because services are activities in collaboration with customers. Product development literature points out how the product is first settled and then services take form to complement that thing (Ulrich & Eppinger 2008). In engineering industry the word '*after*market' is commonly used to describe the life of a product *after* it has been designed and developed. Calling this for aftermarket indicates that a service perspective comes in second place for engineering firms (Normann 2001). These two perspectives, product perspective and service perspective, argue that the value carrier for the customer is either the product *or* the service, yet customers tend to view their purchase from a more holistic perspective (Mello 2002). In the last decade, the vision for engineering industry is to provide their customers with functional offers, meaning that what is sold is the function or the use of the product (Fransson 2004). Hence, engineering firms' business models extend to incorporate a service perspective. This is what is commonly called a Product/Service-System (PSS) offering, and it can be described as a special case of servitization (Bains et al. 2007).

Fransson (2004) has developed a model for how the service degree increases in engineering firms, calling such offerings "functional offers". A functional offer starts from a traditional product perspective where the discrete device is supported by services (at bottom left in Fig. 1). In the next degree of functional offerings, the service part is extended with services that are not usually offered, e.g., customized offerings of expertise from production processes. Then, there are two middle degrees of offerings which put forward that the shift towards a service perspective change how the customer is invoiced, i.e., the engineering firm is paid on the basis of the performance of the device including some services, and at the next degree, *all* services are included. Here, the sharing of responsibilities to uphold the functionality of the device also comes into play.

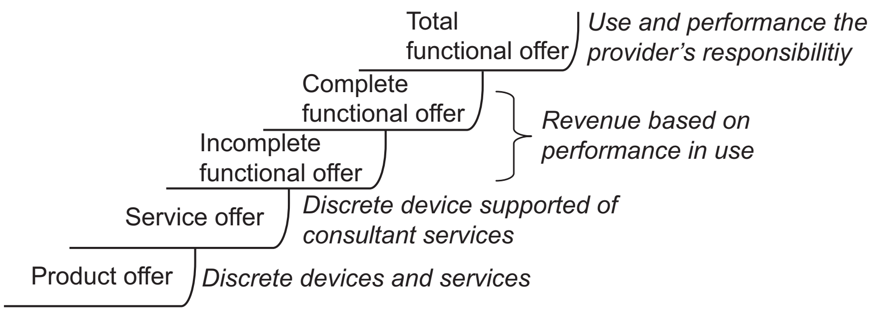


**Fig. 1.** A progress model for functional offerings, after Fransson (2004, p.128).

In a complete functional offering, the engineering firm is completely responsible for the reliability in operation of the device. On one hand meaning that if the device is not functioning, the manufacturer is not delivering what is contracted. On the other hand the manufacturer can control and eliminate risks early on. Here, the customer's usage of the device becomes important. Do they use it as agreed or not? Too much load? Other material than contracted? And so forth. Therefore, Fransson (2004) suggests that companies should aim for as complete functional offerings as possible, where he propose the engineering firm to own, use and handle the device in the customer processes as the highest degree of functional offerings (a total functional offer, at the top in Fig. 1).

Obviously, taking on functional offerings including all services insists on collaboration beyond your company's competences. This kind of business models are suggested to incorporate an organizational structure of a virtual enterprise, i.e., where the collaboration takes place cross several company boundaries (Johansson et al. 2008). There are challenges to realize PSS and provide successful functional offerings, for example, to understand the voice of the customer more profoundly than merely obtaining the requirements (Ericson 2007) and, to implement an innovation approach there is both internal and external issues to tackle (Parida 2008). These examples illuminate that additional capabilities besides the classical engineering ones are part and parcel of developing products for a successful PSS offering. Yet, if the challenges can be handled the advantages abound. For instance, the collaboration in PSS development are expected to reduce some competition through making the business relationships more stable (Alonso-Rasgado et al. 2004), also, PSS triggers changed use patterns that reduces the waste, i.e., provides for ecological sustainability (Mont 2002, Mont et al. 2006).

The integration of products and services into systems in PSS development provide for the opportunity to find a variety of solutions to meet the contracted functions, i.e., different degrees of services has an effect on the design of the product. This indicates that the guiding product development process models need to address innovation. Today, engineering firms state that they continuously on an every-day basis deal with innovation due to developing products; however such innovation is focusing on, e.g., new features on a known end-product, here called incremental innovation. As discussed above, classical product development seems delimited when it comes to manage and progress innovation in view of PSS. That is such innovation that ends in breakthrough products, here called radical innovation. A radical innovation situation has similarities with wicked problems (Rittel & Webber 1973), where several aspects are vague and not fully understood, e.g., What is going to be designed? What should it do? Who is going to use it? And, in what circumstances? (Randall et al. 2007). To deal with these questions the design task needs to be addressed from different point of views, i.e., multiple perspectives

For various development projects, distinct process models give the team guidance for how to begin and proceed, as well as pointers to what is needed to fulfill their missions. These processes, whatever they intend to finally produce, are vital. Also, there is a link between industry and applied research, to develop better products and to become better designers, the processes must be continually improved (Dubberly 2009), this motivates engineering design researchers to study them. Process models are not blueprints of reality; rather they are representations of the design world to deal with the relational complexity in the processes. In view of this, the models depend on how the team's actors interpret and perceive them (Engwall et al. 2005). Further, the logics for products and services are different, thus not straightforward to integrate. Yet, the interplay between these points of views is at the core for PSS development. One industrial challenge for turning into PSS provision is to internally communicate a changed mindset and culture. Besides describing how to do the work, process models are important tools to change peoples' mindset in their design thinking.

Thus, here, we will elaborate on development processes, their models and their appearance. We will do this on an abstract level to propose a frame of reference for a multiple perspective on PSS development. We embark from the parts in PSS, namely product, service and system in light of process models. Also, bear in mind that the examples and discussions here are outlining the issues as either-or. Emphasizing the distinct entities and their underpinning logics is a way towards integration and combination of a product perspective and a service perspective, not a question of favoring one of them. Further, the point of view in this chapter is delimited to engineering design taking in additional issues from other disciplines.

## 2 The Role of Models in Product Development

Roughly, models in general can be seen as managing models, i.e., they intend to manage some aspects of a process. There are models that aim to accomplish more accurate project planning, easier coordination, shorter lead times, more efficient knowledge transfer, and effective quality assurance. Conceptions of models in product development have been analyzed into five categorizes: administrating, organizing, sense giving, team building and engineering (Engwall et al. 2005). The comparison between the conceptions sense giving and engineering is interesting. From a sense giving category, project models provide a view of the complex and confusing web of activities and relations. Such project management models aim to make sense of a confusing world, and the formal models gives a common language for making sense of 'chaos' (Engwall et al. 2005). From an engineering category, the project models visualize a set of technical challenges. Such project management models are used to solve technical problems, and formal models convey documented best practice to support work efficiency (Engwall et al. 2005). The sense giving and the engineering categories describe two distinct perspectives; the first views the problem as concerning human aspects and the latter focus on technical aspects. Seemingly, these models support distinct aspects of the process. The use of the models is depending on how the models are interpreted by their users and, also, how they are applied within each user's conceptual framework. Also, the same model can be used in several different ways. Yet, it has been identified that the role of models is to enable communication within and between projects, and that they provide common models and concepts (Engwall et al. 2005). Hence, it seems like visualizing a point of view in a model makes people work and think together. Simply, they focus a dialogue towards a topic from a certain point of view. By the same token, models are not rigid; they evolve when combined and improve during the use and interpretation of them.

## 3 Changed View for Development

Broadly, looking on products, a discrete device is more or less stable over time, for example a quill pen and a pen can be seen as an enhancement of a comparable product, embodying incremental innovation. Also, a typewriter and a printer can be seen in the same way. When put into so called s-curves, the interface between a pen and a typewriter can be seen as a breakthrough technology and also as a radical innovation (see Fig. 2). In a situation where a company has an agreement on a 20 year contract to deliver 'functionality' or 'performance in use' to a customer, as exemplified here with 'text on paper', providing that function with a pen throughout the contracted time is not viable. During such long time period, new needs, new goals, new missions etc. come up within the context for the product. The world around us changes and opens up for innovation opportunities to find new solutions and products. In a PSS situation, such 'opportunity leaps' are vital for firms' to foresight and they need processes apt to handle them.

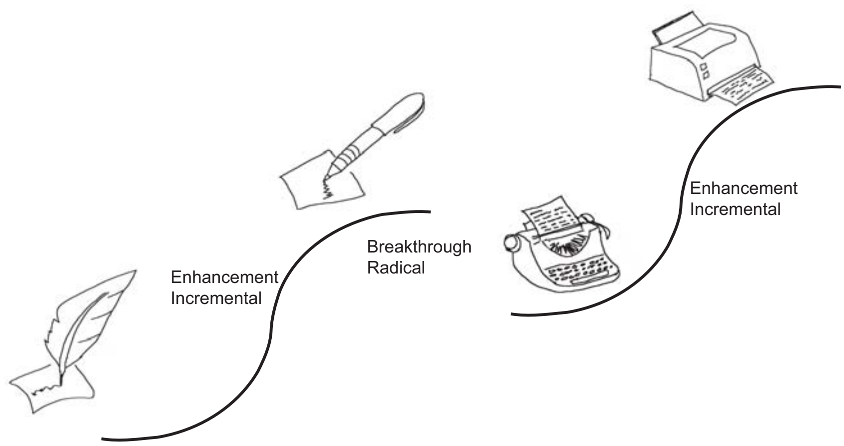


**Fig. 2.** "Text on paper" – enhancement/incremental and breakthrough/radical.

Further, since use is a key for PSS, providing service activities as, for example, leasing (Mont et al. 2006) becomes doable. Going from selling printers to the leasing of printers including the delivery of paper and ink is possible and also done by companies today. Hypothetically, the degree of services can increase if the provider takes the responsibilities for the printer to be always functioning. Practically, to provide that performance will be really challenging, for example, how to handle a paper jam? If the provider will 'attack' the problem from a service perspective, a lot of people on the move is needed, or, from a product perspective the printer as a discrete device needs to be designed differently. Can it alert that a paper jam is coming up? Can it adjust automatically to avoid it? Can it interact with users to avoid paper jam? Hence, increasing the degree of services towards providing functionality or performance in use brings the manufacturer to consider how to develop the devices to make that PSS offer viable.

### *3.1 Product*

The input from, e.g., a market need or a technical invention, sets the early phases of product development into motion. The initial phase is important since the product is settled in these activities. An approach to, as soon as possible, narrow down uncertainties and converge the information flows to focus the design task at hand is commonly applied to increase efficiency. In general, a product development process composes of a number of sequences, going from early design phases to the launch of the discrete device (Ulrich & Eppinger 2008). Today, most models emphasize an integrated, parallel or concurrent approach. Also, the importance of iterations is stressed on in these models. However, on an abstract level the phases in a product development process can be outlined as in the top of Fig. 3.

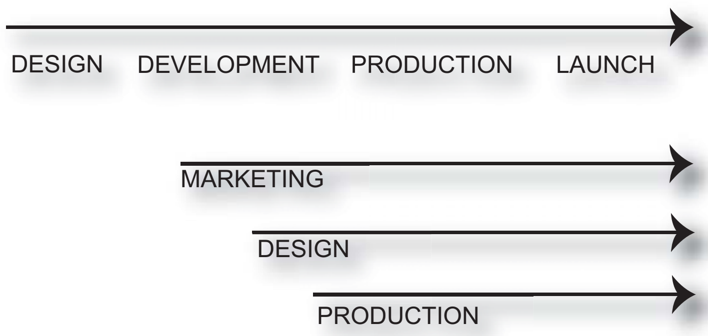


**Fig. 3.** Phases in a generic product development process at top, integrated process at bottom.

Such model emphasizes the stages to take to being able to release a commodity, i.e., selling excellent goods, not services. At the bottom in Fig. 3, a symbolic representation of an integrated process is presented. In an integrated process, the coordination and communication between marketing, design and production is vital (Andreasen & Hein 1987). This might be a reason for the fact that organizational functions are in focus in integrated product development models, rather than the stages to make a thing. Another reason might be that the leap from previous models to integrated ones was based on the perception that the previous gave rise to an ‘over the wall’ process (Ullman 2003). An ‘over the wall’ process describes that information emerge within the organizational functions respectively and that information then is passed on in a step wise manner, making the activities separated. This step wise manner decreased effectiveness and gave long lead-times. The introduction of integrated process models was aiming to prevent this.

Today, commonly, a product lifecycle perspective is important to take environmental design aspects into consideration. Thus, a circle-shaped form can symbolize, for example, that taking care of and/or reduce the waste is vital. In such models, the phases recycle, delivery of the product, its maintenance and its use are visualized as additional aspects to consider (see Fig. 4). One firm’s capabilities and competences are not enough to take care of all lifecycle aspects of a product. For example, taking responsibilities for the products impact on environment, e.g., chose material and production methods with respect to their eco-friendliness, can be done within the manufacturing company. And, for example, recycling is provided by another company. So, at the same time, the picture of several companies working together cross-company is starting to evolve in the models.

Further, collaborating with other companies is necessary and a reality for many manufacturing firms, since they, commonly, are suppliers or partners in a business-to-business context.

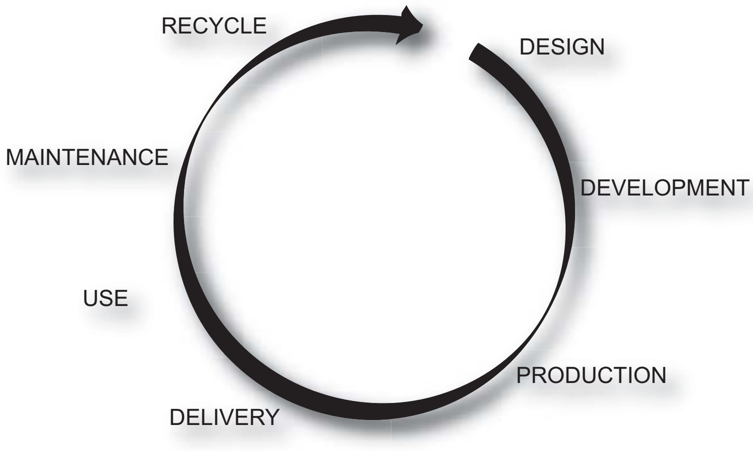


**Fig. 4.** A product lifecycle.

## *3.2 Service*

For service development, visualization of process models becomes problematic since services are partly produced by the customers and regarded as activities

(Grönroos 2000). In this sense, services are partly intangible and unfold in relationships, i.e., people interacting with each other to achieve a goal. Due to this interaction the users are co-producers in services, thus also have an effect on the outcome. Therefore, the customer's own processes are part of the service concept and affect the quality of the service. For example, if maintenance on a machine is planned together with the customer to not interrupt their production, the customer will probably be more content with the service. Besides adding flexibility into the service process, the customer decides if the service fulfilled their needs or not. So, the goal of service development is to make up the conditions for the right customer outcome (Edvardsson 1996).

A service offer is built upon three main development components, namely, a service concept, a service process and a service system. The service concept describes the customer needs, and links these to how the service should fulfill them. The service process describes what has to be working for the service to be produced. Since partners and customers are co-producers in a service process, they are included to some extent in the model (see Fig. 5). Within the service company the internal services (middle of Fig. 5) shows that a service perspective is used throughout the whole process. That is, the internal organizational functions should also be seen as a supplier-customer relationship. So, even though within the same company, the subsequent process steps in the model are to provide services, for example the marketing department is suppliers to their customer - the design department. And, accordingly, a relationship between these occurs and makes them co-producers for the sake of fulfilling the end-customer's needs which, in turn, also are partner in the service process. A service is always seen from a customer point of view (Grönroos 2000), meaning that suppliers should take the perspective of their customer. 'Value adding activities in a business relationship' are words that are generally used to describe the interlinked flows in a service process (Grönroos 2000). Thus, also the internal organization should focus on providing added value to the own company.

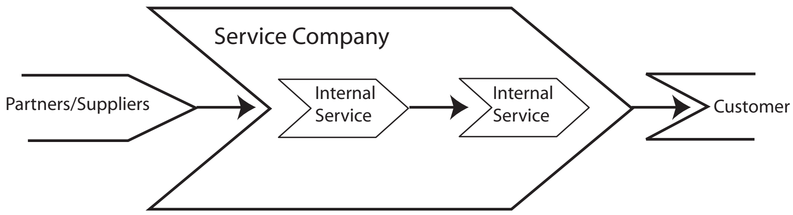


**Fig. 5.** A service process, after Edvardsson (1996).

The service system represents the resources to provide the service, as seen in Fig. 6, this model takes on a customer point of view. The customer is placed in the center at the bottom of the model. The line of visibility is an important aspect for service development, what should the customer's see and get in direct contact with, and what should they not. For example, in a restaurant, seeing into the kitchen area can be perceived as positive if it aligns with the need of smelling and seeing the raw-material become a dish. And, seeing the staff taking a coffee break is perceived as negative for customers standing in a line waiting for their turn (Edvardsson 1996).

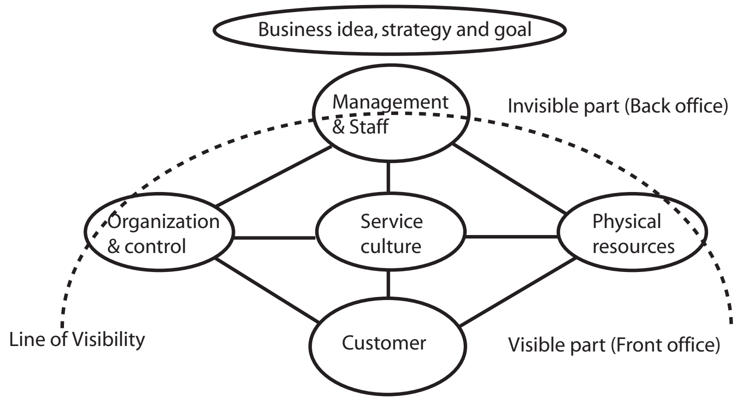


**Fig. 6.** A service system, after Edvardsson (1996) and Edvardsson et al. (2000).

Looking at the service resources from a manufacturing firm perspective and for the sake of adapting a PSS business illuminates at least three issues to consider. First, the customers, be it partners in a business-to-business relation or 'ordinary' customers, has to change their way when communicating their needs. They have to go from talking about what kind of physical device they require, to expressing what kind of performance they would like to achieve. Also, the supplier or the manufacturer has to have a successful way to find the basic needs in these expressions. Second, the organization has to adapt a service perspective. This highlights that, for example, having a product structure might be a barrier. A product structure can prompt people to regard the company as a provider of those specific things. Third, the culture has to change into a service culture. A simple interpretation of this is that all connections and relationships should be seen from a customer point of view, no matter if they are internal or external. A culture can be described as the result of different actions over a long period of time, thus cannot be instilled over night nor fully managed (Grönroos 1996). For a firm focusing on producing excellent goods and provide additional services to complement those devices, the cultural change will be a really challenging issue. This is particularly true, if the development processes are firmly focusing on the commodity as the main carrier for customer value and services are, more or less, something developed haphazard. Starting from scratch like in such a situation, what actions are needed to build up service experiences? Requisites for a service culture concern, not only organization and strategy, but also management, knowledge and attitude (Grönroos 1996). These issues, it can be argued, concern people and their views on the world. Hence, to instill a service culture, the motion towards it has to be built bottom up deriving its origin from individual perceptions and thinking. A suggestion would be that the shift into a PSS business needs some service perspective training and education for product developers.

The physical resources (middle row at right in Fig. 6) are from a service perspective focusing on the equipment, premises, technical systems etcetera (Edvardsson et al. 1996). From a service perspective this means that all actors' resources are included in the production process, e.g., partners, suppliers, customers and so forth. For instance, the service provider - a hotel - can provide a wireless internet connection, and the customer - a hotel guest - brings his or her own laptop to make the service complete. In a PSS context, the product, which is traditionally sold as the discrete device, becomes part of these physical resources. Taken to the extreme, the manufacturing firm develops products for their own users (compare the total functional offer at the top in Fig. 1), but for some other's needs.

In service literature, 'invisible services', i.e., activities hidden in the production processes and not seen by the manufacturer as a competitive advantage (Grönroos 2000) are stressed upon. One example could be expertise about material properties and their behavior when machined in the users' processes. This is often added value for customers and can be a main reason for buying products from the company, while this might be unknown for the seller. Today, services are hidden and not visible in manufacturing companies. But, for a future PSS situation, if the goods are seen as 'just a resource among others', this could bring about 'hidden products' instead. This is a reason for understanding the perspectives respectively, and to take in several perspectives in supporting models.

## *3.3 Systems*

A PSS business firm is enforced to understand services, use and performance in a more holistic way than in a classical product situation. As denoted in the PSS concept, the products and services have the companionship of 'systems'. Already in 1968 Ludwig von Bertalanffy stated that the concept systems had become popular in all fields of science and made its way into popular thinking, jargon and mass media. And, still, used in every day language, the word system can be used to label all sorts of systems, a software application can be a system, the roads and traffic signs are systems, and the laws and regulations in a society are yet another system. Within the area of systems theory there are different types of systems, for example, abstract or concrete, but also, for example, natural or designed. These different systems cannot build up the same system, therefore the interfaces between systems, that is how they are linked and how they have an affect on each other is an important issue for understanding wholes (Checkland & Holwell 1998). Socio-technical systems, for example, compose of a human system (yes, we can be seen as a biological system) and a designed system. The interplay between these systems is in focus for a development process built on a socio-technical view, e.g., in the development of a dashboard in a car it is vital to understand what actions the alert signals are prompting humans to do.

Taking in a systems theory view, a system composes of a set of interdependent real or abstract entities that forms a whole (Checkland & Scholes 1999, von Bertlanaffy 1968). Archetypically, a system is described as having an input, transformation process, an output, a feedback loop and a boundary (see Fig. 7). Thus, in the example of the dashboard above, the input for the dashboard can be a signal from the engine in the car which is transformed into a red light alert as dashboard output. The transformation process is not a 'magic box' (Checkland & Scholes 1999), what goes in (in the example - a signal) comes out even though in a changed form (another type of signal). It is acknowledge that engineered systems exclude for example, social structures and eco-systems (Kossiakoff & Sweet 2003). Thus, the input of a discrete device cannot be transformed to the output of a service and vice versa. So, sad to say, the integration of product and services will not per default come true due to putting in them in the context of one system. Here, one implication for PSS seems to be found in the basic idea of integrating products and services into a system.

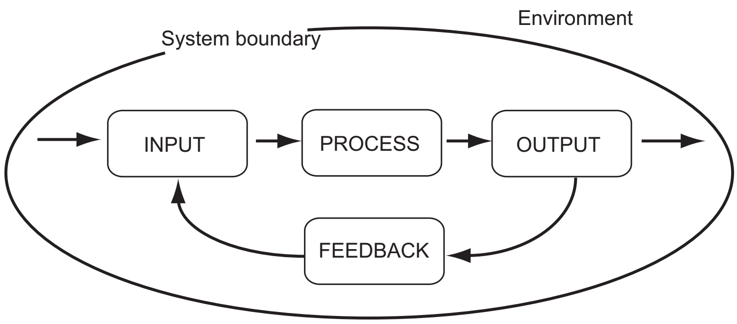


**Fig. 7.** A generic system model.

A hard systems view and a soft systems view are used to differentiate between two fundamentally distinct logics. Commonly, an engineering perspective focuses on technical processes, builds on the hard perspective and strives to understand causes and effects. From this point of view, the product developer is encouraged to focus on problem solving and decision making. The generic systems model in Fig. 7 is useful for understanding causes and effect, but the transformation process is not transparent, i.e., takes the role of a 'black box'. A hard view is apt to deal with technical systems, but has been found as delimitating to handle social processes, i.e., the activities performed by human beings (Checkland & Scholes 1999). Thus, a soft perspective is recommended and, in turn, this changes the appearance of the system model. In Fig. 8, an activity system model is outlined, i.e., a conceptual model to enable dialogue between actors. These kinds of models emerge in the dialogue as a tool to give insights into different reasoning about the problematic situation.

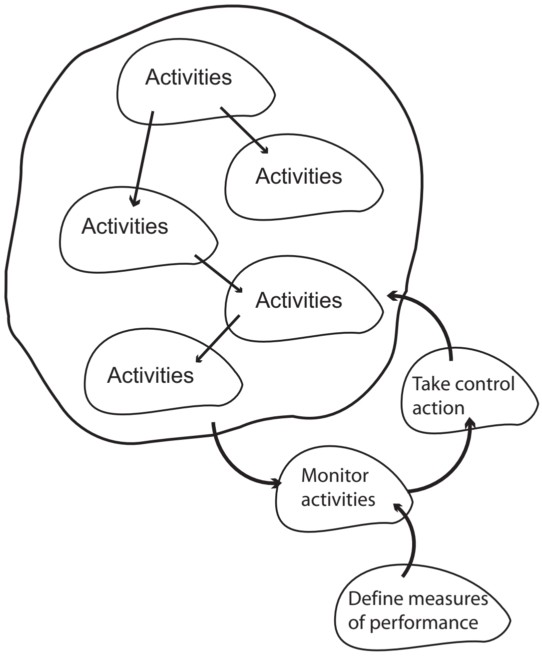


**Fig. 8.** An activity systems model, after Checkland and Holwell (1998).

When drawing a conceptual model, the underlying rationale for the activities, or the worldview of the actor, is important to elaborate on. This worldview is what makes the activities meaningful for the actor; note that the same activities can be seen as irrelevant for another actor. Therefore, making activity models based on each worldview is recommended. Then, the activity models can be seen as a 'logical machine' that can be used to make people aware of their different perspectives, and from those distinct worldviews take collaborative actions. The activities put into the model should be based on verbs and linked to describe the activities (Checkland & Scholes 1999). Thereby, a soft system view strives to open up the 'black box' and make the transformation process transparent, i.e., outline the meaningful activities humans do to change their situations into a new preferred one. In the example with the dashboard, the perspective here changes to the human activities that the red light will prompt. Some people might find the activity to immediately hit the breaks as meaningful, while others might find it more appropriate to go to the nearest garage, and also, there might be people that can have a reason for ignoring the alert. A conceptual model can reveal the underpinning ideas that make people behave in a certain way. To make sense of users or customers, but also team mates in a multidisciplinary team, the practical use of comparing and contrasting several conceptual models has shown useful in a number of development cases (Checkland & Scholes 1999).

## 4 A Multiple Perspective on PSS Development

From an engineering perspective, the implementation of PSS business calls for the engineer's insights into three main types of models, namely models for products, models for services and models for systems. Being *exposed* to customers is a daunting task for an engineer. Engineers are commonly used to do field tests, in these the device is in focus and used as a mediating tool to communicate with customers. The choice of the word 'exposed' comes from empirical data generated in industry and gives some ideas for what the engineers feels about entering the field of customer interaction. Yet, the importance of involving those that should propose a technical solution, e.g., engineers, designers and/or developers, in the early phases of understanding human activities and needs has been identified a long time ago (Faste 1987). Still, such an approach is implemented in a few industrial cases. Some spokesmen argue that the barriers are found within the delimitations in the ways of thinking about product development and also, the attitude among engineers (Kelley 2001).

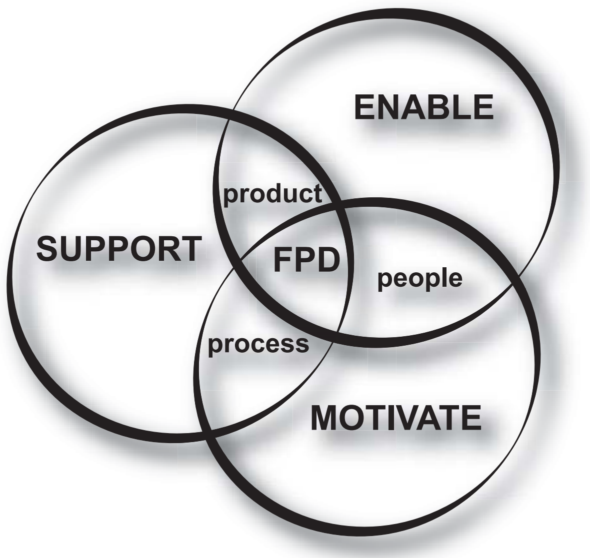


**Fig. 9.** An FPD perspective model for PSS development.

In general, the designer or engineer is trained in problem solving, thus seeing users as a problem to be solved, instead of a source of creativity (Kelley 2001).

Also, the trained problem solver has a tendency to jump into solutions (Patnaik & Becker 1999), without understanding the ‘real’ problem or human behavior. Due to the service perspective in PSS, the innovations should emerge from customers/users needs, rather than merely on technology innovations within a company. So, one implication to implement PSS is to train engineering designers to feel comfortable in interaction with customers. Also, engineers have to be trained to ‘switch on and off’ their technical skills, depending if they are looking for needs or if they are generating solutions. Bridging the distinct logics of services and product development into a cohesive ‘logical machine’ for dialogues in team-based innovation projects is another suggestion. If such a model emerges the communication in and between teams would be supported. An important aspect for a product/service integrated team is that they need to be able to understand each others’ perspectives, and they also have to be able to build a shared understanding based on them.

Based on the argumentation in this chapter, a frame of reference for the progress of a PSS development model is presented in Fig. 9. This frame of reference could guide the development of models to incorporate multiple perspectives. FPD (Functional Product Development) in the middle of the figure, represent a modern product development process for PSS. PSS is not put in the middle due to that the research perspective on PSS is broader than engineering design. And, also industries name their PSS intentions differently, for example, total care, through life capabilities and soft products. Thus, FPD is chosen to represent an engineering development point of view, thus the focus for such modern product development is to bring in service aspects in early phases.

The frame of reference proposed in Fig. 9 visualize that at least three perspectives have to be considered, namely people, process and product. Taking these perspectives, the engineering team is likely to be able to combine, build on, and refine ideas for new PSS solutions. For example, if they take the point of view of people (the actors at the customer), process (the customer’s processes) and product (what meets the customer’s goal and objective). Going to the outer circles, the team can consider what motivates (e.g., finding needs), what support (e.g., benchmarking existing solutions) and enable (e.g., identify resources) the situation from the three perspectives, respectively.

Even this framework can be differently interpreted and used. From a research perspective the framework describes research areas for PSS development. In this view, the outer circle address three main areas that calls for attention: (1) the development team should be supported, for example by tools, methods, methodologies, (2) the team’s work should be enabled, for example by relevant knowledge, expertise, information, and (3) the team activities should be motivated by, for example, creativity, collaboration, communication. All these research areas should also be addressed from the perspectives people, process and product.

## 5 Implications and Suggestions for Industry

This chapter has illuminated a number of implications for the realization of PSS. At the heart of PSS is to provide added-value to the customer, hence a suggestion for realization is to focus the efforts to bring in users and customers into the early phases to increase value development. First, PSS includes going from a product perspective to a service perspective. A service perspective means that it becomes necessary to initially understand users/customers as well as their goals and achievements, i.e., needs, in a completely different way. A recommendation for connecting such needs to the solutions is to let product developers take active part in gathering information about the users. Here, the implication is that the contemporary engineer is trained to be a focused problem solver, yet PSS development also requires the engineer to be skilled in *defining* the problematical situation on a level that takes more than the commodity into consideration. In practice, the marketing and the engineering staff interact with users/customers with different agendas and from different point of views. Marketing are those generating the initial information from users/customers, while the design engineers mainly are responsible for field tests of products. Such situation also means that it is the marketing people that initialize and frame the technical solutions, and not the trained engineers.

Second, product development models and service development models convey distinct logics, and they are interpreted from divergent conceptions and worldviews. Bridging these distinct perspectives is vital, but not trivial, for PSS development. Making the core ideas for each view visible is a suggested initial step. Practically, the existing models within the company for service development and product development respectively have to be used as a basis for conversations in project teams striving to work together. At first, preserving the basic models separate can make the similarities and differences apparent, but also, support understanding for where the dilemmas for PSS lie. Doing so, it seems likely that an interrelated model, that takes the both perspectives into account, will emerge.

Third, based on the discussion that system models provide no ‘magic box’, one implication concerns the basic idea of integrating products and services into a system. In view of a service culture (Grönroos 1996), this system should conceptualize a service system. At this level, the whole company will be challenged to develop new models not only for the development, but also for organization, business, management, project, partnerships etcetera.

## 6 Suggestions for Further Research

We have not considered PSS from a service research area, however this is not neglected. Scrutinizing engineering design and product development having service glasses on has proven to contribute to the understanding (e.g., Fransson), a continuation of this research is anticipated and encouraged. Further, besides an effort for further research on process and system models, there are other areas within the engineering design that we would like to suggest for future studies.

The service engineering area is a promising way to put forward support based on computer applications. Here, the simulation of service activity flows (Sakao et al. 2007) is interesting. Putting such simulations into the hands of product developers in the early phases of the development of the discrete device seems practical, yet base on the gap between a service mindset and an engineering mindset, visualization of results seems like a key issue. A typical engineering concern might be how the decisions made for the device per se is likely to affect the customers' perceptions of the service provision. That is, the engineer has to start studying PSS from an engineer point of view to try out and understand different solutions for how to provide services.

PSS development opens up for innovations in a more radical way than classical product development. By the same token, it also challenges the processes to deal with a ubiquitous and deliberate innovation process. Many breakthrough products have its origin in mistakes or become true thanks to informal management. In the innovation research area, going from how individuals can be encouraged to step out of their comfort zone via the facilitation of creativity in teams to changes in management styles, is of outmost concern. Finally, the academic education of engineers seems to call for a new curriculum. The future engineering has to be trained to think, communicate and work in a different way, that is possess the qualities necessary to deal with multiple perspectives to support PSS innovation.

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