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## USING BLUEPRINTING METHOD FOR DEVELOPING PRODUCT-SERVICE SYSTEMS

Nabil BOUGHNIM, Bernard YANNOU

**Keywords:** *Product Service System (PSS), Functional Sales (FS), service design, Blueprinting, Economic and Environmental performance*

### 1. Introduction

Thoughts about sustainable development have increased in the latest years, especially with regards to the environmental performance of the economic activities. Industrial companies have an urgent need to reduce the environmental impacts of their activities (such as climate change, biodiversity loss and air pollution increase) and resource use. There is a need to achieve more in economic terms, with less environmental impact. Various concepts are presented to reach sustainability such as dematerialization, eco-efficiency and changes in consumers' behaviours and consumption modes.

Today, economic activities are characterized by the focus on more customized offers that can fit with consumers' requirements. These offers present more attractive solutions in terms of quality and price through products, services or a combination of both. Authorities' recommendations aim to encourage companies to provide various offers and to improve the existing production processes in order to minimise environmental impacts along the life cycle of products and processes.

A new concept called "dematerialised" consumption has appeared which consists in getting utility instead of ownership. This concept characterizes the "*Functional Economy*". These new business concepts are emerging and the focus is on fulfilling the desired function by offering system solutions with services including, when needed, physical goods or products. This concept is referenced in literature as Product Service System (PSS) or Functional Sales (FS). Providing the function of a physical product to consumers could help lower environmental impact and lead toward more sustainable styles of consumption. The environmental potential of this new offer is discussed in the core of the paper.

From an industrial point of view, PSS is considered as a complex concept which, surprisingly, does not benefit from any specific support method concerning the development stage (in

comparison with physical products). Up to now, there have been very few publications on developing, extending or refining methods for designing PSS.

In this paper, we propose the use of the Blueprinting method developed by Shostack [20; 21], known as a method for developing a pure immaterial service, for the development of PSS. We will make some proposals for applying the service blueprinting method to a given example of provision that combines both physical products and service parts which can be assimilated to a PSS. Our case study of provision of service consists in the design and the setting of the workplace for an organization.

## **2. Understanding the concept of Product Service System**

### **2.1. What's a Product Service System (PSS)?**

Within the latest years, academics and industrialists have focused their researches on the shift from producing and selling products to developing and delivering services. It consists on the sales of the function of the product instead of the physical artefact, named “Functional Sales” (FS) in industry. Terms such as “Product-Service-System” (PSS) and Eco-Efficient Services (EES) can also be found in the literature and assigned to the same concept.

Some examples of PSS or Functional sales can be found in industry, both in B2B as well as in B2C market. The concept of shared use [17] of product or process is important in B2C, examples of washing services (e.g. Electrolux), leasing of printers (the pay per copy program) of Xerox and car sharing/renting are the most famous. In B2B, the outsourcing of certain activities is directly related to Functional Sales (e.g. Chemical Management services (CMS)).

PSS may be considered as an a priori virtuous paradigm (i.e. an a priori valuable hypothesis). Indeed, decreasing the physical part (the “product” term in PSS) of goods provided to a customer and increasing the service part should be a potential/smart/easy way to lower the environmental impacts, considering a certain frontier when analysing the system. Anyway, PSS is a present tendency in the marketing of goods under the forms of Pay-Per-Use and functional sales (mainly, for B-to-B). The service part in the case of an electronic product is often linked to its softwarization and/or its internalization, which allows a better modularisation/configuration and customization (please, pay to download this function, e.g. spotting a stolen car and warning the police) and a constant update (please, pay to download the last version). Consequently, the larger the service part in a product, the more regular the financial stream from the customers, and the more loyal the clients.

## **2.2. Economic and environmental benefits of PSS**

Traditionally, business profits are tied to increased product sales. If suppliers instead supply a service rather than a product, alternative opportunities for profit are created. For example, one could shift from selling barrels of chemicals, to selling the service the chemical is used for. Both customer and supplier would gain from cost reductions derived from improved resource efficiency. For the supplier, this includes improved customer relationships, value-added services (sub-contracted activities), ensured material input and the opportunity to attract new customers. The customer can benefit from outsourcing of non-core activities, integrated supply chain management and reduced costs [16].

Services are not necessarily more sustainable than products, but if carefully designed, the offers of services can result in significant environmental benefits, such as reduced resource use, waste production and emissions. Authors have pointed out the increased potential for reuse, refurbishment, upgrading of products and recycling of materials. Closing material loops are central, and management in the usage-phase is also an important area [15]. If a person remains the owner of the product all its lifecycle long, product updating, take back and recycling processes become more economic and easier to manage. Increasing the potential of recycling, upgrading and remanufacturing can ensure the reduction of material use in the production of new products and ensure a secondary source of raw materials directly from the market.

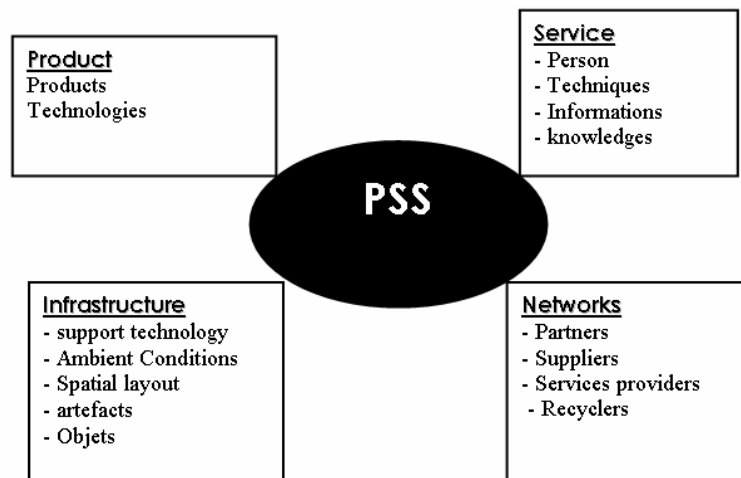
For many companies, financial savings and revenues generated from shifting to services oriented solutions is the most important driver. For example Xerox and IBM consider service orientation as a survival strategy and increase revenues from high volume of leasing and remanufacturing operations [22]. Currently, 50% of total revenues are coming from service orientation [6]. In the USA, the savings from Xerox remanufacturing operations are estimated at about 250 million \$ [23]. However, Electrolux and Interface Inc. state that environmental improvement is the main driver for the shift towards service oriented solutions [7; 4].

## **2.3. The main components of PSS**

Product Service Systems (PSS) can be assimilated to services: the consumer only pays for a provision or the use of the product or the process (utility of product). A PSS system may be decomposed into several components. These components are of different natures and involve many actors along the whole lifecycle of PSS (producer, service providers, consumer, maintenance facilities, take back and recycling facilities,..). In the following, we adopt the

model presented by Mont [14; 18] that decomposes PSS into four categories of components or dimensions that the consumer is able to apprehend: Product, service, infrastructure and networks:

- Product includes physical products or technologies.
- Person-based or other types of services (technical, information and knowledge services)
- Infrastructure can be evaluated when the customer comes into contact with enabling supporting technology, or by the evaluation of ambient conditions, spatial layout and functionality or by evaluating signs and artefacts of the PSS.
- Networks: are not usually visible to the customer, but in some cases may be evaluated when they come into contact with the customers.



**Figure 1: PSS dimensions useful for consumer judgments (see [18])**

Designing or developing PSS hence seems a very complex task owing to the system approach along the product lifecycle and the number of interactions that exist between the different actors involved and the components constituting it. The involvement of different actors inside and outside the process (designer, marketer, sales, production, after-sales, outsourcing, partners, recyclers...) along the whole lifecycle of a product is important to understand their roles in order to manage all the system well. A customer has many opportunities to be in relationships with a PSS, in comparison with a mere product. Moreover, the processes of service purchasing and of service delivery must be considered in the design process of a PSS. In addition, due to closer relationships with the service provider, customers can also possibly be in contact with infrastructure and networks that support the PSS delivery.

Mont [16] has mentioned that there were few examples of design attempts for which an entire PSS has been designed. Developing a PSS notably differs from developing a product. While designing a PSS, the focus is on designing the whole product service system, including the aforementioned components. Interaction between service and remanufacturing organizations is seen as being especially important to yield economic incentives from service activities and manufacturing or design changes. It is also important to integrate other facilities in the value chain in order to develop a system that will take back and recycle products, thus limiting product flows and lowering transport distances.

### **3. Service Engineering**

The importance of the service sector is emphasized in the new economy, which switched from a material to immaterial one, known as “the service economy”. Services dominate most developed economies given that significantly more than half of these countries’ gross domestic product is in the service sector, and projected economic and job growth through the 21st century is expected to be dominated by services [19]. There is an increasing number of businesses that, driven by economic opportunities and innovative ideas, are shifting from selling products to providing services.

Product and service are closely linked: actually, in many cases service is the result of the use of the physical product. Services are often accompanied by physical objects which are only dedicated to the given service and cannot be sold independently. However, contracting service brings additional benefits in comparison with the purchase of a pure product, both for the providers and for the consumers, namely:

- Increasing the profitability of existing offerings,
- Attracting new customers,
- Enhancing the loyalty of the existing customers,
- Opening markets of opportunity

Service design and development issues are increasingly being recognized as important to managers. Many service providers are however hindered by the fact that their present corporate structures and processes are not designed to enable services to be efficiently developed and launched on the market. Weaknesses frequently lie in the fact that there is no official standardized process for assessing the need for a new service, designing a relevant solution, evaluating it and improving it according to the consumers’ feedback. Difficulties are

frequently encountered because the new services offered by firms are not clearly defined; there are no unequivocal descriptions of the service contents, the relevant processes and the necessary resources [2], that can be reviewed later.

### **3.1. New Service Development**

The topic of new service development has long been largely neglected, not just in practice but also in academic research. New service development is the rationale development of new service products to the supplier or to customers [8]. In general, service companies do not have formal processes for the development of services as do manufacturing companies for their product design activities.

Edvardsson & al [2] stated that the following three parts have to be considered in service design:

- The service concept: includes the offers made to customers and the needs that are fulfilled by the services
- The service system: includes resources and infrastructure enabling delivery of the service
- The service process: involves activities undertaken to realise and deliver the service

They have also suggested that the process should involve integrated teams encompassing several areas of skills and expertise (e.g. sales people, marketers and technicians). The process starts with a service-idea-generation phase, in which ideas are formulated and evaluated. Before going on to service design, there is a need to evaluate the ideas to be in accordance with the strategy and culture. The last stage includes implementing the service into the service system through, for example, internal and external marketing and training processes. According to Edvardsson & al. [3], understanding customer needs is vital. Having a service strategy and culture in line with the customers' values and perceptions is important for founding the realization of the service.

Then, services are very often defined in terms of poorly articulated oral and written abstractions. Marketers are not always very good at creating advertising programs rather than actually creating and managing services. A system that documents the structure of the service, maps all processes into an objective and explicit manner and captures the entire essential functions is required. That is why the service blueprinting method has been introduced [20; 21].

Some thoughts about PSS assimilate it to service provision including physical products. The service content appears to be a central component for it is connected to the rest of the system (product(s), infrastructure, networks,..). The focus must be made upon designing a consistent system, including different categories of material and immaterial components spread out all along the product lifecycle. Understanding the processes, interactions and actions to be carried out to develop a service provision is an important field and can bring clearly relevant information about the performance.

### **3.2. Blueprinting Method: Blueprint of service process**

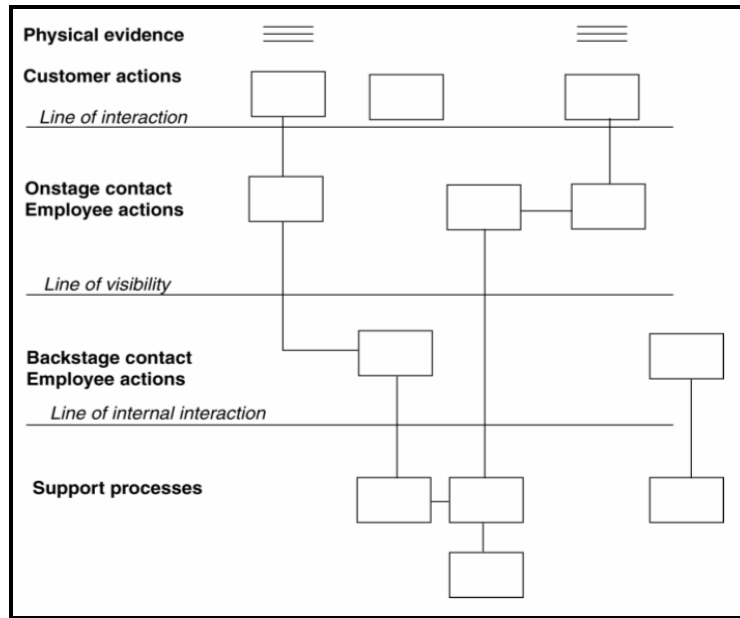
Some tools are available for mapping out the service process, such as service blueprinting or service mapping. *Blueprinting* is a method invented by Shostack [20; 21] and developed further by Kingman-Brundage [11; 12; 13] to visualize expected and/or actual service processes.

Service Blueprint is defined as “*a picture or map that accurately portrays the service system so that the different people involved in its development can understand and deal with it objectively regardless of their roles or their individual point of view*” [24]. It depicts the process of service delivery, roles of customers, roles of service employees, and visible components of service. Service Blueprint answers these questions: *Who does What, To Whom, How often, under what conditions* [10].

Blueprint is a two-dimensional picture of service process. The horizontal axis represents the chronology of actions conducted by the customer and provider of the service. The vertical axis distinguishes between different areas of action separated by different lines [5]. In reference to the application of blueprinting in different purposes in the latest years, three stages of development separated by lines can be identified:

- Line of interaction: separates the customer’s actions area from the supplier’s action area. Above this line, we find activities, choices, needs and interactions performed by customers.
- Line of visibility: distinguish between actions visible and invisible for customers. Above this line one can find the “On-stage” contact and employees’ actions (Front Office).
- Line of internal interaction: distinguishes between front office and back office activities. Above this line one can find the “Backstage” contact and employees’ actions.
- Support processes: processes necessary for delivering the service and carried out beneath the line of internal interaction.





**Figure 2: Representation of Service Blueprint (shostack, 1982)**

The traditional Blueprint of the third stage was revised by certain authors [12; 13; 24]. They said that it is not homogeneously structured and have proposed two additional action areas separated by horizontal lines.

- The line of implementation: separates management zone (planning, managing and controlling) and support zone (support activities)
- The line of order penetration: beneath the line of internal interaction, separates consumer-induced from customer-independent activities.

The integration of two additional lines is the result of the lack of differentiation between customer-induced and customer-independent activities in the traditional blueprint. The revised blueprint [24] shows activities concerning the production structure of service operations and refers rather to the value chain of services than to the structure of service process [5].

Service Blueprint simplifies service complexities by displaying the operation of existing system. When the current operation is explicit, managers can make rational choices about how they will operate in the future. Blueprints can assist Business unit managers in the decision making activities associated with strategy setting, allocation of resources, integration of service functions and evaluation of performance overall. It is also useful for marketing and communication people as a guide to the key service components contributing to consumers' satisfaction and for human resource managers in the preparation of job descriptions [10].

### **3.3. Developing PSS: A combination of services and products**

Product/service combinations that form larger market entities can be quite complex. Since they are highly interrelated components, it is useful to view them in a dynamic and systemic way. They can be viewed very much like “atoms” connected in unique molecular configurations [20]. In some cases, the product content (the weight of the product part against that of the service part) makes a great difference between provisions, for example, the difference between transportation services and banking services lies in the product content itself.

The combination of services and products form the PSS concept or Functional Sales (FS). In many cases the same company provides the service and the product, or shifts from selling pure products to providing service provisions including products. Numerous authors have pointed out that the changes in companies applying PSS are often more organizational than technical [1]. In order to understand the development of these service provisions (including both services and products), it is important to understand the whole development process as well as the connection between developing services and products. Anyway In any case, a clear and systematic methodology for supporting the PSS development does not yet exist.

Kim & Mauborgne [9] have argued that successful companies take advantage of the innovation potential of the product, the service and the delivery. In delivery, they have included logistics and the channels used to deliver the product to the customer. All these sources have to be considered when seeking new values for customers.

The development of PSS seems to be similar to service development; the ambiguity is also to find the adequate service concept, and to manage the different actions led by customers, employees, partners and service providers well. The service concept development is considered as a critical stage in service design and development. This involves understanding the needs of customers in the target market. The elements of the service package, defined as what provides benefit and value to the customers, must be clearly identified and represented in order to depict the points of failure and the process to improve. A systematic representation of a PSS system that would model all its constituents seems beneficial.

Our purpose in this paper is to give a map of a PSS system using the Blueprinting technique as a means to model all processes, actions and interactions inside and outside the company. We do not use the traditional formalism of Blueprinting as presented by its inventors [10] because of the difference between elements involved in the delivery of the service . The

choice of the case study was made on a provision of workplace services provided by an industrial that has taken a new orientation toward service provision instead of only manufacturing and selling products (office furniture). The paramount goal is to help people work more effectively and organizations use space more efficiently. The provision includes furniture and asset management services, workplace strategy consulting, interior construction, and project management services. The choice of this service provision is due to the complexity of service oriented solution.

## **4. Case study: Application of Blueprinting method to a service provision (Workplace services)**

### **4.1. Service provider company**

The business of the company X consists in providing Workplace service provisions to organizations. Its main vocation consists in studying how people work, to fully understand the ever-changing needs of individuals, teams and organizations. By using its experience and know-how in work organization, it integrates the appropriate products and services inspired by what has been learned about the workplace, and finally create solutions that help people work more effectively.

Company X is different from its competitors by its know-how in the layout of workspace. To apprehend the needs of its customers well, the company has developed a methodology based on the study of users' needs, the analysis of spatial constraints, the functional relationships, the organisational hypotheses, the furniture specifications, lighting, wiring and all relevant information about processes and space, with an orientation towards the improvement of its environmental performance.

Service orientation requires the creation of sales leaflets to convince consumers and top management of the benefits of the service provided both from economic and environmental points of view. The integration of new data related to service is hardly quantifiable; it requires the development of scenarios of services and products use with a lifecycle approach that takes the total cost for the user into account, identifies efficiency criteria and relevant eco-indicators. These scenarios can produce a long term vision about resource consumption, maintainability of installation. The development of an information system storing all data (elementary costs, environmental impacts, duration, performance along the lifecycle and space) is a support to design process and decision making. A detailed decomposition of

service can supply information on the different areas of performance. In this paper, we are trying to model an example of workplace service using Blueprinting method as a vertebral column that can provide information on service performance (Economic/ environmental/ social).

## **4.2. Modelling an example of workplace service with Blueprinting method**

We propose using the Blueprinting method to represent the different components of an example of workplace service and to build a consistent model that manages the different interactions between stakeholders in order to render performance areas along the whole lifecycle visible. The example chosen deals with the renovation and organization of an old building to become the head office of a given company. The main activities and processes (design, building works, material flows, end-of life activities,..) are represented in the model (see figure 3). We are hereunder presenting a short description of the different lines of Blueprinting:

- **"Line of interaction"**: the objectives of the clients of the project (company top management, internal and external employees, customers, dealers) consist in having a workspace for employees which is also a place for training and welcoming of the external customers and visitors, allowing the company to position its brand well, to control its costs and to improve the social life of employees and partners.
- **"Line of Visibility"**: above this line, we find actions and activities which are visible for the customer, including the choice of the site and the building, the technical feasibility study, the proposition of solution to the company, the partitioning inside of the building (Zoning), as well as the various meetings of the client with actors involved in the realization of the project.
- **"Line of internal interaction"**: it separates the zone of management (scheduling, management, studies, and control) from the support zone (support processes). Above this line, actions such as the process of definition and selection of a layout solution (company know-how) and analysis of users' needs. The main steps of renovation and the realization of works dealing with the internal organization and external adjustment of the head office are represented.
- **« Process supports »**: includes all products, equipments and infrastructure as well as actors' networks operating in back office activities. For workplace service, building materials, product lines (furniture), and technological equipments specified to lay out the workspace, as

well as all suppliers involved and the related logistic activities. The subcontractors' facilities involved in the re-organization of the building (wiring, lighting, electric networks, ventilation, air conditioning, and maintenance), the different means operated and the various End-of-Life activities for some products (take back and recovery of end of life products, upgrading, recycling, remanufacturing, and disposal) are represented.

### **4.3. Interpretation and main results of the Blueprint**

The use of the Blueprinting gives us an overview of the total system of services; the role of each component for delivering the service is shown including products, equipments, and technology. All actions and activities are represented with the chronology that this type of service requires.

Each activity or process can be considered alone and analyzed to measure its performance as well as its cost (as in Activity Based Costing) and the environmental impacts it generates. On the other hand, Blueprinting enables to find defects in the service provision through abnormal contributions of a process into the global cost, a given environmental impact or a non-quality aspect [5]. We can have access to the activities and actions performed by a given actor, which makes the identification of responsibility easier and tells target actors where the problem comes from.

If we isolate each element, we can measure each environmental impact when it occurs along the life cycle; for instance we can quantify the volume of transportation (products, equipments...) required for the realization of service, and therefore the environmental impact generated and then identify the preponderant outsourcing activity. The cost involved for the elementary activity is easy to calculate and hence, the total cost of the service (Product-service system). This makes the cost center more visible for the manager, and allows him to reduce it.

The modelling of the product-service system by Blueprinting presents a step that gives useful information to make an evaluation or analysis of economic and environmental performances of service. So, identifying the points where it is important to improve the present situation is more visible.

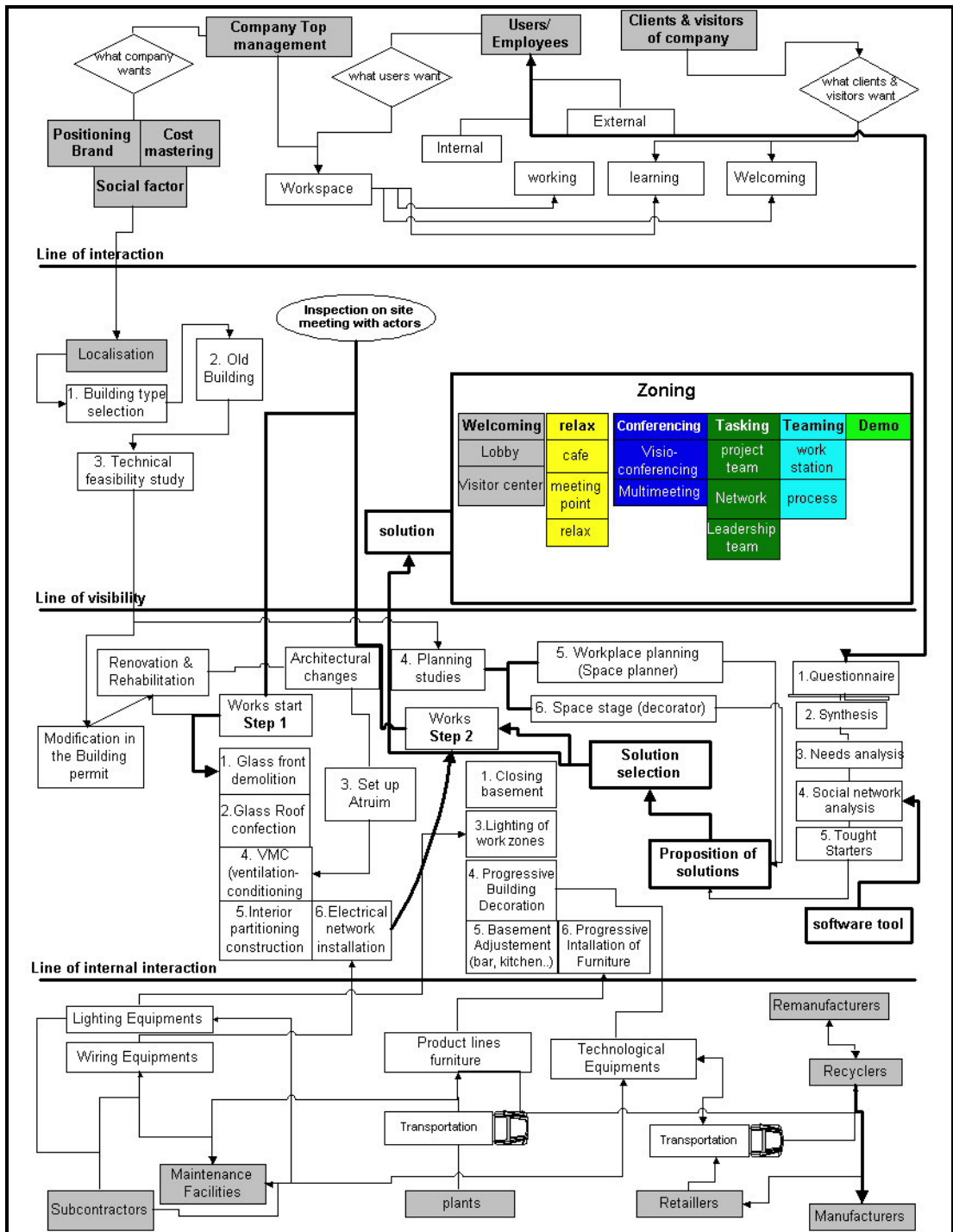


Figure 3: Workplace service Blueprint

## 5. Conclusions

The notion of service was neglected by designers and engineers for a long time because it is considered as immaterial and is not related to technical requirements, in spite of the direct correlation between physical products and services. Research in the service development is increasing due to the new tendency toward service economy or Functional economy. Considerations about the satisfactory environmental potential of service make the orientation toward service development important and can be a response to the legislative constraints.

Literature and industry deal with service using several terms such as Product-Service Systems (PSS), Functional Sales and so on. PSS is a service that contains a variable product part. This makes the study of performance more complex, and hence requires a detailed modelling of the whole system. In this paper we are proposing a representation of the different components of a service provision (combination of product and service) assimilated to the PSS concept and the interactions between all stakeholders involved in the system (consumers, producers, service providers, subcontractors, end-of-life facilities,..). Information about how goods behave during the use phase and how they can be handled in the end-of-life, are difficult to capture and to integrate in the preliminary design of the service. The application of Life Cycle Analysis (LCA) and costing (LCC) to service seems difficult to operate and not reliable. Modelling tools can identify each element of service in order to make an evaluation of total performance, and therefore have a true idea about the economic and environmental potential of PSS

We use the Blueprinting method known as a service design method that maps all required processes, to model a PSS system (Service provision). We have found that this representation method has allowed a fine and relevant description of the system all along its lifecycle. In addition, a precise analysis of each elementary process and of its related physical components has been made possible. The study of the performance seems easier in this case, the sources of elementary costs and environmental impacts are made explicit and the company may now compute a reliable global cost and aggregate environmental impacts along the lifecycle of the service provision. It can now be envisaged to use this information structure to build a simulation system for modelling different feasible service provisions and for globally simulating their advantages and drawbacks for the clients. Also, this can make possible developing arguments in order to convince customers and to prepare different scenario of service provision depending on price. That way, the clients could be informed of different commercial proposals to make their final decision on the basis of the triples (technical

performances, global cost, environmental impacts). The final choice between these different optimal (Pareto) solutions could be made by the degree of the client's awareness on sustainable development.

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