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PRODUCT, SERVICE AND COMMUNICATION: AN INTEGRATION AS A CONTRIBUTION TO THE DESIGN METHODOLOGY

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1. Introduction

Increasing the integration between post-production services and the communication between industry and the final customer is one of the modern tendencies in industrial product marketing practice, that could also play a significant role in the design methodology of a product.
In fact, the feedback coming from the final user can suggest new and sometimes unexpected product development directions, the great advantage of which is that they cover actual needs.
How it is possible to achieve the integration of product development with communication and service, that will result in an upgrading of the design process?
First, it would be useful to highlight that the development of an industrial product can be subdivided into three fundamental and general steps:

a) individuation and formalization of the function to be performed by the product;
b) individuation of the principles and constructive solutions that can perform this function;
c) consideration of the whole product life cycle. By such consideration, it is possible to choose the “best” principle or constructive solution among the principles and constructive solution of step b) and upgrading the relative behaviour.

As a first step to integrate service, communication and product development, it is important to clarify the meaning of the terms service and communication within this approach.
We can call “service” every process that creates a benefit by facilitating a change in customer tangible and intangible resources. The service could then be regarded as a non-material equivalent of a good, since it increases utility and therefore can be “sold” at a price in a market.
We can call “communication” all transmission of information related to the product in every phase of the life cycle of the product self.
The linkage between product and service consists in realizing that the function could be performed by the product or by a service.
The linkage between product and communication consists in the individuation and correct design and realization of all communications in each phase of the life cycle of the product.

2. Objectives

The objective of the present paper is, starting from the above mentioned considerations, to propose an approach for a design procedure that takes into account the possibility to realize a product that could also play the role of a service or used to accomplish a service and how to consider the communication in each phase of the life cycle of the product.

3. Method

As example for the step a), Figure 1 shows the starting point for the design of a transportation system, as to say its principal function.

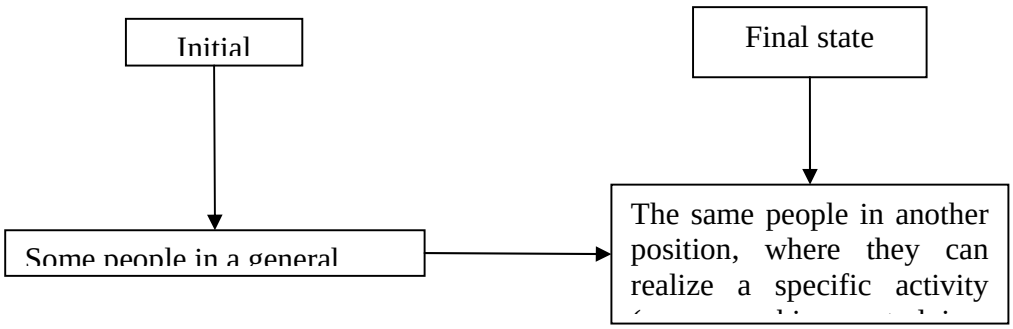

Figure 1. Example of formalization of the function relative to a transportation system

It is possible to accomplish this function in two different levels:

1. motion of the people, e.g. with car, airplane, railway, …. This situation corresponds to a product;
2. motion of the activity, e.g. with e-shopping, e-learning, virtual museum. This situation corresponds to a service.

With reference to the step b), the determination of the principles (or constructive solutions) that perform the given function can be derived from known heritage (like as historical solutions and state of the art) and from innovation (with heuristic methods, TRIZ, and so on). Figure 2 shows an example of approach of an archive of principles relative to the function "transportation of kinds" [Biggioggero 2005].

Figure 2. Archive of principles for the function "transportation of children"

With regard to the step c), it is worth noting that the principles (constructive solutions) have to satisfy all the requirements in the whole life cycle (Figure 3) [Asimov 1962] [Rovida 1997], that can be subdivided in several general and specific phases (Table 1).

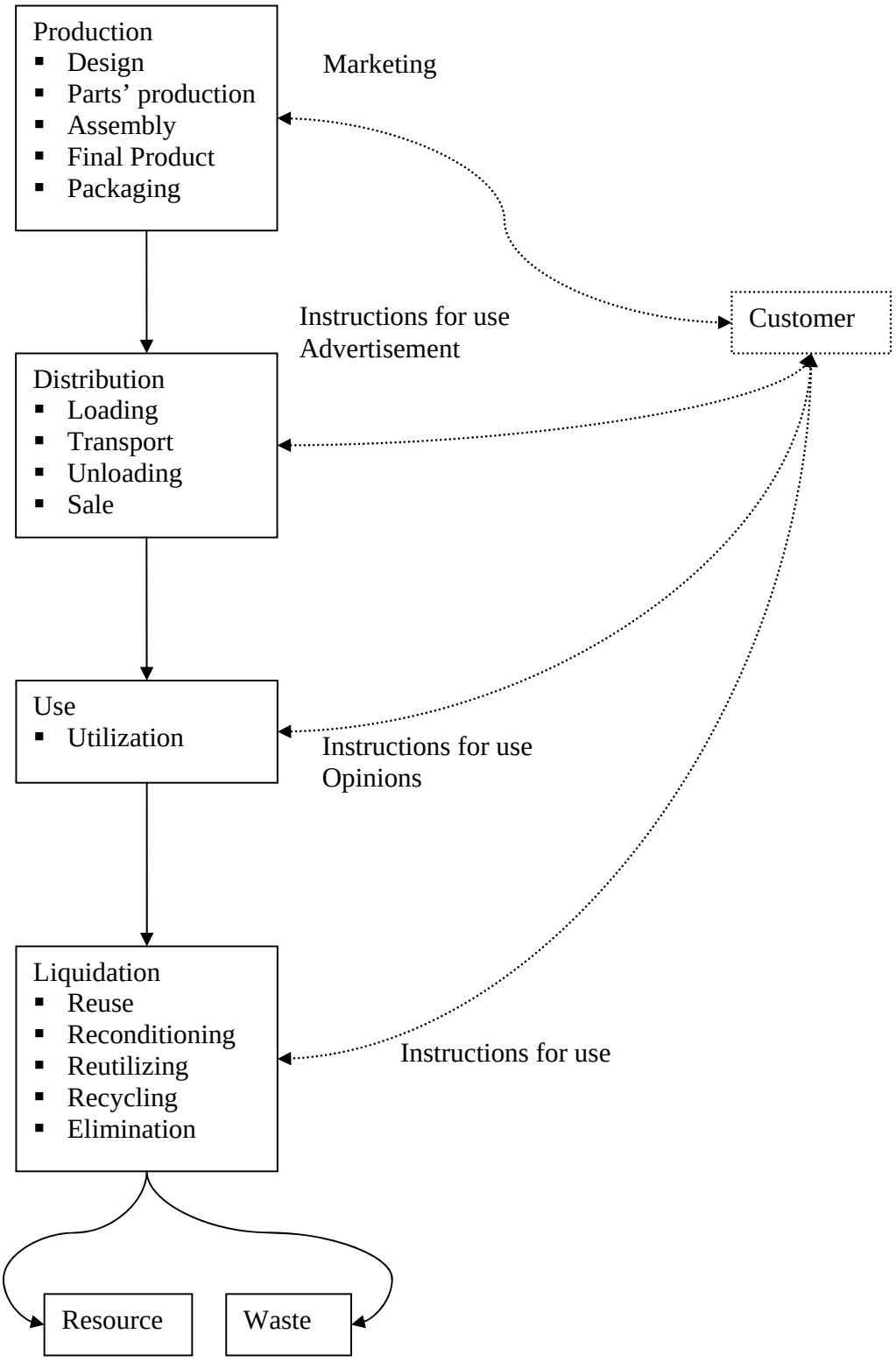

Figure 3. Life-cycle diagram of an industrial product.

Each general and specific phase as well as each communication and service referring to a specific phase can then be evaluated in relation to some requirements, for example: simplicity, efficiency, sustainability, safety, costs.
In figure 3, the interaction with the customer (expressible as communication) is highlighted.

Table 1. General and specific phases from the life-cycle diagram

General phases	Specific phases
Distribution	Packaging Charging Transportation Discharging
Utilization	Behaviour Maintenance Ergonomics Safety Reliability Aesthetics
Liquidation	Reuse Reconditioning Reutilinzg Recycling Elimination

Figure 4 summarize these considerations.
In this way, it is possible to determine the behaviour's aspects of the industrial product.
As an example, if we consider the requirement "sustainability" for the specific phase "replacement" of a used product, it is possible to enumerate some environment related aspects (Figure 4 shows a possible method), that have to be considered in the integration product-service-communication (Table 3).

Table 3. Aspects of the component "replacement" specific phase.

Aspect	Product	Service	Communication
Utilization of substances with low environmental impact	DfX		Instructions for use
Substances with environmental impact easy to separate	DfX	Collection service	Instructions for use
Low energy consumption	DfX		Instructions for use
Substituted parts easy to recycling as products	DfX	Collection service	Instructions for use
Substituted parts easy to recycling as materials	DfX	Collection service	Instructions for use

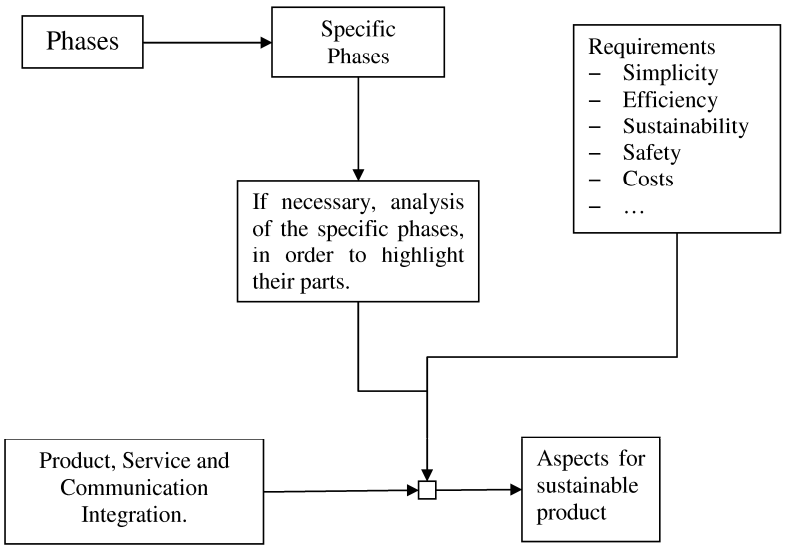

Figure 4. General procedure

In analogy to the well known "Design for X (DfX)" concept, it is possible to introduce the concept "Communication for X (CfX)", as to say an approach that considers also all the forms of communication related to the X-phase of the product [Rovida 2006].
It is possible to recognize a relation between DfX and CfX: this relation was first recognized, in the environmental field, by Manzini [Manzini 1998] and then confirmed by other authors [Santos-Reyes 2001]. Figure 5 shows a sample relation between the main aspects involved in these two methods.
The authors opinion is that this relation can generalized in almost every X-phases.

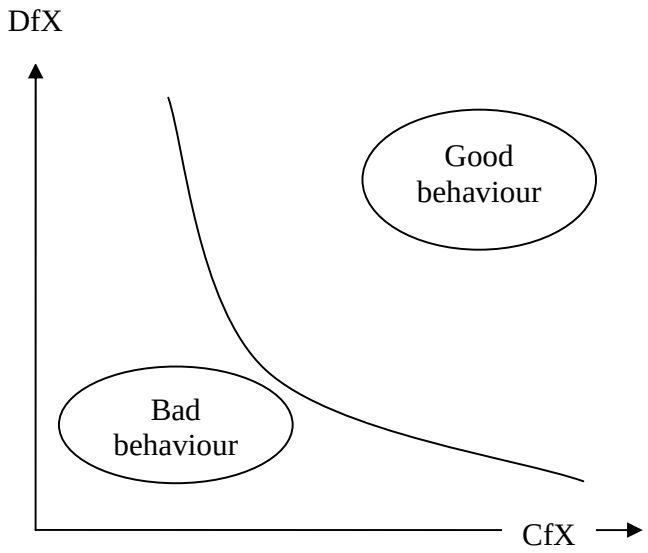

Figure 5. Relation of culture (CfX) and technology (DfX)

In the generic phase X of the life cycle, a good behaviour is obtainable both with a high DfX (high technology), or an high CfX (high communication and, consequently, high culture of users). Starting from the above developed considerations, it is possible to develop adequate communication means and techniques in each X-phase (e.g., instructions for users) to reach an high integration with the DfX design approach, with the aim of achieving a good behaviour in X-phase.
Finally, the integration with the service can be expressed by the concept “Service for X” (SfX): as to say the realization of the X-phase as a service, distribution of necessary parts and materials, collection of utilized parts and materials.
Even in the product-based solution it is also possible to consider the use of the product as a service: e.g, instead of purchasing a car, it is possible to propose a car-sharing system.
Figure 6 shows a synthesis of all the above mentioned concepts.

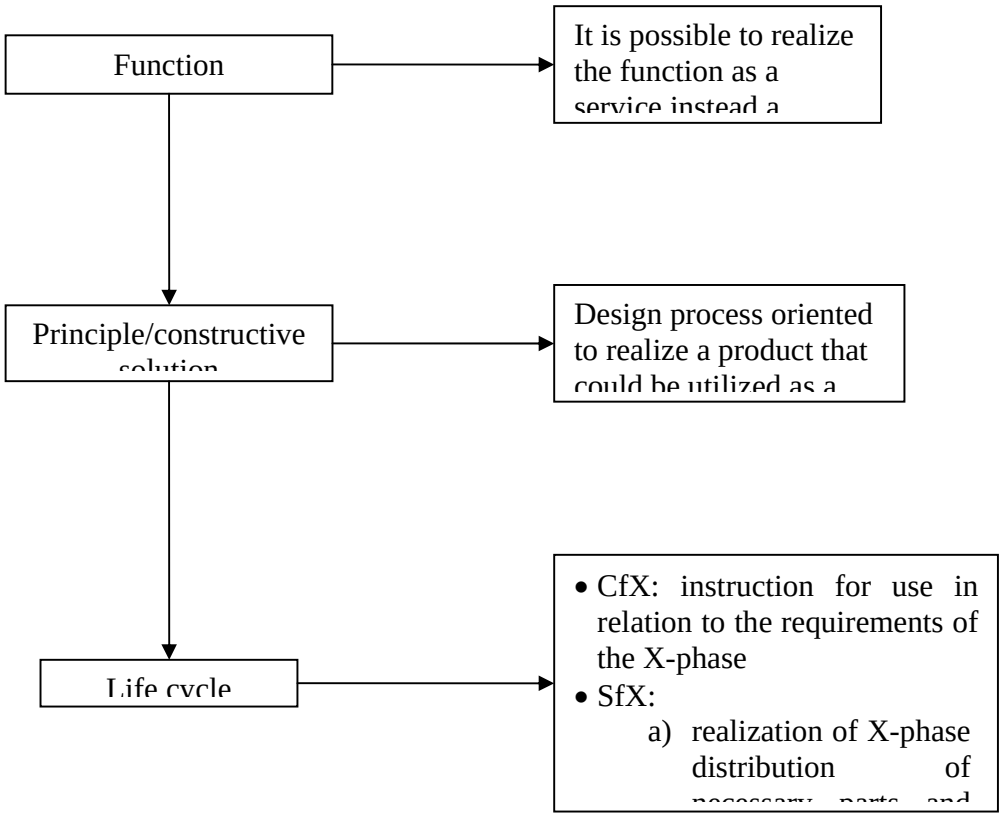

Figure 6. Service and communication as integration with the product

The following guidelines refer to the sample aspect “replacement parts easy to recycle as products”:

1. **Product**: DfX concepts could help to study products with parts that could accomplish at least the principal function (the first and fundamental function accomplished by the part) and, maybe after minor reconditioning, a secondary function (that could be accomplished after part removal from the first product).
2. **Service**: The possibility of utilization of parts for lower level function can be integrated within the DfX concepts. For example, it could be possible to organize a service to collect

the parts which principal function lifetime has been expired, and recondition and deliver them to the new users.

3. **Communication**: The user guide has to highlight that some parts could be re-used and the collection service will work: this shows once more the importance of a deep connection between design and communication.

4. Example

In order to show an example of the above described approach, the tyres problem will be analysed.
First of all, it is necessary to individuate all the possible use of a tyre at the end of its life.
Table 3 shows an example of this kind of analysis applied to this specific product.
In Table 4 there are some examples of "DfX" , "CfX" and "SfX" for the specific case.

Table 3 Tyres Liquidation

Specific phase	Description
Reuse	Tyres again used on vehicle
Reconditioning	Reconstructed tyres
Reutilizing	As protection elements, e.g. on ships, harbour, motordromes
Recycling	– energy: combustion, utilizing the thermal value of rubber (7.000 kcal/kg) – material: triturate tyres and add to other material, as beton or asphalt
Elimination	As waste in dump

Table 4. Aspects of the component "substitution".

	DfX	CfX	SfX
Reuse		▪ Instructions for use ▪ Indication on the tyre	Collection system of tyres and distribution service
Reconditioning			
Reutilizing		▪ Instructions for use with a collection of examples	
Recycling	▪ No substances that will become toxic during tyre combustion	▪ Instructions for use ▪ Course for operators	
Elimination	▪ Avoid the release of substance that will pollute the environment ▪ Biodegradability	▪ Instructions for use	

5. Conclusions

In analogy with the DfX approach, also communication and service management can be approached keeping in mind the whole life-cycle of the product, so that both can be more clearly defined and addressed to the particular phase of the product's life-cycle.

In this sense the DfX family of methodologies can be enlarged introducing and integrating the Communication for X and the Service for X concepts.
The integration among DfX, CfX and SfX would help the designer to improve the project and conception of a product for a determined objective (as cost, assembly facility, repairing or other). In particular product's sustainability could be greatly improved, since, as stated in the previous sections, user's culture could help in reducing the amount of waste and pollution: an adequate communication about the possibilities to use the product after is "normal" life, or about how to dispose it, can be a simple but valuable addendum to every instructions manuals.
This approach requires that there is a system of services that supports the user in the final phase of the product's life-cycle, in particular if the product to be dismissed is very complex and should be disassembled or requires particular procedures, equipments or to be treated in an industrial plant.

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