Assessment of supplier involvement in the product development process (PDP) based on a reference model for the food industry

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Abstract: Despite the successful involvement of suppliers in Product Development Processes (PDP), many companies still find it difficult to manage this involvement. One of the critical points is that such companies fail to clearly define their PDP and strategies in order to encourage supplier involvement. Consequently, there is no clear idea of how and when suppliers should be involved in PDPs. The purpose of this paper is to assess supplier involvement in the product development process based on a reference model for food products development. The model evaluated here involves some concern with supplier involvement in "know-how", reviewing the literature on supplier involvement in PDP to date.
Keywords: reference model, food, PDP, ESI

1. Introduction

In the current competitive market where products from different countries compete in common markets, consumers are provided with a wide array of options, and as a result are becoming more demanding in relation to the quality, price and performance of products.

In view of this situation, product development process (PDP) is fundamental for companies to become more competitive - from the correct identification of market opportunities to the launching of new products with a view to satisfying the new expectations and needs of customers as well as of other agents (e.g. stakeholders) involved in the development process.

In this sense, there are managing practices in the Supply Chain Management (SCM) that attempt to involve suppliers in PDP, especially by adding greater value to new products, allowing the companies to keep focused on their businesses and thus producing distinct products in relation to their competitors.

Despite the successful involvement of suppliers in product development process (PDP), many companies still find it difficult to manage this involvement. One of the critical points is that such companies do not clearly define their PDP and strategies for the involvement of suppliers. Consequently, there is no clear idea of how and when suppliers will be involved in the PDP.

Considering this problem, the current paper assesses activities and tasks present in a reference model for FPDP (Food Product Development Process) aiming to identify managing techniques and practices for the involvement of suppliers in PDP.

2. Practices adopted in supply chain management

Over the past years, one of the tendencies in Supply Chain Management (SCM) has been the restructuring and consolidation process of the supplier and customer base. This process can be summarized by the reduction of the number of suppliers with which the company intends to continue working and keeping a direct and effective communication channel. According to COLLINS et al. (1997), this tendency to reduce the supplier base associated with the tendency of *globalsourcing* and *followsourcing*, make a supplier base move towards exclusivity.

In practical terms, the suppliers' development and involvement activities in PDP can vary from a simple informal assessment of their operations to the creation of an investment program along with training, improvement of products and processes, among others. In general, the development of suppliers demands from both sides capital compromise, human resources, appropriate sharing of information as well as the creation of an appropriate mechanism to measure the performance of the development process.

Outsourcing is a practice based on a set of products and services used by a company (i.e. a supply chain) which is provided by another company in a collaborative and independent relationship. The supplying company continuously develops and improves performance and infrastructure to serve customers, who no longer owns it either fully or in part. According to PIRES (2004), outsourcing increases the flexibility of responses to demand, especially as regards development and launching of new products.

Many suppliers become specialized in manufacturing products and components which often were not developed by them. These suppliers are labeled *Contract Manufacturers* (CMs), and one of the main characteristics of these producers under contract is the fact that they are "brandless". CMs benefit mainly from specialization and scale and scope economies offered by the simultaneous production for many different clients. Manufacturing several products and similar components for various clients enables a CM to reduce and absorb better fixed costs.

In Plant Representatives – the full-time job of representatives in a supplying and client company creates a dynamic and highly-reliable channel of communication in the relationship between the companies involved. The most common situation is to have supplier's representatives along with the client. From the perspective of the client company (e.g. Tetra Pack), another possibility is to have client company's representatives allocated in its facilities.

Early Supplier Involvement (ESI) – the involvement of suppliers from the initial stage of the product design is a practice that spread widely in the last decade within the context of SCM. ESI involves the supplier early in the conceptual stage of the product, where the supplier brings its competence and know-how to the

service of a product developed more rapidly, at an lower cost and with a better quality. The factors that have led many industrial sectors to adopt ESI are explored by BIDAULT et al. (1996). These factors are divided into three main groups: 1) pressures coming from the external environment; 2) social and industrial rules in force; and 3) company options.

BIDAULT et al. (1996) propose five supplier involvement levels in the partnership. Level 1 (design supplier – development according to design): supplier receives the specification of technical needs from client (in terms of product and process) and provides the product following the standards of traditional sub-contract; Level 2 (design shared - shared design): supplier sends some input and feedback to client in terms of design, including improvements of costs and quality; Level 3: supplier participates effectively in the product conception based on the technical specifications of the client company; Level 4: based on the functional specifications and viability studies, supplier takes responsibility for the component design from conception to manufacturing. The ownership rights of the development can go either to the supplier or the client; and Level 5: based on the functional specifications, supplier takes full responsibility for the component design from conception to manufacturing. In this case, ownership rights for the development goes to supplier.

More recently, CALVI et al. (2001) put forward a model based on five levels of integration between client and supplier. This model presents five potential types of supplier involvement in PDP. Figure 1 illustrates the proposed model.

CALVI et al. (2001) also remind us that a fundamental point in ESI is not only the supplier involvement from the initial stage of the product, but also the appropriate way in which such involvement takes place and managed. In this sense, the models herein represented can serve as a good reference point for the issues being discussed. Moreover, these issues are not limited to the ESI context as they constitute interesting issues that can be used in outsourcing and partnership building.

Postponement – from the manufacturing perspective, the logic of this practice is to postpone (not to finish) the final configuration of the manufacture, as companies such as Dell Computers have successfully been doing.

The decoupling point is a very important concept in the context of postponement, as it is a link in the supply chain where the product is not produced in a generic way anymore (for storage), but it is produced to meet the order of a specific client. It becomes clear that the decoupling point divides the productive cycle into two distinct stages which are 1) mass production and 2) customized production. The positioning of the decoupling point varies a great deal from chain to chain.

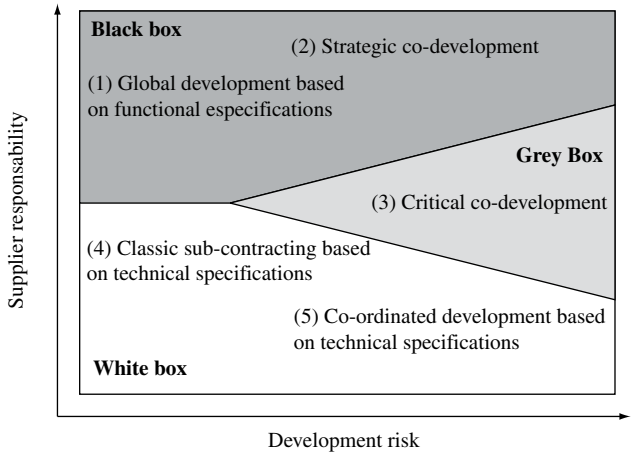

Figure 1. Five possible types of supplier involvement (adapted from CALVI et al., 2001).

According to PIRES (2004), in an increasingly globalized world, not all is positive about postponement. The basic logic of transfer from the decoupling point to a position closer to the final consumer has clear advantages in terms of reduction of production costs, logistic costs, etc. without damages to customization (even if limited) of the end product. However, postponement has also been a target for criticism when it is analyzed from the perspective of the exporting country, as the final stages of value-adding procedures are carried out to products in other countries and generate wealth away from the main producer. This trade-off must be considered.

3. Product development process

Product development process (PDP) includes managerial and technical aspects in which an organization transforms market opportunities and technical possibilities into information to be used in the production of a commercial product. This process includes the design development of a new product that is coherent with the "product life cycle", starting from its planning and finishing with its discontinuance and withdrawal from the market.

PDP is usually seen as a corporate function and not as an isolated activity carried out by the company. Also, the product development process tends to be a spread process rather than a centralized one (verticalized). It involves a large number of partners outside the corporation with the aim of meeting their client's needs.

There are many activities in the context of product development not directly connected to manage supplier involvement in the design of a new product. WYNSTRA et al. (2001) define four management areas for the integration of the supplier in the product development:

- **PDP Management** – establish management policies and guidelines for the involvement of suppliers in the product development, and define the technological areas of collaboration;
- **Management of the interface with the supplier** – build an infrastructure or supplier network which can contribute to product development process;
- **Design Management** – manage the involvement of specific development designs; and
- **Product Management** – define the specifications by means of a developed product.

According to WYNSTRA (ibid.), the basic objective of distinguishing the differences between the management areas above is to facilitate the definition of what to integrate. Studies in this particular research area do not define what is being integrated. They usually make gradual recommendations for the involvement of suppliers in product development process. The author's argument for such distinctions is based on features of activities found in practice.

4. Reference model for PDP in the food industry

PDP started to be outlined around the 60 s, however, the food industry took a long time to recognize and adopt PDP as a scientific method of research and development of products and processes.

Within this context, Food PDP models published in the scientific community and used here as reference are: GRAF & SAGUY (1991), MACKFIE (1994), FULLER (1994), RUDOLPH (1995), EARLE (1997), POLIGNAMO & DRUMOND (2001).

By means of this critical analysis of models found in the literature, it was noticed that no fairly detailed model for food PDP had yet been presented. In fact, none of the existing models provided ways in which these systems could be developed more easily and with a lower level of abstraction.

In view of this problem, two models were developed at *Núcleo de Desenvolvimento Integrado de Produto* (NeDIP – Nucleus of Integrated Product Development) in the Department of Mechanical Engineering from University Federal of Santa Catarina, Brazil: the models were proposed by PENSO (2003) and SANTOS (2004). The two models complement each other, but in this paper they are treated as a single one. These models aim to organize information along the food product development process.

The model proposed for FPDP (Food Product Development Process) by the authors has three macro-stages: 1) pre-development; 2) development; and 3) post-development. For each knowledge domain there is a set of activities and tasks that must to be carried out. These activities require interaction with different company departments.

Each stage of the developed model is described by means of activities, tasks, inputs, outputs, methods, tools and support documents. The tasks and activities represent "what to do" and the methods and tools represent "how it is to be done". Inputs and outputs are the physical resources or the information necessary to carry out the activities and tasks. Figure 2 illustrates the detailed structure of the model developed herein.

Based on the information provided by the model, activities related to the suppliers were extracted with the aim of identifying management practices and techniques for the involvement of suppliers in FPDP.

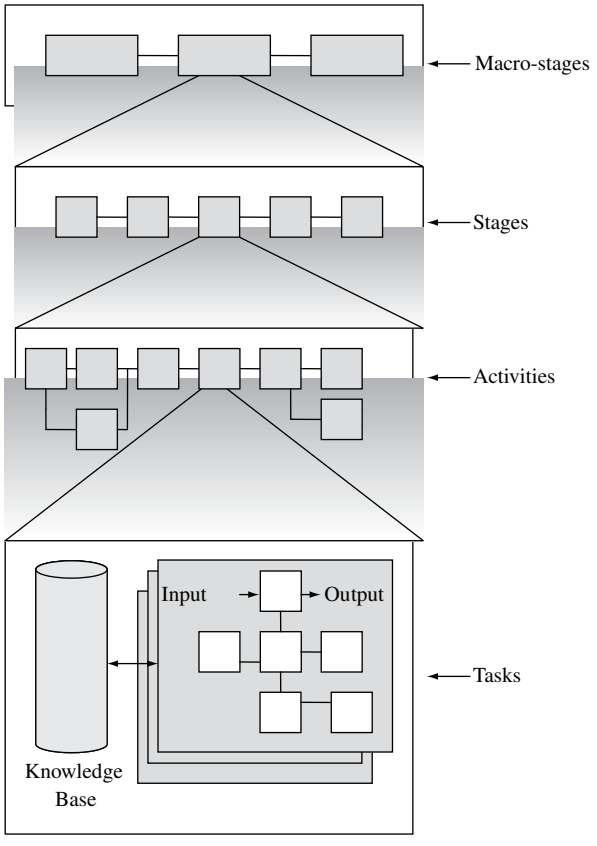

Figure 2. Detailed structure of a reference model for food product development process.

At the pre-development macro-stage of the proposed model, the report of technological opportunities is produced. This report specifies the available and necessary technologies for the development of a new product as well as information that can be used to produce a innovative product. Table 1 presents a summary of the development macro-stages of the model for PDP in the food industry.

Suppliers are usually investigated in terms of their potentialities at the pre-development and product development macro-stages. At the preliminary design stage, it is decided whether the product will be produced or purchased. At the detailed design and launching stages, the relationship of the product with other links of the supply chain is studied.

The objective of the models proposed by PENSO (2003) and SANTOS (2004) is not the involvement and management of suppliers in the FPDP. However, through the rereading of the models, it is possible to notice a certain concern with the involvement of suppliers along the whole PDP. The main distinction between WYNSTRA et al. (2001) proposal and the model developed herein is in the organization of the activities at tactical, operational and managerial levels. In the case of the model for FPDP there is a concern with "know-how", thus aiding the decision-making process.

5. Final comments

The literature studied up to the present moment about the involvement of suppliers in PDP presents a high level of abstraction using a typology very similar to the types of supplier involvement. Important aspects of this involvement, such as quality of the exchanged information, kind of exchanged information, tools, resources and devices used, contract records, legal aspects between purchases and development sectors, among others, are not considered in detail.

A more intensive study of the supply chain management practices in the involvement of suppliers in PDP aids companies in the decision-making in terms of the strategies to adopt in the involvement of the client. The creation of a document that establishes the basic guidelines for the company in dealing with its suppliers must be made by the higher management with the intent to advise the design team about the company policies in relation to the suppliers and co-development partnerships.

While the widening of the research work scope must be analyzed by considering an integrated focus on the product and collaborative development, different aspects must also be jointly analyzed such as organizational aspects (e.g. structure of design team, responsibility sharing, integration mechanisms, among others), aspects related to the determinants of contract duration (i.e. legal aspect), aspects related to the information technologies, methods and tools, among others. These aspects must be included in a way that makes it clear when and how to involve suppliers in FPDP.

Therefore, there is room for improvement in the model proposed for PDP in the food industry, through the widening of the scope and the involvement of the supply chain in order to aid companies to define when and how to involve new partners in the development of a new product and aid a supply chain design structured from the beginning of PDP. Such observations are being investigated in a doctoral thesis proposal.

This study continues to be carried out through PhD design being currently developed (Design for Supplier Chain Management, Product Design and Process Design - 3D), at Research *Grupo de Engenharia de Produto e Processo* (GEPP – Group of product and process engineering) the Department of Mechanical Engineering from

Table 1. Summary of the development macro-stage of a model for PDP in the food industry.

Informational design	The objective of the informational design stage is the generation of technical specifications for the design. To do so, it is necessary to understand who the clients are, what their necessities, and what design requirements and restrictions exist to produce the product. The use of methods and techniques of sensorial analysis and experiment design as well as scientific literature and information coming from equipment, raw material and packaging, suppliers help to fill in the Quality Function Deployment (QFD) matrices, which is the principal method adopted at this stage. The activity of gathering information for the design involves research into new technologies and product and process restrictions, while the suppliers are one of the main sources of research. Due to the complexity involved in the development of a food product, there is a necessity to analyze the design specifications of the process in relation to the involvement of the supplier. To help in this activity, a supplier involvement plan is devised and contemplated on the next stages of the FPDP model.
Conceptual design	This design aims to develop the product and also the production process concept. At this stage the suppliers are involved in the activity of developing alternatives for the formulation of the product, alternatives for the production process and packaging of the product being developed. In a morphological matrix it is possible to combine different product formulations, different processes and different concepts to conceive the final product, aiming to identify the concept which has the best potential to meet the design specifications. These concepts need to be tested so that the concept with the greatest potential to meet the design specifications can be selected. Therefore, the involvement of suppliers become indespensable on this stage, which includes two activities: • Prepare alternatives for tests whose objective is to prepare a structure (in case there is not one) in order to test the alternatives of product formulation and of process. These tests can be carried out in a laboratory, industrial kitchen or pilot plan, simulating the process of food transformation in the best possible way; • Analyze and execute the test samples. These activities can be carried out in the supplier's facilities or with the aid of the supplier in just a few processes. At this stage the involvement of suppliers in the proposition of alternatives to conceive the product is suggested. At this stage, suppliers along with the client, assess the fulfilment of the technical specifications. Tests are jointly carried out to comply with the client's requests.
Preliminary design	This design aims to establish the final formulation of the product, final layout of the process and the assessment of its economic viability. One of the objectives of this stage is whether This stage includes the decision of making or buying, which has as its objective to decide whether it is more viable to develop, produce or buy, for instance, raw materials, ingredients and additives, equipment and packaging). At this stage costs, time, capacities and competence to develop and supply raw materials, ingredients and additives, equipment and packaging are investigated. With the information about costs, process behavior, process and product specifications, parameters of process control, security and product quality, the decision of what will be produced and bought is made. Afterwards, the technical specifications for the purchase of supplies will be prepared and the contract with the suppliers will be signed. One of the main activities at this stage is the application of product tests in pilot lines or industrial plans. Initially, the plan for the product test is devised, involving the equipment supplier. The samples of ingredients/additives and raw materials are analyzed with the aim of guaranteeing, controlling and identifying possible quality deviations in the raw materials that will be used. At this stage of the proposed model there is sufficient information to make decisions about which SCM practices are to be adopted with the suppliers involved in the development of the developed. Different SCM practices can be adopted for different suppliers in the same design.
Detailed design	The Detailed Design stage has as its objective to detail the industrial plan for the production of the product being developed. The beginning of this stage entails the use of information coming from the preliminary design stage: documents referring to the design technical specifications for purchase, suppliers' proposal report; report on the industrial facility needs, report on the peripherals' needs; report on the process behavior, report on the product and process tests. The preparation of a co-development design plan is required because of the partners involved in the making of the industrial plant. In this co-development design plan, information is shared with suppliers (equipment and services) for the preparation of the industrial plant. At the end of this stage, the assessment of the detailed design stage is carried out, which refers to the formal acceptance of the industrial plan design where the authorization for the production stage is given. At this stage, the design can be revised or cancelled. At the detailed design stage, the signing of the contracts with the suppliers involved is carried out.
Production Preparation	This stage involves the implementation of the product in the production line and the closing of the design. Suppliers at this stage are highly involved with the success or failure of the design being developed, while the principal output of this stage is the pilot batch of the product. This activity takes place after the complete implementation of the industrial plan, operation and assessment procedures of the optimization possibilities of the product and process are tested.

University Federal of Santa Catarina, Brazil. Further information about the developed reference model, please contact the authors.

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