ININVOLVEMENT ASSESSMENT OF SUPPLIERS IN THE PRODUCT DEVELOPMENT PROCESS (PDP) FOR THE TILE CERAMIC INDUSTRY

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Abstract
The organizations’ ability to new product development by means both technological answers and their ability to meet customer needs does not guarantee the survival of market stability. Today, businesses depend on strategic relations with their customers and suppliers to create value for developing product and to obtain better mark-share. 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 purpose of the present paper is to supply a path for the ceramic tile industry aiming to identify managing techniques and practice for the involvement of suppliers in PDP. For solve this problem, it was used a model reference for PDP and practices adopted in supply
chain management. This work contains an assessment the product development process in a ceramic tile industry in the south area of Brazil, Santa of Catarina State; in addition it presents possibilities of challenges and opportunities for ceramic tile industry competitiveness.

**Keywords:** product development process; ceramic tile industry; supply chain management.

1 Introduction

The Brazilian Ceramic Tile Industry is a sector controlled by suppliers. Innovations originate from equipment and input producers, having an impact on productive processes and on the characteristics and quality of products. Suppliers of ceramic colors (enamel) have played a central role in the ceramic coating sector. They are responsible for most relevant innovations both in processes and products, whose life cycle varies in most cases between two and three years.

The Brazilian Ceramic Tile Industry is one of the four leading world industries in the sector. It is the third largest world producer per square meter ($m^2$) and the second largest consuming market in the world per square meter ($m^2$). The Ceramic Tile Industry of Santa Catarina accounts for approximately 55% of the Brazilian export of ceramic tiles.

However, a study carried out by Kieckbusch & Lopes (2005) on Santa Catarina ceramic tile industry concluded that there is a lack of a structured taxonomy for the ceramic product development process (PDP). A structured taxonomy that makes companies more competitive - from the correct identification of market opportunities to the launching of new products - taking into consideration important aspects of the supply chain such as the involvement of suppliers in the PDP. In this sense, this paper seeks to awaken the interest of ceramic tile companies in a systematized product development process in which actions can be planned, improved and controlled.

Within this context, this paper aims to assess the involvement of suppliers in the PDP of ceramic tile companies based on a reference model for the product development process.
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 follow sourcing, 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 a 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: (i) pressures coming from the external environment; (ii) social and industrial rules in force; and (iii) 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; 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.

3 The Reference Model for Product Development Process

The product development process is one of the business processes of the supply chain management (Lambert & Cooper, 2000) by which an organization transforms market and technical opportunities into information so as to produce a commercial product (Clark & Fugimoto, 1991).

The reference model for the product development process was developed by Rozenfeld et al. (2006) and it stemmed from the marriage of methodologies, case studies, models and best practices developed and recorded in the last years by the research teams coordinated by professor Henrique Rozenfeld from Núcleo de Manufatura Integrada por Computador (NUMA) at USP [Nucleus of Integrated Manufacture by Computer at the University of São Paulo], professor José Carlos Toledo from Grupo de Estudo e Pesquisa em Qualidade (GEPEQ) at UFSCar...
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The model is divided into three macro-stages: pre-development, development and post-development. Each stage of the model is described by means of activities, tasks, inputs, methods, tools and supporting documentation. Tasks and activities represent “what” needs to be done and the methods and tools “the how of it”. Inputs and outputs are physical resources or information necessary to perform such activities and tasks (see Figure 2).

![Figure 2 - Reference model for product development process (adapted from Rozenfeld et al, 2006)](image)

4 The Reference Model for Product Development Process

The marketing area is the source of data for the development of new products. The largest companies adopt a strategy used by European companies, thus paying little attention to the new Brazilian designs and tendencies, as it occurs in Italian companies which have the image of the brand “Made in Italy”.

With the idea of products at hand, the product development team will investigate how this product can be produced; whether there is available technology in the market; who the main suppliers of raw materials, ceramic colors and equipment are; and if there are plans already installed with this technology. Thus, a preliminary economic assessment of the objectives of the company is carried out.
Input suppliers can be divided into two types of raw materials used in producing ceramic coatings: non-metallic minerals (clay and rocks) which form the ceramic body and the enameled components (frits, colors and chemical additives) which cover the higher surface of ceramic pieces.

As regards the suppliers of mineral input, there is a certain opposition of ceramic companies for strategical reasons to outsource extraction, especially due to the fact that these companies already possess equipment and also due to the non-existence of a larger and better qualified group of suppliers.

Suppliers of enamel components mostly consist of branches of foreign companies, especially those of Spanish origin, which apart from offering inputs, also offer design, tests and all technical assistance in the enameling area for the companies. The development of a prototype product consists of attempting to reproduce the concept of a product in a smaller scale (laboratory or pilot plan). Industrial plans offer an advantage as they provide the real behavior of a product in process, reducing the number of variables during the tests. However, assembly line stoppage is necessary to carry out the product tests.

For a “new manufacturing plan”, the plans of manufacture’s equipment are generally used. Production flowsheets are discussed between the equipment suppliers and the product development team with representatives in the areas of engineering, production and quality control. However, methods or tools that aid decision-making were not verified.

The product development process concentrates especially on the traditional areas of R&D, in which one considers that the success of product developing companies depends mostly on the professionals who work in this area and on the larger amounts of money made available to them.

A detailed and ordered methodological deployment of PDP, which provides companies with the security of controlling its product development process, was not observed in the surveyed companies. On the contrary, the work is carried out in a way that the decisions made by professionals are based on their previous knowledge and environmental conditions.
5 The Involvement of Suppliers in the PDP of Santa Catarina Ceramic Tile Industry.

Due to the lack of a detailed methodological deployment as well as methods and tools to aid the decision making in the product development process, an assessment of the involvement of suppliers was carried out using the reference model for PDP.

5.1 Pre-development stage

Product Strategical Planning Stage: in practice, it means a list describing a company's product line and designs to be developed, which will help to reach the strategic goals of the business. One of the main tools in this stage, which involves the suppliers, is the competitive intelligence tool. Among the surveyed companies, only one large company uses the tools of competitive intelligence as a way to maintain and increase its competitive advantage in the market. One of the main activities in this stage is the analysis of the company's product portfolio. Generally, this analysis is carried out only in large companies.

Design Planning Stage: one of the main objectives of this stage is to identify those who are interested and involved in the design based on the possible types of supplier involvement in the PDP as proposed by Calvi et al. (2001). The surveyed companies usually present a low level of supplier involvement in their product development process, but, on the other hand, the inputs and equipment provided are the equivalent of flight/event data recorders (black boxes) for ceramic tile companies.

5.2 Development stage

Informational Design Stage: the objective of this stage is to generate the target specifications for the product. It was observed in some of the surveyed companies that the necessities of all clients involved in the design of a new product (see Figure 3) are not defined. Many companies heavily focus on intermediary clients, and as a result there is no detailed study on the necessities of the consuming sectors. This can generate some problems for the company as regards its other business processes such as environmental, manufacture and product use processes.
Conceptual Design Stage: the objective of this stage is to generate the product concept from its target specifications. It is at this stage that there is a large involvement of the suppliers of enamel input; however, one can also observe that there is a great necessity for methods and tools that aid PDP teams in the decision-making process of the surveyed companies. At this stage, combined tests are conducted with the objective of responding to the client’s requests.

Detailed Design Stage: The main objective of this phase is to detail the new product that will be produced based on information originated in the previous stages. Also, the suppliers of the industrial plan, which receives adjustments of the production process, are involved in this stage.

Production Preparation Stage: 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 in the success or failure of the developing design and the main output of this stage is the pilot lot of the product. This activity begins after the complete installation of the industrial plan, the operation procedures are tested and the assessment of the possibilities of optimizing product and process.
The results from the pilot lot are assessed and there are situations in which the product or process needs some adjustments before the design is finalized.

6 Concluding Remarks

At present the literature investigates the involvement of suppliers in the PDP and presents a high level of abstraction using a very similar typology in the involvement of suppliers for different types of industry and without considering the particularities of each productive sector.

The product development process is recognized by companies as an essential process in order to be more competitive in the market. However, the surveyed companies need subsidies to integrate and optimize the different aspects involved in the PDP, for example, the need for methods and tools to aid decision making, especially in relation to the involvement of the supplier in the PDP.

PDP depends also on the model and management adopted, that is, even having specialists in the development of the product, it is possible and necessary to manage the PDP, planning, carrying out and controlling activities in order to seek for the best performance and learning results.

Despite the fact that innovations in the sector depend on the suppliers, there is still certain neglect as regards PDP. Most companies HAVE invested heavily in the last years to bring their products up to international standards for exportation, but still there are some problems in the management of the PDP preventing these companies from keeping competitive in their operating markets.

A more detailed study on the management practices of supply chains, especially as regards the involvement of suppliers in the PDP, can help companies make decisions in relation to the strategies adopted for the involvement of the supplier.

The suggestion of future work as the modeling of a reference model for the ceramic PDP – considering the particularities of the sector – can enable something more than the competitive advantage of cost and the technical development of the product. It can enable higher speed and reliability of delivery and flexibility.
Studies on the development of design with an authentic “made in Brazil brand” can become a competitive advantage by means of the market niches that have not yet been explored.

As for the involvement of suppliers, it can be observed that such involvement is vital for the ceramic coating sector. Nevertheless, a structured model taking into consideration the particularities of the supply chain can anticipate problem solutions and especially improve the suitability of the product concept as to the user's necessities, that is, the quality of the developed product.

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