

FURNITURE INDUSTRIE: WHAT NEEDS TO CHANGE IN THE PRODUCT DEVELOPMENT PROCESS?

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ABSTRACT: *Companies are increasingly dedicated to improve the conception and development stages of new products, aiming at increasing their competitive advantage by the reduction of the time-to-market. One strategy consists on using new methods and techniques to achieve these goals. Companies not able to adjust to the requirements imposed by the market, such as focus on customer needs and product quality, are in danger of being eliminated by its competitors. In this context, the product development process is becoming a differential in the competition between industries. However, specially small companies fail to live up to the standards regarding to best practices in management, technology and marketing capabilities needed to adapt to this evolution and survive in the globalized world. The furniture industry faces such challenges, although they have managed to continue to grow, responding to increasing market demand, and have a significant importance in the economy of most producing countries. It still is characterized mainly as a handcraft industry, if compared to other industry sectors. Brazil is no exception to the common industry organization, where companies are arranged as clusters of small companies, established in accordance with the local productive culture of each region, known locally as “Polo Regional”. Companies are traditionally owned and managed by family members; the productive process is based on the experience acquired through learning by doing methods, with little documentation or standardization of practical or tacit knowledge. Production is hardly managed using formal measurement and control systems based in performance indicators, not to mention the use of continuous improvement tools for quality management common to more structured sectors. In many furniture companies, the product conception and development processes are informal, frequently based on copying products from leading competitors, from customers, without major systematisation or documentation of procedures. The empirical knowledge acquired during many years of practice is preponderant, making change processes difficult, especially in the complex activity of creating new products. This article describes a case study in the Product Development Process - PDP carried out in a furniture company in Brazil. This study aims at contributing to the development of a PDP method to help companies to structure their product development process, believing it is crucial to improve their strategic competence in innovation. The field research showed two questions: a structured PDP are still not in place; deficiencies in communication among development team members are frequent, often causing wastes of some nature. The article discusses the importance of the PDP in this complex globalized market, in order to respond to changing consumer demands. It describes the gaps small companies in the furniture industry present and the difficulties they face to put current best practices in place: to better understand and internally disseminate customer needs, to project products which respond to customer demands and to integrate development and production in order to establish continuous improvement processes needed to keep pace with the competition in the hard field of innovation.*

KEYWORDS: *Product Development, Furniture Design, Industrial Design, Lean Product Development*

1. INTRODUCTION

The strong competition industries face nowadays along with the global economic crisis create an appropriated environment for change in the Product Development Process (PDP). One way companies under market pressure respond is replacing their old PDP's by turning them into more competitive and efficient processes. The furniture

industry is affected by such pressures. According to Schuler and Buehlman (2003), furniture became international consumer good, forcing companies to redirect their competitive strategies towards adopting new business and new product innovation models.

In most countries the furniture industry is highly fragmented and made out of mainly small and medium companies. There is a tradition of property and familiar management. In this context, decisions regarding new product developments are centralized and made without proper consideration of consumer needs - Leslie e Reimer (2003). A company's success can be related to its capacity to introduce new products into the market. Product differentiation is the basis for competitive advantaged, concerning several aspects like consumer needs, quality, development cycle and cost. Literature reports on success cases of manufacturing companies that managed to overcome competitive challenges by adopting a management model based on "lean thinking" principles. Created and applied by Toyota at the 50's, it was not until the late 90's that they became known and recognized in Western Europe, when the book written by Womack, Jone and Roos (1990) was published. From that moment on, lean thinking is becoming a new paradigm – a tool to increase product value from the costumer's point of view, a tool to reduce costs by eliminating wastes (Machado, 2006; Liker 2004; Morgan and Liker, 2006; Womack et al, 1990).

The central issue of this research arises: *is it possible to build a method for the initial phases of product development using lean principles?* To answer this question we will create a product development method using lean principles and will validate it by applying in the furniture industry. Our main goal is to create a method that can direct the new product development (NPD) team and help to understand and to put into practice some techniques that can improve PDP. We intend to create a culture of learning that relies on lean thinking in order to pursue excellence in product quality.

We believe that the adoption of a new method of continuous improvement based on practical knowledge, aiming to widen comprehension, perception and team potential awareness, as well as interpretation of customer needs and understanding how to do more with fewer resources, could help NPD of furniture industries.

2. THE FURNITURE INDUSTRY IN BRAZIL

The Brazilian furniture industry comprises over 16 thousand companies (75% very small companies, 21% small, 2,3% medium and 1,7% large companies), employing over 206 thousand direct workers. With a turnover of 991 million dollars, the industry is dependent on the external market (ABIMOVEL, 2006) and run by familiar management. Exports are concentrated in the South (São Bento do Sul-SC and Bento Gonçalves-RS), where 57% of export companies are located. Other industrial clusters are located in São Paulo-SP, Araçatuba-PR, Ubá-MG (Garcia e Motta, 2007). Export destinations are the USA (34%), France (14%), Argentina (14%), United Kingdom (8%) and Netherlands (5%) (ABIMOVEL, 2006). Authors such as Luza (2003), Rodrigues (2005), Quadros (2002) present evidences of the productive potential of the region on one side and the need for investments to improve innovation, management, technology and production competences on the other side. There has been a major growth in furniture production but there is still a lot to do what concerns product development methods, original designs and strategies for product differentiation.

3. THE IMPORTANCE OF NEW PRODUCT DEVELOPMENT

In the fast changing and turbulent environment, new product development process is one important strategy to win a competitive advantage Nunes (2004). According to Ulrich e Eppinger (2004), the term NPD comprises a set of complex activities, from the product idealization to the product or service delivery to the customer at the marketplace. Literature shows that the implementation of structured development processes with built-in flexibility can increase the probability of product development success Cooper (1995). As found by Griffin, (1997), the best performing firms are more likely to have NPD processes and strategies in place. Several models of product development have been proposed and used in the past: from traditional craftwork to new models based on more dynamic and flexible methodologies, as reviewed by several authors such as Ulrich e Eppinger (2004) and Hatchuel (2003).

Early development projects often used unsystematic methods. As the production systems complexity increase, more disciplined methodological approaches were advocated Fitzgerald (1998). Even so, Griffin (1997) found that 38.5% of USA firms did not use a formal process for managing NPD; Fitzgerald (1998) in a study of 776 organizations on the adoption of product development methodologies observed that 60% did not use any of these techniques. Companies using some methodology referred to it as a negative factor that could lead to inertia in the development process and interfere with actual work. On the positive side, it was referred that NPD methodologies facilitate project control and increase visibility of the development process.

The methodologies of new product development processes used by many companies are generally centred on the adoption of a formal systematic design model, as proposed by Pahl (1988), which distinguishes three stages in a design process (functional, conceptual and embodiment design), or the stage gate processes, proposed by Cooper (1995). In the stage gate method, the development process is controlled through several formal reviews (the gates). The quality, cost and especially the lead time pressures can dictate the activities that are overlapped and the time of each phase. The

sequential models with a variable number of interactions represent the traditional paradigm, as seen for example in Cooper (1995) and Ulrich and Eppinger (2004) models.

Product development models provide a roadmap to transform an idea into a concept and a viable product. All models aim to speed up the development pace and increase the innovation process success rate, through more creative and innovative products. However, given the uncertainty associated to the development process, authors like Tomke and Reinerstein (1998) recommended the process should be designed to be sufficiently flexible so that every contingency is accounted for. Most functional areas of a company are generally involved in a NPD process (Morgan and Liker, 2004; Nunes 2004).

Morgan and Liker (2004) pointed out the increasing role of NPD excellence as a strategic differentiation factor, considered nowadays more important than the production capacity itself. Thus, they proposed a framework based on Toyota's Product Development System, based on 13 principles divided into three subsystems as described in Table 1: People, Process, and Tools and Technology. In a lean NPD system model, these three subsystems are interrelated and interdependent, affecting an organization's ability to achieve its goal.

Process	People	Tools & Technology
1. Establish customer defined value to separate Added-Value from Waste.	5. Develop a Chief Engineering System to Integrate Development from Start to Finish.	11. Adapt Technology to Fit your People and Process.
2. Front-Load the Product Development Process to Explore Thoroughly Alternative Solutions while there is Maximum Design Space.	6. Organize to Balance Functional Expertise and Cross-Functional Integration.	12. Align Your Organization Through Simple, Visual Communication.
3. Create a Leveled Product Development Process Flow.	7. Develop Towering Technical Competence in all Engineers.	13. Use Powerful Tools for Standardization and Organizational Learning.
4. Use Rigorous Standardization to Reduce Variation, Create Flexibility and Predictable Customers.	8. Fully Integrate Suppliers into the Product Development System.	
	9. Build in Learning and Continuous Improvement.	
	10. Build a Culture to Support Excellence and Relentless Improvement.	

Source: Morgan and Liker (2004)

TABLE 1. Lean product development model and 13 principles of the Toyota PD System

The study being reported aims to understand the specificities of the furniture industry and analyze in what extend and how the principles of Morgan and Liker's model are applicable in the context of this specific industry sector.

4. METHODOLOGY

This research adopts the case study strategy proposed by Yin (2003) and uses as framework the principles of Toyota's Product Development System, identified by Morgan and Liker (2004). The present work can be classified as exploratory qualitative research, using the case study method (Bryman (2000) and Symon & Cassel (1999)). The study involved two phases: collect data and information related to the problem proposed, and definition of the method. Data collection was carried out by semi-structured interviews to directors, designers and NPD team members, production engineers and staff involved in the product design and development and by direct observation of NPD related activities. Data collection was carried out on March, August and September of 2007, during 13 visits. The topics discussed were related to: people, NPD process, production techniques, product families and company profile and culture (illustrated in figure 1).



FIGURE 1 – Interviews Topics

Main questions used during the interviews:

- How do you define the types of products developed at your company?
- How do you identify customer needs?
- Do you use any type of structured methods of product development?
- Which are the main difficulties associated to NPD?

4.1 CHARACTERIZATION OF THE STUDIED COMPANY

Our case study is a medium sized export manufacturing company, producing wood furniture for the residential and office markets. It is among the 10 major exporters of the cluster located in the South of Brazil (São Bento do Sul). It operates on an 13,000 m² plant area, with about 300 employees. Since 1993, 100% of production is exported. Main customers are located in the United States in and some European countries. Management counts on three professional directors and 19 sector leaders.

5. RESULTS AND DISCUSSION

As stated above, a well structured NPD may be one of the company's strategies to pursue innovation and to overcome the challenges imposed by competition. Innovation can be deployed through the adoption of new ideas and behaviours, but change in industrial organizational structures are not easy to implement, as we observed in practice. Preliminary research results show a lack of formalized NPD process in the company studied, neither traditional nor lean approaches are in place. Most product developments are based on reverse engineering (for export markets) or less detailed designs (for the internal market). A gap were identified comparing lean practices recommended for NPD as described in literature with the actual practices observed in the field research. Knowledge about the lean principles is almost nonexistent. There is awareness and a will to move towards a more innovative design pursuing higher profitability rates. However, there is diffidence and resistance by some team members, mainly in design development areas, as expressed by the production manager: "We have a hard time to convince elder employees to learn new processes. The problem is not only their individual unwillingness, but also the influence on others, making it difficult to teach new methods and routines". We observed that senior management agrees on the need for change in order to survive in the market place: "We have the know-how and the practice, the University has the scientific knowledge, the paths for innovation, and we need to modernize and improve our productivity and products." Regarding product development, this manufacturing company seems to follow what literature recommends: companies must faithfully satisfy the consumer's wishes. However, the process used to generate products seems not to support company's capability to design innovative products. The development stages are based on information received from trading agents and the presence of an intermediary actor between end customers and the NPD team often makes the interpretation of customer needs more difficult. It is a work based on reverse engineering, a common procedure among furniture companies in Brazil, according to studies presented by authors previously cited. Not having a feedback from end-customers present a challenge to many companies in Brazil. This makes the market timing process slower. Figure 2 below shows the study case company NPD steps.

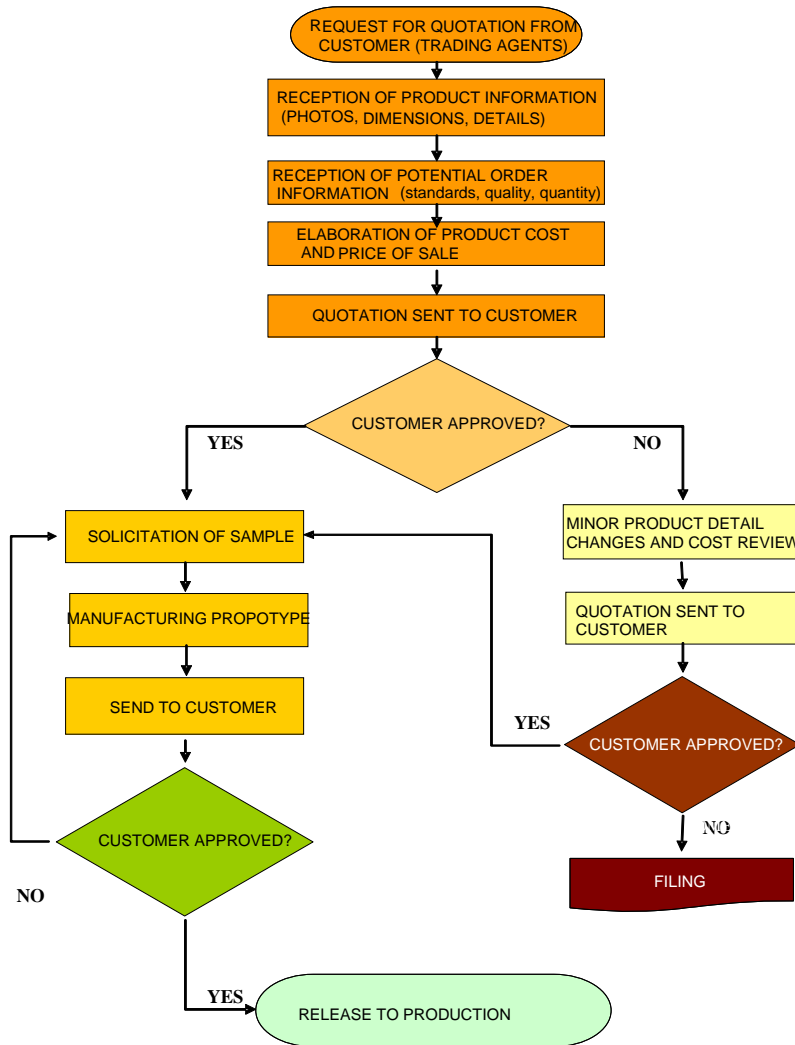


FIGURE 02 - NPD flowchart of study case product development

The company studied has adapted to a cost-based competitive strategy, since target price is a customer mandatory requirement. The main customers for the export markets are private label clients (production for brands under product design definition with some degree of detail changes), represented mostly by intermediate trading agents. As a typical local furniture industry, this has a centralized familiar management and long production lead-times. Decision to introduce a new product is generally made after a first trader/distributor/customer contact, asking for a price quotation on the basis of less or more detailed drawings. Upon acceptance of the quotation, the prototype development and approval follows, resulting or not in an order placement for production. Lead times over 4 months for a product line made out of about 6 to 10 pieces of furniture are typical. Long lead-times reflect low flexibility to customer needs. Although managers recognize the problem, they do not seem to be aware of the central role that product development techniques might play in the solution. Along with product development they face production management challenges: long production lead-times due to big production lots, characteristic of mass production systems, quality problems and rework with the well known impacts on production costs.

The industry best practices in place are based on mass production techniques. The impact of implementing lean practices or the prospect of using Toyota's model to restructure the furniture industry is still unknown. The background described justifies the research question: *Can lean thinking principles, methods and tools be applied in product development in a traditional sector such as the furniture industry?*

Research conducted so far identified several shortcomings:

1. The furniture industry does not use any formal NPD management process; thus there is a need to build competences through a learning process of well establish best practices in other industries;
2. A reduced set of lean principles should be used to structure a NPD method for the furniture industry, compared to more complex industries such as automotive or aeronautical industries. The NPD process should take also into account

the fact we are dealing primarily with small and medium companies, with limited human resources that have to play a polyvalent role.

Thus, the current research focused on a more limited set of basic principles than the subsystems proposed by Morgan and Liker (2004). The principles chosen to be applied in each subsystem are:

- a) Process: establish customer defined value to separate added-value from waste; front-load the product development process to explore thoroughly alternative solutions while there is maximum design space;
- b) People: develop a “chief engineer” system to integrate development from start to finish; Build in Learning and Continuous Improvement.
- c) Tools & Technology: align the organization through simple, visual communication; use powerful tools for standardization and organizational learning.

The work reported in this paper is related to the first subsystem “Process”, with particular emphasis the value assessment in the PDP. The set of principles that form the subsystem Process, according to Morgan and Liker (2004), includes all the tasks needed to take a product since the concept until production start up. Particular attention was paid to the current PDP practices of the studied company, to compare the actual situation with recommended lean principles, presented in Table 3, focused on the Value assessment according to Morgan and Liker (2004).

Lean practices	Practices in study case company
The consumer is the initial point for value definition according to its necessities and preferences	A standard method to interact with end customer is not available, customer needs are defined by intermediary trading agents
It concentrates all the efforts in the gathering of information that disclose the specific value of the product, defined for the customer preferences	Information of customer needs are scarce and vague, generating poor and incomplete product briefings
It uses tools and methods to understand and create the value defined by customer, aligned with the company objectives.	Tools and methods for customer value definition not available, company’s goals are mostly unknown to team members
To develop generation of concepts with the exact comprehension of value from the customer perspective	The concepts development is not based on the exact costumer requirements. Reverse engineering is used instead, from a pre-defined concept (copy)
The chief-engineer is fundamental and acts to integrate teams and to line up the objectives throughout the program	The chief-engineer in the studied company does not exist. Development work is fragmented
To produce a report with all the gathered information (qualitative and quantitative objectives) documenting the generated concept to submit to consensus and approval	This document is not elaborated and the concept idealization is carried out by the company director

TABLE 3. Lean versus current furniture industry practices for value identification

Table 3 reveals a gap to be filled in value identification practices between lean recommendations and the current case study practices. A premise of this work is that a method structured by a set of activities and techniques helps the PDP team to interpret the necessities and define customer value. There is a will to move in the direction of process improvement, towards a more innovative design and higher profits, as stated by a company manager: *“Everything should be done to increase process flexibility, to use fewer resources without compromising product quality, supporting us to compete with multinational companies.”*

Two important problems are the information flow and the communication process, both internal among team members and external with the end-customer. Both make value identification and waste elimination difficult. Lean thinking considers the information flow a key part of PDP. In the case study, communication is a visible flaw admitted by the PDP team, as stated by a PDP member (prototype production): *“Many mistakes occur in the execution of the prototype, because communication does not exist. Sometimes, a small detail in product specification is modified, the information is not adequately transmitted, incurring in a production error.”* The same difficulty is present in important phases of product definition resulting in rework and waste. A strong familiar presence could be observed in the product development sector, especially in product concept phases, centralising decisions at the very early stages of PDP. This is not aligned with lean practices, which recommend multi-functional teams applying *front load* principles, deciding on product concept as a consensus process. The results obtained up to now give some subsidies to answer the question proposed from the research: *“Can lean thinking principles methods and tools be applied in PDP in traditional sector such furniture industry?”*

We come to the conclusion that there is some room to adapt lean principles to the improvement of PDP aspects, such as: the introduction of a structured PDP; a method to identify customer value, integrating and involving the design

team in the search for appropriate tools; the introduction of an efficient flow of information between the entire team of PDP and the process as a whole; more flexibility in the decision making process focusing on serving the end customers; the development of the chief engineer role. Considering the centralised structure of decision making, the chief engineer can represent a more qualified link between team members, assuring a better flow of information. If the choice of the a chief engineer is based on seniority, leadership recognition among the company’s employees, communication skills to share company’s goals and strategies, it could be a suitable way to help the company to focus on consumer satisfaction and continuous improvement.

The method proposed has three phases, as shown in Table 4. All stages are considered crucial, and each one has a set of actions which seeks to implement the elements of lean principles most appropriate for the furniture industry.

Phase	Outputs
1 st : To sensitize, to inform and to prepare	Highly committed administration, renewed organizational culture, involved and trained multi-functional teams
2 nd : To adopt and to implement	Prepared leaders and professionals, integrated to learn, to solve problems, to explore new alternatives and to identify new alternatives
3 rd : To evaluate and to adjust	Committed team in the search of perfection through the continuous improvement of products and processes

TABLE 4. Proposed method phases and expected outputs

The next step of this research consists on building a method with practical guidelines for every principle mentioned above. Research about lean best practices in NPD in other industry segments will be deepened in order to adapt to the furniture industry.

Future research includes the test and validation of such guidelines, identifying how the experience of leading sectors like the automobile and electronics can help traditional industry sectors overcome its competitive challenges.

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7. RESPONSIBILITY NOTICE

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