The focus of this paper is to present some practices of lean product development used in Brazil’s largest private companies by revenue in sales in order to identify the types of projects, if the products are developed in the country, which processes the lean approach are being applied, supplier involvement, standardization, learned lessons record, techniques to capture the voice of customer, value stream mapping and others. To achieve this objective, an exploratory descriptive survey was conducted in a non-random sample, using as instrument for data collection a questionnaire with 23 questions sent by e-mail after telephone contact to the person responsible for product development in the companies. In this paper is presented some tools used by the Brazilian’s automotive sector. The results shows that there are some practices being implemented by the companies, but so far, there aren’t a reference company in lean product development in the country. In the conclusions are described some industry trend and future prospects of automobile industry.

Palavras-chaves: Lean Product Development, Survey, autoindustry
1. Introduction

This paper uses the survey methodology, also known as evaluation research, which consider a significant sample of a problem to be investigated. In this study the focus is to diagnose the existing lean practices in product development of the largest Brazilian companies. Firstly occurred the literature research in journals, theses/dissertations, books and conferences on major issues of Production Engineering, Product and Process area - product development, lean approach and benchmarking as a method of diagnosis and implementation of improvements. Thus, was elaborated a questionnaire to be applied to the sample of companies. The sample was chosen the top 500 firms in sales in the year of 2009, according to the criteria of Exame (2011). It’s contain the main financial indicators of companies, such as sales, sales growth, profitability, adjusted net income and margin of sales. From an initial sample of 1245 firms, was selected only those sectors that develop products such as automobile, capital goods, consumer goods, sundries, electronics, pulp/paper, metal and textiles. After this filter and after connecting businesses that merged to with each other, it was left 306 companies. Figure 1 diagram the sample of the research and its classification in the sectors of the economy. All the remaining, in a total of 63 companies in the automobile industry were contacted by telephone in order to obtain the contact of the responsible for product development process and explain the focus of the work. A questionnaire with 23 questions was developed, it was given enough attention to make the questionnaire as straightforward as possible, leaving no room for contradictions, the responses could be multiple choice, yes / no and descriptive, when needed it was given the option of answer "do not know" and the responders could make comments on the questions. The questionnaire was sent to all contacts, totaling 210 of all the sectors mentioned above and 54 for the automobile industry. The questionnaires were sent after the contact by telephone and companies had 15 days to respond. Due to an initial low response rate, the questionnaires were resent twice, resulting in a final response rate of 27%.
According to Perrien, Chéron and Zins (1984), this type of sampling is fit as non-probabilistic, because it is obtained from some kind of criteria, and not every elements of the population has an equal chance of being selected, which makes results not generalizable. The objective of this paper is to present the preliminary results of the automobile industry. According to Miguel (2010) this survey was characterized as exploratory descriptive, it is also one of the initial stages of the thesis of one of the authors of this paper for later provide the basis for a more detailed survey.

The questionnaire was developed based on current problems on product development identified in literature (ROZENFELD et al., 2006; DAL FORNO, FORCELLINI and PEREIRA, 2009; LOCHER, 2008; MACHADO, 2006; MARTINS and LAUGENI, 2006; MAY, 2006; BAUCH, 2004; FIORE, 2005):

- Lack of integration between the areas and areas with the business strategy;
- Organizational and communication barriers;
- Runtime exceeds planned;
- Variability in the tasks and method;
- Constant reworks;
– Relationships with suppliers are not long-term, based on philosophy of partnership (win-win);
– Deficiencies in measurement and control;
– Lack of a structured Product Development Process;
– Unclear definition of the input data (specifications and requirements);
– No record of lessons learned and historic of projects.

To minimize some of these problems, the lean approach aims to add value and eliminate waste. Some practices are countermeasures for waste and are related to people, process and tools. Therefore, this paper describes some key practices of lean product development in section 2, in section 3 some results of the survey is presented and concluded in section 4.

2. Lean product development practices

The questionnaire was developed considering the lean practices of product development mentioned in the literature. Some of these practices, also called the tools includes involving strategic suppliers since the beginning of the development process, have few and reliable suppliers to create a relation of partnership and joint development, value stream mapping, planning techniques problem solving, standardization, have a matrix structure rather than departmental, involving different areas (marketing, engineering, production, sales, PCP, design), techniques to capture the voice of the customer, visual management, efforts to understand the needs of internal customers, virtual simulations to avoid rework prototyping, reuse, library of projects, record lessons learned, concurrent engineering. These practices will be defined now.

– **Value Stream Mapping (VSM)** - Aims to develop a picture of the current state to identify the waste and calculate the lead time. After that, in the designed map and action plan, improvements are planned Rother and Shook (1998), Loker (2008),

- **Voice of the Customer** - One of the basic fundamentals of any development process is to incorporate the client's needs in the project. In automobile industry, the automakers consult clients on variations in aesthetic items, comfort and convenience. A variety of formal techniques like Quality Function Deployment (QFD), Focus Group, market research are used to capture the voice of the customer. Since customers often use a subjective language and do not define clearly what it wants, the VOC is rarely used in early stages of the PDP (CAR 2007). According to Thabet and Badinelli, 2009 QFD has been a very useful tool to reflect the voice of the customer.

- **Visual management** - devices that detect errors in the source. Examples are parametric CAD systems, checklists, detailed and standardized test plans. A visual board with the schedule and phases of ongoing projects helps you visualize the achievement of deadlines and take preventive measures in time, according to the frequency of checking the performance of the project (Locher (2008), Parry and Turner (2006).

- **Project Library** - This practice summarizes the learning and the habit to maintain a record of lessons learned to facilitate the reuse of knowledge Nonaka and Takeuchi (2008), Senge (2004), Morgan and Liker (2008), Waal and Counet (2009)

- **Early Supplier Involvement** - The intention is to keep fewer suppliers and involve them from the beginning of development and thus establish a partnership relation (long term). The benefits are reduced risk, reduced cost and lead time, joint development and establishment of shared goals. Gurumurthy and Kodali (2009), Salzman (2002), McAdam, Hazlett and Anderson-Gillespie (2008), Magnan Birou and Fawcett (1999), Cha et al. (2008), Dero, and Yusof Salleh (2006), Ge and Fujimoto (2006) and Sobek (1997)

- **Standardization** - Standardization is the basis for reducing variability through checklist and as a mechanism to capture knowledge. The project’s standardization
involves the product, its components, raw material and its architecture. The standardization of processes involves common tasks, sequence and duration of tasks and standardization of technical skills is related to the capability of people involved in the development team. Emiliani (2008), Muenstermann et al. (2010), Marksberry et al. (2010), Wang and Kleiner (2005), Wee and Wu (2009), Gurumurthy and Kodali (2009)

- **SBCE (Set based concurrent engineering)** - In this tool, the entire development team takes a series of parallel and independent alternatives through the phases of the PDP, the alternatives are eliminated until there is a better alternative generated from a combination of systems, subsystems and components Kincade, Regan and Gibson (2007), Schäfer and Sorensen (2010), Hines, Francis and Found (2006), and Madhav Appan (2010), Salah, Rahim and Carretero (2010), Doll, Hong and Nahm (2010), Mols (2010), Person, Loureiro and Alves (2007).

3. Results

In this topic will be presented some preliminary results regarding the analysis done with the questionnaires considering the automobile industry. In this industry companies are classified in automakers, which are at the tip of the supply chain and also the first-tier suppliers, in this case suppliers of the parts and automotive components. Companies of these industry who responded to the questionnaire consist of the following, three major representatives automakers of Brazil and fourteen companies that supply parts. Some companies that were part of the sample analyzed are: Agrale, Autometal, Bridgestone, CNH, Cummins, DHB Componentes, Suspensys, Trelleborg, Behr, Marcopolo, Eaton e ZF Sachs.

Was asked directly if the company uses the lean approach, 83% said yes and 17% said no. Out of those who said they use the lean approach, 86% uses it in manufacturing, 50% in product development and 36% in both processes (production and product development).

The Value Stream Mapping (VSM) tool, commonly used as an initial step for diagnosis and identification of waste, only 33% of companies affirm to use it.
Figure 2 shows that approximately half of the firms reduced the number of suppliers in recent years, a trend considered to be lean.

![Pie chart showing number of suppliers changed](image)

**Figure 2 - Total number of suppliers**

All the participants affirmed to have a standardized product development process. Although, even many companies claiming to be lean, 53% of them still maintain a departmental structure as can be seen in Figure 3.
To capture the voice of the customer, one of the practices most well recommended and most complete is QFD. However, only 35% of companies questioned use QFD. One way of measuring the waste is through overtime, which shows that not always the quality of the information is good, it also shows that there is incomplete or duplicated documentation, lost time between one process and another. Even when the product is launch on time, 56% of companies said they use overtime hours on projects.

For monitoring the projects, most of the companies use MS Project, followed by MS Excel and Visual Board. Figure 4 shows the percentage of use of each software.
To control the project, whether incremental or innovative, control is very important to avoid problems related to the scope in terms of cost, time and quality. From the 17 companies that answered this question, 81% of them monitor the project performance weekly, 6% and 13% accompanying fortnightly and monthly respectively (Figure 5).
Was also asked the companies to mention some indicators used in the process of product development. Some indicators mentioned were:

- Adherence to schedule;
- Project cost;
- Project Scope;
- Customer satisfaction;
- Excellence in Design;
- Suppliers requirement;
- Percentage of the project carried out according to the pre-established phases;
- Results of the tests;
- Numbers of problems encountered during the project development;
- Parts produced in accordance with the project.

The record of lessons learned is a way of reusing knowledge from previous projects, both requirements and solutions that worked and also the ones that didn’t work, 76% of companies said that record and use the lessons learned.

4. Conclusion

The lean approach has been increasingly used in product development to reduce time to market and deliver a value product to the customer. Many Brazilian companies already use these practices in manufacturing process and are expanding to other areas and process of the company.

However, much needs to be done. The focus of this paper was to show an initial diagnosis of Brazilian automobile industry. The literature shows that this industry is well developed, taking Toyota and APQP as benchmark. Yet, it is clear that the lean approach goes beyond the implementation of practices, companies need an understand the principles and
have a global view, seeing the product development process as key of success that generate value to internal and external clients.

A company can’t be totally lean or totally not lean. Even when the lean approach is not applied completely, some practices are used, either directly or indirectly. This paper showed that even 83% of companies calling themselves to be lean, there are many practices that need to be better implemented. People are fundamental in the process of transformation and continuous improvement. Changing a departmental structured organization to a process structure (strong matrix) impacts on the company's culture.

Due to a response rate of 27% of the total sample, the exploratory-descriptive survey does not allow generalizations, but it is possible to identify a trend that the Brazilian automobile industry is seeking to improve its processes to be competitive internationally. A deeper study will point out correlations between the practices, the maturity level of each company and plan of action for those who want to eliminate waste and deliver a value product with better quality in less time and at lower cost.

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