Product Development Systematization and Performance: a case-study in an automotive company

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Abstract. Product development process (PDP) has been recognized as a source of competitive profits and nowadays has received special attention from companies. Recent literature suggests that to get an effective systematization it is necessary to analyze and improve this business process. Then PDP models had been a common place in the research agenda. This article describes the case of product development systematization in a specific automotive enterprise. During the case research it was collected recent data of company performance and history information regarding changes on its PDP model and practices. This research allowed us to identify actions, best and bad practices and analyze the impact on performance in order to identify aspects to be studied.Finally, this research discusses gaps between implemented activities and PDP models related in the bibliographical review.

Keywords. Product Development Process, Systematization, Performance.

1 Instruction

Recognized as a source of profits, product development process (PDP) nowadays has been viewed with key-point of success once through PDP systematization companies can reduce their costs and development time and increase their product quality. Available literature suggests that to get and effective systematization it is necessary to continuously improve the PDP so that it can follow the continuous necessity of develop better products to be launched to the market. Then PDP models describing phases, best practices and methods for product development had been discussed a lot in the agenda [2, 5, 6, 9-11]. Even considered as a key-point of success, it is not commum to find companies carrying or working on PDP systematization. In addition, a small number of studies can be

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found discussing effective PDP models implementation, considering steps this implementation represents and also how to proceed PDP improvement and performance impacts are aspects were not be explored sufficiently.

Actually, automotive companies have good maturity level if compared with other market segments and the idea that originated this article was thecase of product development systematization in a specific automotive enterprise. During the case research it was collected recent data of company performance and history information regarding changes on its PDP model and practices. Through a holistic case study [12] this research identified actions, best and bad practices and analyzed the impact on performance in order to identify aspects to be studied at theory. To analyze PDP systematization and performance it was selected six concluded product development projects which were developed on two different periods of time: before and after a set of PDP systematization actions. Results of the two project groups were compared through some key performance indicators.

2 Product Development Process Reference Models

Product development process (PDP) is not a process made by independent activities and under the responsibility of marketing, production, process and product areas anymore [5]. Nowadays companies understood to get an efficient product development it is necessary to get a multifunctional team working together, following same directions and goal. To apply this approach is fundamental the use a formal PDP process, that means to produce a map describing the new product development process. Business process modeling, or enterprise integration, provides a set of techniques that make this possible [2]. Kalpic and Bernus [3] demonstrated the importance of this approach in a case study specifically at this area. Authors explain how reference models can be helpful in activities related to project, management and execution of business process.

Since the emergence of the business processes approach on NPD, more or less elaborated reference models have been proposed to help professionals to identify the best available practices [4, 5].

3 PDP Sistematization

To be effectively systematized, PDP needs to be reviewed into companies. It happens by activities belong to PDP or not; as example activities can belong to continuous improvement process that is a support process that can be applied for all process into a company. This research considers both processes as we consider they also can help PDP systematization. Into this context, the standardization of activities is one of the key-points to get systematization, once if activities are standardized they can be faster understood, used and multiplied into the company. As consequence, standardization can eliminate wastes of the process.

Nowadays there are some published researches that suggest PDP systematization based on a reference model [4, 7, 8, 11]; main point is that they

don’t discuss or analyze their effective applicability. [4] developed a research with focus in a re-organization of the management of PDP model.Many activities and tools discussed by the literature – specially applied on production process into companies – can also be applied to PDP, if they are right adequated to its particular characteristics such as creativity and intangibility. Some of them are described by: Benchmarking; 5S Program; Lean Thinking; Kaizen culture; Stage-Gate, etc.

During the analyses of case study it was possible to find many of these activities and tools been implemented and used by that company. They will be better explained during next chapters. Detailed discussion about list of those activities and tools available on literature can be found on [1].

4 Case-Study

The case study of this research is a Brazilian unit of a worldwide auto parts. The site selected is a technologic center located in Brazil since 1999. First product development activities under local team responsibilities happened in 2001, when it was allocated first product engineers. Before this all responsibilities were located in the USA and Brazilian team only supported them. In 2002 it was established a Project Support Office (PSO) to support developments which local project managers as strategy to increase business in Brazil. In 2006 they had 35 projects, 25 advanced projects (strategic developments without a agreement from customer) and many business opportunities for future competition in the market.

5 Product Development Process into the Case-Study

5.1 PDP Reference Model used by the company

Figure 1 brings a general vision of PDP model into the company. It is called *Phase-Gates*; it was a way they found to analyze development during their evolution and to give direction (from high-levels of the organization). These directions can be: stop developing, keep working or re-make.

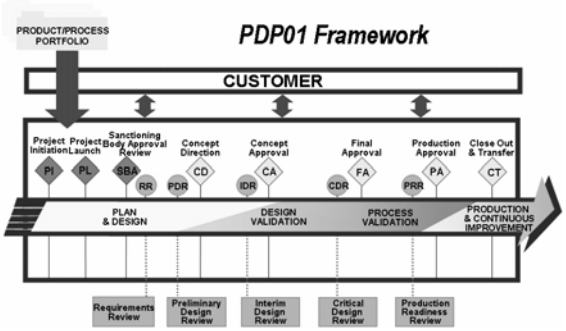

Figure 1 - PDP Model into the company

There are two types of gate-review: technical ones, called *design reviews* represented by lozenges on Figure 1 and management gates, called *project reviews*, represented by circles; this last kind of gates has the goal to verify if actual status of a specific project is aligned with proposed plan on the scope, by the beginning of the project, including key-dates, scope, customer requirements, costs, timing, etc. Communication with customer happens during all development guarantying its participation and that they are following the voice of customer during the project. PDP model empathizes plan and design begin phases. It also suggests a global project categorization by types (A, B, C and D), where A category represents a most complex product and process development and D represents a routine project. Each category has its own requirements and steps to be followed.

5.2 History of Enterprise PDP Implementation into de Site

Product development process adopted by the company was firstly published by the head-quarter in the USA in 1995, just after APQP manual published by the cars-makers. The proposal of model was to define a standard for all new product development project, ensuring conformance with requirements from customers.

In 1997 PDP model was reviewed at the first time and again in 1998. The most recent PDP model revision happened in 2001, when it was eliminated all micro-activities from the model and also the ones considered as not added-value to the customer. This revision represented a decrease of more than 50% when compared with previous revision. On this new scenario, all required activities from PDP model represented only 105 activities. For 2007 is expected to get a new revision, decreasing again the number of required activities and adding some activities they missed during the use of actual revision. First re-organization into product development department was held in 2001, when - by continuous efforts from Brazilian high-level hierarchy with the headquarters in the USA – it was allocated first product engineers and project managers in Brazil. From 2003 on the site formalized a parallel structure in the organization to support product developments. It was called *Project Support Office* (PSO). This group, with an independent supervisor, standardized and created practices to control, organize and make new product development activities. It was held many training sessions for multifunctional team to share knowledge, with focus on model and activities.

PDP systematization was leaded and facilitated by PSO; they identified gaps, defined and implemented plans and verified their efficiency with indicators previously defined. Many post-project audits were held to capture new knowledge, lessons learned and best practices and to turn them available to the rest of the team.

5.4 Process Vision Culture

During the research it was possible to note that the systematization of PDP into that site was based in an introduction of a model to structure activities, where many areas of the company work together, working on their own tasks but looking for a common goal: better products to be faster offered to the market, following strategies of the company. This model is known and adopted by multifunctional team but it was noted some of people of the group don’t know all PDP activities as

they should. Otherwise they know exactly and in details their responsibilities into projects and what is the best to way to do their activities. Main problem regarding PDP model into the company refers to people from multifunctional team but who work outside that site. To solve those issues PSO team established some activities and tools for all multifunctional team executed a set of efforts demonstrated at the figure 3, including process culture diffusion, training e projects audits.

The figure demonstrates that it was more intensive done last three years.

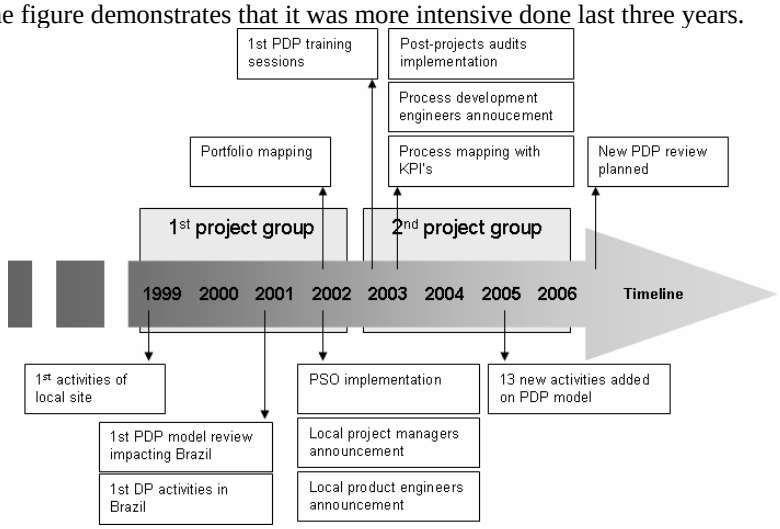

Figure 2 - Examples of PDP Systematization Steps into Case Study

6 PDP Systematization and Projects Perfomance

To analyze effectiveness of PDP systematization into the site it was firstly selected six different projects, which were developed on two different periods of time: before and after a set of PDP systematization actions. Results of two project groups were compared through key-performance indicators previously defined: number of allocated people; planned budget/timing x executed budget/timing; planned x executed nationalization; number of compliments from customer.

Criteria for project selection are described below and represented on Figure 3:

- Each pair should belong to the same product line and complexity;
- 3 projects from each group (1 or 2) should be executed by the same period;
- All projects should be concluded until the date of this research;
- Each project from each pair should be executed during different periods.

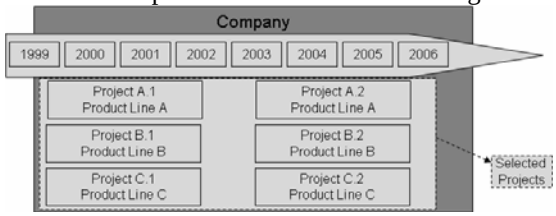

Figure 3 - Selected Projects by Group

After a research on available literature it was identified activities and tools suggested by literature that could facilitate PDP systematization. Examples are listed below; full list can be found on [1]:

1. Use electronic mock-up to simulations;
2. Use quality tools to ensure performance: FMEA, QFD, DFE, etc;
3. Define specific department to support product developments;
4. Define and monitor performance key-indicators;
5. Implement *stage-gates* methodology;
6. Implement a depository of lessons learned;
7. Use concurrent engineering;
8. Define programs to stimulate continuous improvement practices;

Characteristics of the activities and tools were divided by three different groups with the goal to better understand maturity level of first and second project groups:
- Formal: activities and tools with frequency, methodology and responsibilities previously defined; in other words, there is a formal procedure to be executed;
- Ad-hoc: activities and tools happens according punctual necessity; it doesn't matter about frequency or responsible. There is a known methodology but it doesn't require any formal procedure to happen;
- No-exist: activities or tools suggested by literature but didn't find on the case.

The results of the data collected are represented as follows:

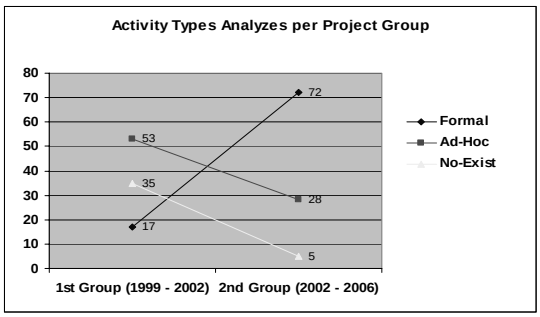

Figure 4 - Compares Two Project Groups

Analyzing presented results by the number of found activities and tools in each project group we have a significant increase of formal activities on the same time we have a big decrease of ad-hoc on not-exist activities. It represents that the effort located to PDP systematization resulted in a formalization of most of activities and tools they had or they knew it was important to have and decided to implement.

Regarding key-performance indicators we have:

	Product Line A		Product Line B		Product Line C	
First project group (1998 - 2002)						
	Project A.1		Project B.1		Project C.1	
	Forecast	Actual	Forecast	Actual	Forecast	Actual
Category	B	B	B	B	C	C
Involved People	15	12	30	30	9	9
Timing	2 years	2 years	3 years	3 years	14 months	14 months
Budget	100	90	100	100	Not defined	Not defined
Nacionatization	0%	0%	Not defined	3%	10%	10%
Fails aftermarket	Not defined	1000 ppm	Reduction of 70%	Reduction of 70%	0	0
Formal complaints from customer	0	0	0	0	0	0
Second project group (2002 - 2006)						
	Project A.2		Project B.2		Project C.2	
	Forecast	Actual	Forecast	Actual	Forecast	Actual
Category	B	C-B	B	B - A	C	C - B
Involved People	10	10	20	20	9	9
Timing	2 years	2 years	2 years and half	2 years and half	2 years	2 years
Budget	100	90	100	80	100	95
Nacionatization	10%	10%	More than Project 1	35,30%	Not applicable	Not applicable
Fails aftermarket	500 ppm	500 ppm	1000 ppm	445 ppm	1000 ppm	445 ppm
Formal complaints from customer	0	0	0	0	0	0

Figure 5 - Key-Performance Indicators from Projects

Results are present in percent and not in real numbers due to confidential requirements from the company. Indicators demonstrate that first projects (belong to the first group) met expectations of the company and the customer because timing, budget and quality requirements were met. By the other side, analyzing all data it is possible to note that goals of the first group were easier than the second group, especially for timing and costs and as consequence, easier to be achieved.

Local responsibilities also increased a lot for the second group once during the first projects they only supported activities in Brazil.

The second group of projects presents better results with compared with the first group and also they have targets more difficult to be achieved. One example is budget defined to the projects.

7 Conclusion

Examples of PDP models on the literature seem to be generic and weren't applied in a company yet. It is necessary to implement some of available models to study their performance and impacts in a practical business scenario. Those indicators validate previous discussion found in the available literature that the implementation of activities that contribute to PDP systematization and formalization brings wins profit and reduce development timings, and, in addition, keep the company with competitive advantages in the market.

Project analyzes show PDP systematization brought positive results so that this research suggests it can be important to have a reorganization of complementary processes to PDP, such as continuous improvement process. One of hypotheses that this research suggests is it can be essential to have a systematized continuous improvement process with focus on PDP and not only as a support process for PDP, as described by literature. The case study demonstrated it is necessary to have continuous improvement activities being formalized for PDP activities.

Analyzing case study results it was also possible to see available projects categories are not enough to describe all projects into portfólio they have, in other words, it is not clear to multifunctional team how projects can be added to one or other categories. A prove of this if that two of the six analyzed projects were changed their category during the development. It demonstrated that probably there is a necessity to nationalize project categories according local necessities (with bases on global ones).

Projects behavior, even if in different categories, was similar, considering first and second groups separately.

A continuation of this research could be a validation of the hypotheses that continuous improvement process needs to be not only a support process but also a systematized process with focus on PDP, once it was demonstrated that continuous improvement activities helped to improve product development results. It could also be analyzed same scenario of other auto parts companies other in companies from other segments.

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