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EVALUATION OF PRODUCT DEVELOPMENT PROCESS USING EMVS

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ABSTRACT

This paper evaluates a PDP model application in an auto parts company, leader in its segment. From the application of lean thinking in the supply chain and the EMVS performance analysis methodology for PDP, a check list is created to avoid waste in project management. In this paper, we show that EMVS can be positively impacted through active management of knowledge within a project. This paper suggests that the value-enabling portion of a project manager's role requires aligning knowledge across these three key domains regarding PDP Gates (Phases) at company manufacturers of auto parts, Lean Thinking and Value Stream, and methodology for managing projects through performance-term rates and costs. The results show that the methodology has positive aspects, but its implementation takes time and has repercussions throughout the supply chain. Further this research try to explain the types of wastes and view of new products' development is enhanced and associates a manufacturing strategy focus on EMVS performance analysis and lean thinking, PDP and value stream mapping showing the important of contribution this tools at reduction of waste.

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Keywords: PDP: Product Development Process, Lean thinking, Value stream and EMVS: Earned Value Management

1. INTRODUCTION

The product development process (PDP) is essential for the competitiveness of companies in several market segments. Guided among best practices for management is the use of process approach, which has the aim of integrate activities, techniques and methods from different areas of knowledge such as cost, engineering, logistics, quality, marketing, project management, among others. The aim of this study is to analyze the potential application of mapping value stream management in the supply chain associated with PDP. It evaluates a case for applying PDP Development model of new products that makes part of the unified model of PDP (ROZENFELD, et al, 2006). The results are evaluated using the methodology EVMS - Earned Value System Management - used in project management through costs and schedules KPIs.

This paper is organized into these sections - Lean Thinking and Value Stream, PDP and Supply Chain Management. The following is a PDP integration proposal which analyzes the value stream and presents a case study with an application of this concept. Finally, conclusions regarding the proposed integration are presented.
Knowledge management has emerged as a major priority of the organizations by the urgency and demand of differentiation through knowledge in order to become an entry barrier to competitors, and remains sustained competitive between aspects of technologies of information and knowledge (ANDRADE et al*,* 2010).

This works aims to contribute for the existing gap supporting workers and researchers to create abilities related to tactile and explicit knowledge to joining them with product development process. The impression of this work is applied on a motor manufacturer company at the end.

Most of the business information and knowledge available in organizations, and even some of their business processes, is not to be found in (explicit) structured, documented form, making it unavailable to both veteran and new employees, and to other stakeholders. In some cases, these resources are ultimately lost within the organization. Accordingly, the development of theoretical structures that make provision for capturing knowledge about business processes that contribute directly

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or indirectly to adding value to goods or services generated, and for sharing it among individuals and groups, is fundamental to business success (MELO et al, 2010).

This challenge is particularly intense for companies that are high-technology, long maturity cycle and high-complexity dependent of the resulting set of developed components and applications based on existing technology. In this sense knowledge and innovation abilities are key factors of success and are enablers for better comprehension and assistance of clients' needs for products and services (SANTOS, 2008).

2. METHODOLOGY

The method to be used will be qualitative, since the method is consistent with the formulation of problem and project objectives. In this study, data collection was obtained by using three sources of evidence: interviews with 12 people (analysts, supervisors and managers) of the Manufacturing, PCP, Planning Materials, Development Engineering, Logistics and Sales areas, documents analysis of the company chosen to study, and participant observation of the development process of new product company studied.

The case study was conducted in automotive organization segment where it was studying the launch of a new product within an existing production line. For the case study the reference Yin (2001) was used to define case study. According Yin (2001) case study means an empirical study that investigates a phenomenon within its current context, inside their reality context, when the borders between phenomenon and context are not enough defined and various sources of evidence are used.

Reich et al. (2012) made contributions relevant to this paper — dimensional zing knowledge management, identifying project-based knowledge types, introducing the concept of Knowledge Alignment. Each is briefly described below.

3. LEAN THINKING AND VALUE STREAM

The principles are associated with creating customer value and eliminating waste in the process. In this sense, one of the most important tools of lean thinking is value stream mapping. The Value Stream Mapping is an essential tool because it helps to visualize more than just individual processes. It helps identifying sources of

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waste, provides a common language for dealing with the manufacturing process, makes decisions about the apparent flow, so you can discuss them; join lean concepts and techniques, which helps to prevent the implementation of some techniques in isolation, form the basis for an implementation plan, and shows the relationship between information and material flow (RHOTHER; SHOOK, 2003).

According to Seth et al (2008), the goal of building a production chain representation where individual processes are linked to their customers or through a continuous flow or pull production should be seek. The idea is to approach each process of producing only what customers' need when they need.

In contrast, the goal of manufacturing is playing without errors the same product continuously and, depending on the industry, this value can vary between dozens and hundreds of thousands.

Burlikowska (2011) explain the final product of industrial good quality is a result of project quality plan, quality production and also holding quality: design quality - a degree of excellence of the project compared with the requirements. For the PDP effective it is necessary to perform the integration of projects due to the complexity and the size of them, and paw the contributing both system information management as knowledge management.

4. PRODUCT DEVELOPMENT PROCESS (PDP)

The Product Development Process (PDP) includes technical and managerial aspects of an organization that turns market opportunities and information about the technical possibilities to be used in a commercial product production. This process includes the design and development of a new product Lean Thinking and Value Stream.

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According Fawcett et al (2011), to share information about the PDP and invest in connectivity technologies, it is essential, further refer to critical information - eg, sales, inventory levels, sales forecasts, technology roadmaps and market effectively leverage minimum income improvements in decision making coordination, quality and performance. So, in turn highlights the importance of using success criteria, approaches to use financial, the information technologies, and build periodic reviews of the portfolio to create opportunities to classify projects (COOPER, EDGETT ; 2006).

4.1. The model Stage-Gates

This model classify project according the current stage and avoid to wasting time mangers in gates did not need to be performed, delays in project execution for performing unnecessary activities or waiting for gates postponed due to lack of agenda of members of the evaluation commission, resistance to implementation of new practices. The concepts are indeed sine qua non conditions for organizational knowledge creation and innovation processes, and is still both theoretically and empirically under-explored.

ALVARENGA (2011), in order to maintain competitiveness, multinational companies need to create suitable conditions for knowledge to flow among their subsidiaries (HENRIQUES et al, 2013). The assumption of this is that headquarters have more power to manage their international operations, using the successful methods of their home country (MURITIBA, 2010).

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According to Zamberlan (2007) the development of new products is being considered as an important means to create and sustain competitiveness. Continue an effort in this area is a strategic need to continue to operate in the market. The applications of the new products have a hope of increasing their market share and improve profitability. The modernity product is analyzed by diversifying the quality of the product and its life cycle, which are innovative (new generations of products), horizontal diversity (variety), which is an adaptation of the usefulness of the product requirements, and tastes of the individual operating conditions, diversifying vertical (classes) is based on the division level of the same functional tools. This approach makes it possible to find many of the different quality settings product quality owned businesses. (BURLIKOWSKA, 2011).

As Miguel (2008) it is clear that the process of new product development the focus on traditional factors such as financial return and, of course, acceptance and customer satisfaction and also the automotive industry is one of the most important industries in Brazil. The lack of a criterion of success at the strategic level is consistent with the fact that a prioritization of project portfolio officers throughout these lifecycles are relatively recent and still in the process of internal acceptance.

It is also evident that the factors of agility in new product launches in the market are allowed, however they do not have a formal role in the practical development of new products. Process development vision of manufacturing is an organizational learning process, as who prepares the organization for new choices strategic and favors the development of new ideas (BORHO et al, 2012). Below at Figure 1 we show the Knowledge management in PDP automakers.

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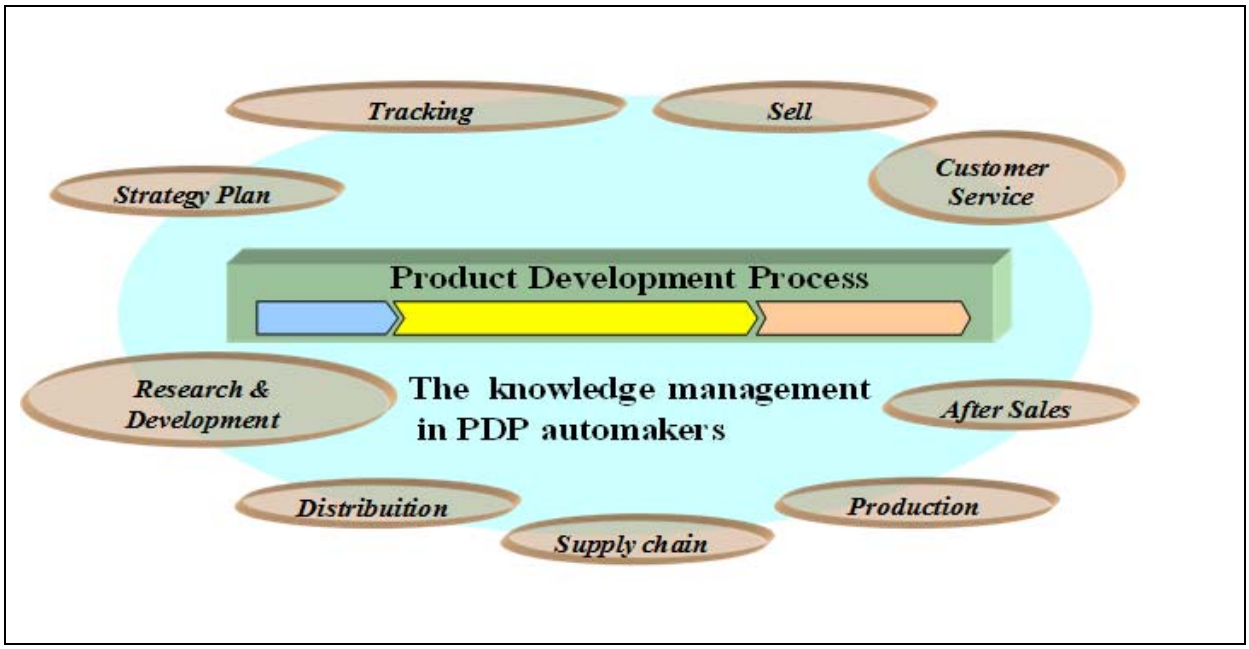

Figure1: The Knowledge management in PDP automakers

5. SUPPLY CHAIN MANAGEMENT

The concept of Supply Chain Management presented by Handfiled and Nichols (2002) is conceived as a tool that goes beyond the logistics by dealing with processes that are not part of its scope. It encompasses all organizations and activities associated with the flow and processing of goods, from raw materials stage to the final consumer, with associated flow of information.

The Integrated Supply Chain has represented a promising new frontier for companies interested in obtaining a competitive advantage and can effectively be considered an expanded, updated and, above all, the holistic vision of traditional materials management, including the management of the entire chain production of a strategic and integrated way. It also assumes, fundamentally, that companies should define their competitive and functional strategies through their positions (both as providers and as consumers) within the production chain in which they operate.

Note that the theme introduces an important change in the competitive paradigm, as it believes that market competition is, in fact, at the level of production chains and not only at the level of business units (isolated), as set out traditional work on Porter (1993). This change results in a competitive model based on that nowadays the competition is among "virtual business units", i.e. between supply chains.

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Thus, there is an opportunity to integrate the PDP process through the value stream map and lean thinking to the whole supply chain, where the goal to be achieved by analyzing the value stream is to obtain a continuous flow, driven by the needs of customers, from raw material to finished product.

Performance evaluation monitors, controls and directs all the activities that contribute to completion of the transport (BOWERSOX; CLOSS, 1999). The monitoring accompanies and records chronological system performance, and maintains both clients and transport managers informed. The control continuously accompanies execution of the activities, enabling corrective action to be taken wherever values do not match the planned goals (BALLOU, 2001). According Borsch (2010) reports that logistical competences have key roles to transition from one PDP to another supply chain. In this regard, a large number of studies have shown that the development of processes with partners in the supply chain offers distinct advantages (SAEED et al, 2011).

6. CASE STUDY

The company studied is one of the leading American manufacturers of auto parts. The business focus is development and manufacture of diesel engines. The production volume in year 2010 was 143,800 engines. The company's products meet vehicular, agricultural, industrial and marine segments.

Business in three industrial units, two units installed in Brazil and a unit in Argentina, has about 3,000 employees. The company has the objective of assisting customers in the region and work as a base for exporting products worldwide. Today the company exports to over 30 countries in South, North and Central America, Europe and Oceania. The unit's engine company headquarters in the United States and has approximately 4,500 employees in five plants. The company develops products in two countries and has a unique development process that is adopted with some modifications to fit the company's organizational structure in each country.

We applied a model of this company based on PDP Gates (Phases), as the unified model proposed (ROZENFELD et al, 2006). This application was performed by a team composed of 12 people involved in the process, coming from diverse areas (Manufacturing, CFP, Material Planning, Development Engineering, Logistics and Sales), included one of the authors of this article. The team was able to diagnose

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weaknesses, which resulted in improvements in the management process of project development.

The case study was situated on additions to existing product lines: new products that complement the established product lines of a company. There was a division into two phases, as shown in Table 1.

Table 1: Types of waste

Types of Waste	Phase 1	Phase 2
Waiting	21 days	3 days
Transport	100% Express Shipping	customer withdraws
Unnecessary movement	Exclusive routes and off the path	Adherence and synergy of the process routes
Lack of Discipline	without planning	check List
Reinvention	not applicable	not applicable
Overproduction	not applicable	not applicable
Defects	Lack of specific entries	Elimination of defects for this failure mode
Inadequate processes	Blurred of beginnings and endings of activities	Clear definition of responsibilities

6.1. Studies Phases

In the first phase, through the collection of information to analysts, the group followed the trail of the production of a product from the consumer to the supplier. After flow adjustment to the organization, it was possible to list and analyze the related processes, diagnosing weaknesses such as lack of a logical sequence of activities that optimize the time and to order the actions predecessors, problems of communication between areas, lack of an array of responsibilities, lack of time to ratify the new parts and drives unnecessary.

With this diagnosis, strategic actions were proposed as the second phase, in order to improve the active participation of group members in the process. The improvements proposed in the second phase were two, as follows.

The first refers to the structuring of the process steps that allowed him to see the flow, helping to identify the seven types of waste: time, unnecessary movement, transportation, inventory, lack of discipline, overproduction and reinvention.

The second refers to the identification of the scopes are constantly changed and consequently so are the schedules. Thus, the promised lead time is always greater than the desirable and the difficulty in meeting deadlines becomes a constant.

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Later there was a performance analysis to validate the new process, which began with a management meeting for consensus by applying the tools defined by the PDP.

We used the analysis focused on the performance criteria EMVS Earned Value Management System, to validate and measure during the evolution of project activities, and allow the review of planning to achieve cost and schedule goals established previously. The second EVMS is a methodology for managing projects through performance-term rates and costs. The project development is controlled with the aid of three curves, which are defined from these indicators:

- SPI Schedule Performance Index - "Schedule Performance Index" is a variation on time performance in relation to its planned schedule;
- CPI (Cost Performance Index)= is a variation of the planned cost performance against the real.

For SPI and CPI calculations we used the formula SPI = EV / PV and CPI = EV / AC, where:

- PV (Planned Value) = Budged Cost of Work Scheduled (BCWS) - Budgeted cost of the activities scheduled for completion by the date.
- AC (Actual Cost) = Actual Cost of Work Performed (ACWP) - Actual cost of the activity undertaken to date.
- EV (Earned Value) = Budged Cost of Work Performed (BCWP) - Budgeted cost for completion of activities undertaken to date.

The SPI and CPI are the indices that measure project performance. The measurement takes place as follows:

- SPI> 1: Schedule in advance and CPI> 1: Under the budget
- SPI and CPI = 1: Schedule and on Budget day
- SPI <1: Timeline late and CPI <1: Over budget

6.2. Results

From a measurement date is determined possible to verify the relationship between the cumulative and time. This is to, budgeted cost estimates for completion of activities to date, estimated cost for completion of activities undertaken to date

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and, above all, the real cost of the activity by the same date. From the data analyzed was possible to determine the SPI and CPI are presented below in Table 2.

Table 2: Spending on procurement of materials and transportation

Expenditures on acquisition of materials and transportation			
BCWP	Budged Cost of Work Performed	R$ 44.000,00	Work budgeted
BCWS	Budged Cost of Work Scheduled	R$ 35.000,00	Work performed is less than budgeted
ACWP	Actual Cost of Work Performed	R$ 36.500,00	Work incurred is less than budgeted
CPI	BCWP/ACWP	1,21	Save of 2 %
SPI	BCWP/ BCWS	1,26	Schedule is ahead

The schedule was analyzed with 100% of completed activities; therefore, this study did not use the concepts of change of schedule (SV - Schedule Variance). The schedule variance indicate whether the project is early in the day or late in relation to what had been planned and is calculated by subtracting the budgeted amount of the scheduled value. Positive values indicate favorable conditions, negative values indicate problems.

With the premise that it is easier find problems than proposing solutions we identified obstacles that were impeded environment management optimally. From these, we created intermediate objectives to overcome obstacles and to advance to the next stage of the methodology, which gives rise to the deployment plan.

To perform changes a deployment plan was built and a Check List was created. Differently from traditional management, which owns the project individually, managing it only by chronological timeline, this Check List is a tool that also provides the resources to manage project implementation.

For implementation of the Check List a functional group (Task Force) was created, with the following activities:

- Preparation of list of prioritized projects and their respective activities;
- Review of supply networks, already developed for the projects and their management characteristics in the traditional, chronological control;
- Review of the resource pool, as previously were sequential activities, as if the projects were only, disregarding the conflict of using the same resource on multiple projects.

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The final idea is to obtain a clear view of the PDP process and some of their waste and guidelines for effective analysis to optimize flow and elimination of waste. The check list below (Table 3) has proven to be a guide or a single instrument, a set of issues, application of holistic analysis rather isolated and better sequencing of activities. Especially also showed the relationship between information flow and material flow.

Table 3: Check List – Registration and information system for the assembly line

	Checklist - Engine Assembly	Engineer	Quality	Logistics	Prog Management	Purchase	Sales	Material Planning	Finance	Production	Status
1	Engine registration	x					x	x	x		ok
2	Input of purchase requisitions			x							ok
3	Purchase order					x					ok
4	PAPP Parts			x				x			ok
5	Carry Over Parts	x									ok
6	Schedule MRP (4 weeks)							x			ok
7	Forecast volumes				x		x				ok
8	Packing			x		x					ok
9	Updating schedule engine assembly									x	ok
10	Add packing at expedition		x								ok
11	Assembly Quality Audit		x								ok
12	Quality Report		x								ok
13	Liberation Status	x	x					x			ok
14	Work plans on the assembly line	x		x	x			x		x	ok
15	Training time										ok
16	Workshop tools validation	x		x						x	ok
17	Finishing quality activities			x							ok
18	Records and staff separations supply			x	x			x			ok
19	Validation parts several list							x			ok
20	Assembly pilot line	x	x	x	x	x			x	x	ok

Signs of improvement were seen between information cost and schedule of the project, communication, better sequencing of activities, increased visibility of the responsibility matrix and material flow. Considering the preparation of the Check List and tabulation of data on the stages of development of new products, it is remarkable to see the need for training in time for the value stream, selecting the value stream for improvement, define the elements of the value stream; analyze and map the current state, to analyze a map or a map ideal future, implement new processes, and continuously improve (NAZARENO et al, 2007).

7. CONCLUSION

Providing a common language for dealing with manufacturing processes, considering that in the case of launching a new product, the existing line, made decisions about the flow visible. This allowed the team to discuss, together lean

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concepts and techniques, helping to prevent the implementation of some techniques individually, and thus customize the situation of each company and overcoming the difficulties identified.

A deficiency is found that although there are various descriptions to support the diagnosis, lack a guide or a single instrument, a set of questions, for example, ready to use. In the case of the research model has been studied in detail for about 60 days to prepare the model presented Check List.

Therefore, the recommendation of the methodology of EVMS in launching new products is sparingly.

This paper was focused on identifying knowledge contribution for development of new products. Acquiring this kind of knowledge becomes one of the main company objectives when it realizes creation, organizing, retention and learning are an effective formula against other companies and contributes to improve abilities and to protect achieved results.

There are few systems available in the market leveling the displacement of activities, requiring constant follow-up, adaptation and improvement of the parameters. Thus, optimization may lead time, resources and costs used in both individual and multiple projects.

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