Is the design process integrated to product development?

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Abstract. The objective of the article is to compare the Engineering and Design fields in relation to the Product Development Process (PDP). In both areas we can identify different methodologies that guide, each one under its own optic, the Product Project. Although aiming the same objective, the Product Development, these two fields present a certain disconnection, if we compare the models presented in the literature. This can be explained by the fact that Engineering traditionally develops the products with emphasis in the technical aspects of the products and Design investigates the interfaces of the users with the products. Considering this, this article consists in a theoretical discussion regarding to an appropriation of planning models of the Product Development by the Design field, from the the problem solving process as well as the systematization and coordination of the creation activity. As conclusion, the work presents a methodological systematization with the implementation of new techniques for the process of Design, focusing at the trends adopted for the corporations that search constant innovation, efficiency of the products and services, and adaptation to the changes, among others factors.

Keywords. Design Process; Product Development; Design Management, Product Development Process.

1 Introduction

Nowadays, accordingly to new understanding, businesses have to focus on what can be done to please the external clients as much as balancing its profits so

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that they do not go bankrupt. In this case the demand for a better understanding of Processes are very important in Business as in Production terms.

The concept of process is considered here like in its origin from the Latin word *procedere,* as a verb that indicates the action of going forward, going ahead (*pro+cedere*) [12]. It is considered also as a peculiar sequence of changes that intends to reach a certain goal. Process is used to create, invent, project, transform, produce, control, keep and use products or systems.

For a better understanding, the concept of Business Process [11] in this work will be differentiated from the *Design* Process concept. The first will be considered as the management action, while the second as the projectual action [13]. Following this, in this paper, *Design* is considered the processual activity, which is developed since the enterprise's strategic business, named strategic *Design,* to its operational aspects, named Operational Design [18]. The term *Design* will refer not only to the result of the design action, but also to designate the process of transforming actions.

Another initial consideration must be done in respect to the differentiation between Design Process and Product Development concepts. Design Process is considered here as a project activity will be considered as a project activity oriented to the resolution of interface problems that someone can have with his surroundings and Product Development is considered the activity developed by the Engineering field, in which many functional sectors of the enterprise are involved.

Comparing the definitions of DP e PD, we can see that in both areas a group of systematic project activities is developed, and these group of activities involve organization, people, functional areas, the product itself through information transformation, data, inputs, considering the enterprises technological and human resources. From the realization of these activities it is possible to create and produce products that fulfill the expectations of the markets where they are requested, as much in Design as in Engineering approaches.

Considering this, it is possible verify that there is an overlapping between the Product Development (PD) and the PD activities, when developed by Engineering or by *Design*. To both Engineering and *Design* areas, the basic principle of Product Development (PD) or the Design Process (DP) is founded in one kind of Process, hence the initials (PDP) for Product Development Process, which is a transformation process through which an idea becomes an object (product) with the premise that it be industrially produced in sufficiently large scales in order to satisfy *stakeholders* conditions, and also conjugate and harmonize knowledge from a handful of different natures.

Subsequently, in this work, the terminology Product Development Process (PDP) will be adopted in this work, considering that in PDP, both Engineering and *Design* areas, Product Development or Design Process include activities that act in an integrative interdisciplinary way, for they develop a "group of systematic activities" that encloses product, processes, people and organization, they are either simple or direct.

Then, this paper aims to discuss the overlapping between these two fields, Design and Engeneering, the first under the concept of Design Process and the second as Product Development. Doing this, it searches a new correlation between both areas, improving the Design Process.

2 Product Development and Design Process: Strategic Level

2.1 Engineering's Actuation

Product Development (PD), at a strategic level under the Engineering's approach, is characterized accordingly to the Product Development Management (PDM). The work of [7] allows us to identify two (2) distinct approaches of PD: the Engineering Production approach, which focuses on the development processes and products production and the Marketing approach, which focuses on strategies of products intended for the market.

When discussing the PD issue, from a strategic level, as a permanent attempt of articulating the market's necessities, technologies possibilities and the enterprises competences in such a horizon that allows the enterprises' business to have continuity, the same author, the Portfolio Management is characterized by three (3) objectives:

1 - Aligning development project strategies with the business strategy;

2- Maximizing the *Portfolio* values by taking into consideration the available resources; and

3- Balancing the projects under many different criteria.

This first objective, aligning the strategies of the development projects with those of business, suits perfectly to work developed by [20] They presents a Product Management structure is a work that is about a model that an excellent reference for improving the Product Development Process (PDP), where the approached PDP one structure presented by the authors penetrates all of the organizational business model.

Still, these authors present, in details, an amplified vision, including all PDP's phases, coming from Pre-Conception, through Development until it gets to Post-Development. In the Development phase, a special emphasis is given to the Engineering activities.

Subsequently, the work developed by [20] does not only present approaches from the Engineering optic, but also from Business, Marketing, Production, Strategy, Quality, Information Technology, Knowledge Management, among others.

However, an area that was not totally explored is *Design*, as the approach given by the authors identified it only in the Conception Project, where *Design* is mentioned merely as the study of Ergonomics and Aesthetics of a product. In other words, the authors considered the activities developed by the Design in a reduced way, as we will see further and reinforced the notion that Design is an activity that operates mostly in a formal way.

The authors excluded, at this point of their work, other characteristics of Design activity, like, for instance, the activity considered as being an expression of cultural values, whose *Design* objects, resulted by the Product Development Process (PDP) are the carriers of preoccupations, motivations and dominant values in determined historical moments in a society.

Part of the difficulties in understanding *Design*, its benefits and actuation inside enterprises, comes up with the need to study how this activity is seen and how its relations on a business environment happen. A discussion about the design practice, its importance and influence on the business objectives, may contribute to the understanding of this activity and how relations should happen for its effectuation.

It is also important to emphasize that, throughout history; the professional of this activity has developed in distinct manners due to the social-economical, cultural and technological characteristics existing in each country, which lead to different actuations of the designer in society.

2.2 *Design*'s Actuation

The strategic level of *Design* practice is characterized in literature by the field of Design Management (DM).

It is possible to identify some of the main authors proceeding from business, who focus on organizational, planning and strategic managing, and innovation models and even adopt the term strategic *Design*.

It was in England, according to HETZEL apud [18], in a joint action of London's *Royal College of Arts*, and of the *Design Management,* of *London Business School,* directed by Peter Gorb, that the awareness of the roll that *Design* can have over economy and its enterprises came up. In 1975, in the United States, Bill Hannon and the *Massachusetts College of Arts* established the *Design Management Institute* (DMI[2]), in Boston, which is nowadays a reference in Design Management, and which also, together with the *Harvard Business School*, develops the TRIAD, first international research project about Design Management. The link of the two institutions was reinforced and the school has diffused the cases edited by the DMI since 1995. In 1989, the *Design Management Journal* was launched, the only periodic dedicated to the professional of this area. [18].

According to [22], *Design* Management "organizes and coordinates all of design activities, they include "structuring of projects and activities, planning of duedates, selection and planning of personnel, planning and controlling the budget" always having the enterprise's objectives and values as a basis. What should be incorporated to the enterprise's mission and to its basic premise for efficiency is the awareness and accepting of design as a quality and strategy factor by the management. According to the author, PM's activities are done in the operative processes are - the concrete accomplishment of the works to be done – and in the strategic projects they are – definition of objectives.

These works, following the same tendency observed in the production engineering field, start comprehending *Design* not only from the operational point

[2] DMI's goal is helping design managers to become leaders in their professions; making studies available, financing, promoting and conducting research in design management and sustaining the economical and cultural importance of design (DMI, 2004).

of view, but also, they materialize when what is important is to correctly develop the efficiency-product in the design process, and being integrated and participating in the enterprises strategic definitions starting from the highest deciding level and interacting with all of the relevant areas of an enterprise [16].

3 Product Development and Design Process: Operational Level

3.1 Engineering's Actuation

As soon as one approaches Product Development's (PD) operational level as an activity done by Engineering, one focuses on the operational matters of the product development, which are centered on specific projects and a special attention is given to the project itself and to the use of methods and techniques. This approach quotes two (2) models widely used, they are:

- The funnel structure one, with its variations by Clark & Wheelwirght apud [7]; and The "*stage-gate*" generic structure one, with its stages and decision processes by Cooper apud [7].

Cheng also presents a list of bibliographic references that approach specific topics of the operational level.

3.2 Design's Actuation

From the *Design* perspective, at the operational level, this activity, according to [16] is defined as "actions turned towards the design process, sorted as work "from the inside to the outside" in intellectual conception style and functional simplicity (European) as well as of what is worth selling and advertising (American). It does not integrate to other areas and the form follows the function (with an emphasis on the practical-operational functions)".

Nevertheless, opposite to what was presented in Cheng's work [7], in the *Design* field, there was no significative development of methods and techniques that guide the *Design* Process in the way that Product Developments presented nowadays, in constant improvement and in accordance with new business structures, horizontalized and by processes.

Despite having a moment in which Design has looked for developing a methodology of its own, which would congregate many branches of knowledge, whether they are artistic or technological, apparently, throughout history, there was no development of project methodologies, methods or techniques according to the requirements of the product, like Engineering does it.

On the contrary, the empiric methods and a strong basis on creative processes is a common practice of the professional dedicated to this activity. Maybe, that is what led the other areas to see *Design* as an area that only worries about the product's aesthetics. Due to its lack of attachments with a methodology, more strongly based on an analytical thought, whether it is reductionist (Cartesian) or

deterministic (cause/effect) or even to the mechanicist methods or the deepening of the system theories

A historical analysis of the design methods evolution shows a connection, initially, with scientific disciplines like General Systems Theory**,** Information Theory, Decision making Theory and Creative Process Theory. However, what is found in the *Design* methods is that, in its majority, its methods have two (2) good bases, one base guided by the systems theory and another guided by creativity.

Among the many analyzed authors who dedicated themselves to building up a new methodology for *Design upon the systems theories,* the main authors are: Bruce Archer [2], Hans Gugelot e Christopher Alexander quoted by John Christopher Jones [14], Gui Bonsiepe [5], Bernad Bürdeck [6], Bernard Löbach [15] and Mike Baxter [3].

There are others with a tendency for searching a Method based on creativity and with techniques like brainstorming (Alex Osborn, 1938), Sinetics (Gordon e Prince, 1961) Jones which consists in the analogy between a problem to be solved and a similar one, and also the lateral thinking – characterized by Edward de Bono [4] as a deliberated and systematic process that allows us to activate our capacity of developing and implementing solutions with an optimized productivity – and with this focus, many authors who consider perception as the guidelines to the project can be found, they are: Bruno Munari [19] which consists in the analogy between a problem to be solved and a similar one, and also the lateral thinking – characterized by Edward de Bono [4], Tomás Maldonado [17] Taboada and Nápoli [21].

4 Conclusions

With what has been exposed, it is important to observe that Design Process (DP), as well as Product Development (PD), activity developed by Engineering, are very wide human activity branches that center on problem resolution, creation, and coordinating and systemic activities.

Each problem to be solved implicates generating balanced results for a number of products developed under the optic of technology, of production, of the market, of the user, of the economy among other factors presented by the two activities.

This fact led processes to be systemized, the information flow to be mapped and the group of activities to be clear and objective, so that, activities and tasks of the process itself that aggregate value to the PD could be done, moreover, capacitating people with different skills and knowledge, generating indicators that improve the process' performance for a constant improvement.

However, in the *Design Process* activity, one can see a stronger preoccupation in developing a knowledge body, operational models with strong links to business, marketing, planning, strategies and management. That means an advance in the developing of *Design* at a strategic level, as shown before. In this case, the term used by professionals of the area is D*esign Management.* With this new scenario, the methods and techniques previously used became outdated or simply were not used anymore by most designers. So, there was a failure of the methodologies that had been developed more rigidly until the 70's. The teaching models and,

consequently, the professional activity were slowly substituted by empiric methodologies with strong links to the creative process.

However, contrary, the methodologies or models developed by Engineering searched to systemize activities performed at the PDP, and taking advantage of the analytical theory, organized the steps logically the phases of the product's project to reach the pre-established objectives. In its majority, methodologies present systematic procedures that conduct the analysis, generating proposals so that they can be verified and, therefore, contrary to the project requirements initially defined.

In the repetition of these models, a constant perfecting and continuous improvement on each phase of the Product Development was attempted. These constant improvements allow models developed to provide more trust in all of the process, whether it is during the collecting, analysis, proposals generating or making decisions that a Project's team requires in order to continue the Product Development, and allow the enterprise to reach its goal its desired success.

Subsequently, from the operational level perspective, *Design* can be considered as an integrating part of the knowledge body needed from the Product Development Process Management (DPM) as well as Marketing, Product Engineering, Manufacturing, Logistic and it does not, in anyway, substitute the PDM. It can be considered one among the several processes that as a group of activities aggregates values to the products developed and that deals with information in a differentiated way, as it adopts as a focus of its actuation, the interactions Man/Object/Environment.

So, *Design Process* must reconsider its methodologies, models, at an operational level. In other words, it must explore, develop and update in the same way as Engineering does. Besides that, these methodologies must consider in its structure *Design'*s main tasks, which are identifying and evaluating structural, organizational, functional, expressive and economical relations targeting the enlargement of a global sustainability and environmental protection; offering benefits and freedom to a human community as a whole, to the final individual and collective users, protagonists of industry and commerce; and still must support cultural diversity, despite the world's globalization; give to the products, services and systems, forms that are expressed semi-optically and be coherent with the aesthetics of its own complexity.

In this sense, it maybe that the lack of a speech in favor of *Design* comes from this lack of demonstrating that its performance contributes for the progress, from the development and application of the methodologies available, or even from the creation of a model that can suit the new market conditions, executives, organizations and even go against the new business models that make all of the market's technologic, economical and industrial context more dynamic.

The current methodologies and the models are little systemized and little deepened. That permeates teaching, and with that, professionals without a more dynamic and contextualized project methodological basis are formed, without the knowledge of managing tools, like diagnosis, accompanying, evaluation, time and investment return, without any security in the evaluation of the market's product results, which needs to accompany the dynamic now found in the many industrial sectors.

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