

BASIC STUDY OF CONTEXTUALIZATION BETWEEN PROJECT MANAGEMENT AND PRODUCTS DESIGN

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Abstract. *Currently companies search better alternatives to apply their efforts aiming strategic positions in the market with groundbreaking products, better quality and customers' satisfaction. In this context, the interests and applications of project management have increased, however, there are still some gaps when discussing the concepts application of project management and products design. Therefore, this study aims to present an overview about products design and project management with the goal to explain possible integrations, similarities and differences through the review of these methods. Although this is a basic study, it is initial discussion that can contribute to understanding which steps of project development that apply products design and project management, increasing ability of professionals and minimizing misinterpretation of these concepts in practice.*

Keywords: *Project management, Products design, Project development.*

1. INTRODUCTION

Capitalism generates a large need for formation of a global market, where it is possible to connect the world considering economic, social, cultural and political aspects. The main consequence of this is the increased competition and competitiveness, where competitiveness is the ability of an organization to be more attractive than its competitors, it is based on the perform of needs and expectations of customers. According to Dengen (1989), the competitiveness is the basis of the success or the failure of a business in a free competitive environment, and also matches company adaptation in their market niche.

The current global market is strongly composed by competitive enterprises. The intensification of competitiveness is result of demand increase by customer ever more demanding, where highlights some challenges as: flexibility, shorter time for release of different products, high quality, attractive prices and robustness. Nowadays, these features become premises. In this context, Meerkamm (2011) describes that wish of customers are more and more demanding due to the fast technological development and the close competition between companies.

It is possible to highlight that inside a competitive market it is difficult for a company survive, because of this scenario, it suffers several transformations. An important point of leading companies is the adaptive feature to these constants changes in market. Thus emphasizing that competitiveness varies according to the time, it's possible describe that today one company can be competitive however it is not sure that same company was competitive in the past, furthermore we can also not ensure that will still keeping the same condition in future.

Therefore, the market variations are depending of external environment, in which is dictated by science and technology development. According to Sánchez *et al.*, 2013, an important factor to improve the industrial competitiveness is to develop strategies around product design, focus on the innovation and high quality in all stages.

Consequently, in these contexts of innovation and changes it is necessary to handle appropriately informations, making it an opportunity to apply the knowledge of products design and project management as competitive differential of market. During last decades, stand out the constant and significant increase of project management enforcement with the goal to assure market advantage (Grant and Pennypacker, 2006). Still in this approach, Formaggio and Cauchick (2002) have presented that one adequate elaboration of new product planning and development is most important to enterprises because allows winning new markets and attract new customers.

Currently several techniques and tools are applied in the support of product or project development, therefore the companies use both concepts of design product and project management aiming to achieve strategic position. Thus in first moment, it is not clear the differences between applicability and development of these concepts. Based on this background, this paper aims to propose a basic overview about product design and project management resulting in an

initial discussion for develop future perspectives of research, which approach good practices of design and management minimizing empirical decisions or trial and error methods, and also allowing a better flow and process in the project design.

The main methodology used in this research was a literature review, from books and periodicals about concepts and trends of project management and products design. Marconi and Lakatos (2010) commented that literature review or bibliographic research are result of approaches principal works published, therefore they are very relevant because provide updated informations about chosen topic, representing an essential source of data.

2. PROJECT DEFINITION

Firstly the contextualization of project is important for correctly distinguish their application of daily activities. Thus the project is not a company's routine. The Project Management Institute (PMI), from their guide of project management know as PMBOK, defines a project as a temporary endeavor undertaken to create a unique product, service, or result (PMI, 2013). It is possible to note that temporary and exclusivity characteristics are the parameters that make projects different from each other. The projects are finished when their objectives are achieved or when the projects were interrupted due to identification of impossibility to achieve of initial objectives.

According to method PRINCE2™ of the Office of Government Commerce (2009), project is temporary activity organized to produce one or more predefined products or services, therefore are important means to support changes, mainly carried out under conditions, when normal operations cannot delivery proper products or services. For Kerzner (2006), project is a venture with objectives well defined, that consume resources and works under pressure of cost, quality and deadlines.

The projects arises inside of company motivated by different strategic objectives, therefore they may be aligned with corporate strategies where their focus is to define task and plans which give benefits for the organization. Still in this subject, it is important to highlight some particular characteristics of project as date of start and finish well determined, specific goals, multidisciplinary, the projects always are different despite the application in similar products, it is also developed by people and lately have many constraints, for example time and resources.

Projects differ in complexity and size, and they can be qualitatively categorized through the relationship between complexity (quantity of variables) and level of uncertainty of the result. Independent of the size or complexity level, all the projects has one structure of life cycle, as shown in Fig. 1 below.

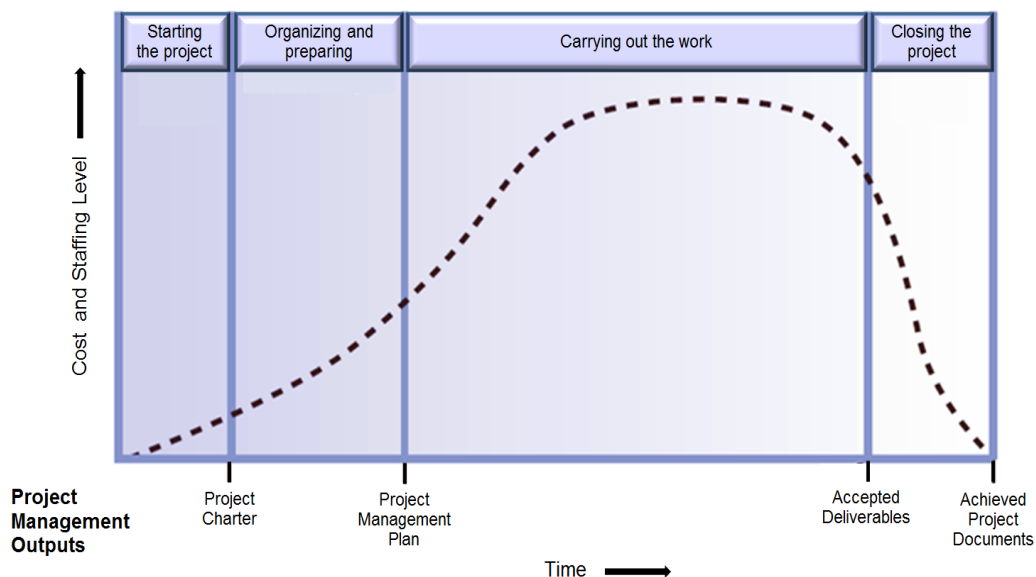


Figure 1. Generic project life cycle structure (PMI, 2013)

Based on this chart, the generic life cycle structure presented a low level of cost and staffing in the beginning, and it achieves maximum amount while the project is executed and it decline quickly when the project is completed. It is also important to mention that the stage that takes more time and resources is the phase of project execution.

According to PMI (2013), the project life cycle is independent from the life cycle of the product produced or modified by the project. Therefore, it is necessary to pay attention to distinguish the project life cycle and product life cycle. The project life cycle is composed by all phases and stages of the project where deliverables are defined, that goes since its conception until product creation, in some cases the project life cycle may be a part of the product life cycle. Already the products life cycle describes the evolution of product or service on the market, and can be set in four

steps, which are introduction, growth, maturity and decline, each one with specific characteristics and different strategic directions.

Having established the basic concept of project is possible to start contextualization between project management and products design.

3. PROJECT MANAGEMENT

Project management is not a recent subject, since the beginning of civilization the humanity works with project management, even without full knowledge about techniques and methodologies currents, people were concerned with control time, cost, materials and resources, beyond to assess risks. Over time, the development and organization of production methods emphasizing the interest in this area knowledge, now characterized by industrial presence.

The background of project management is oriented through standard set of the book Project Management Body of Knowledge (PMBOK Guide), that have sum of knowledge and best practices within the project management profession. This guide is a generic material, which is possible to apply for all knowledge areas, that can be used both in the construction of a building, in industrial manufacturing process as for software development.

In terms of project management, it is possible to define that is based in process which ensure knowledge applicability, abilities, tools and techniques that receive information creating results focused to promote general project management. For PMI (2013), the project management consists in the application of knowledge, tools, skills and techniques in the project activities to attend project requirements. These project requirements should attend necessity of customers, who are main stakeholders in this scenario.

According to PMI (2013), the project management is accomplished through the appropriate application and integration of the 47 logically grouped processes, which are categorized into five basic process group and ten knowledge areas. The five processes group are initiating, planning, executing, monitoring & controlling and closing, as shown in Fig. 2.

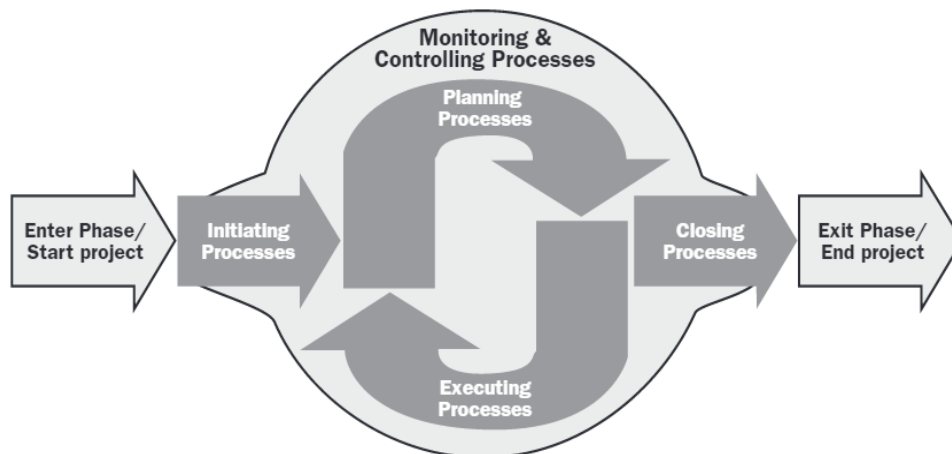


Figure 2. Project management process group (PMI, 2013)

Initiating process defines and allows the start of project, featuring the existence of the project or phase. The group of planning establishes and refines the objectives, and guiding the team to plan necessary actions to achieve objectives of scope, deadlines, cost and quality, for which the project was idealized. Still in this step, the schedules are prepared as well as the dependency between activities, resource allocation, cost analysis and the secondary management plan as communication plan, risk and quality, so the aim of this phase is to detail all projects activities

Already the executing process is the phase of fulfillment of all that was previously planned, the largest part of budget and project effort are consumed in this step, by last any error generated in the earlier stages become evident in the executing process stage. Monitoring & controlling processes ensures that project objectives are being reached, evaluating and monitoring their progress, and taking corrective actions when necessary.

The final process group is the closing that formalizes project acceptance and finish in an organized way, in this phase the customer's satisfaction is measured and lessons learned are recorded.

The five process groups described are associated in the ten knowledge areas, which are project integration management, project scope management, project time management, project cost management, project quality management, project human resources management, project communications management, project risk management, project procurement management and project stakeholder management. The Figure 3 summarize the relation between process group and specific knowledge area.

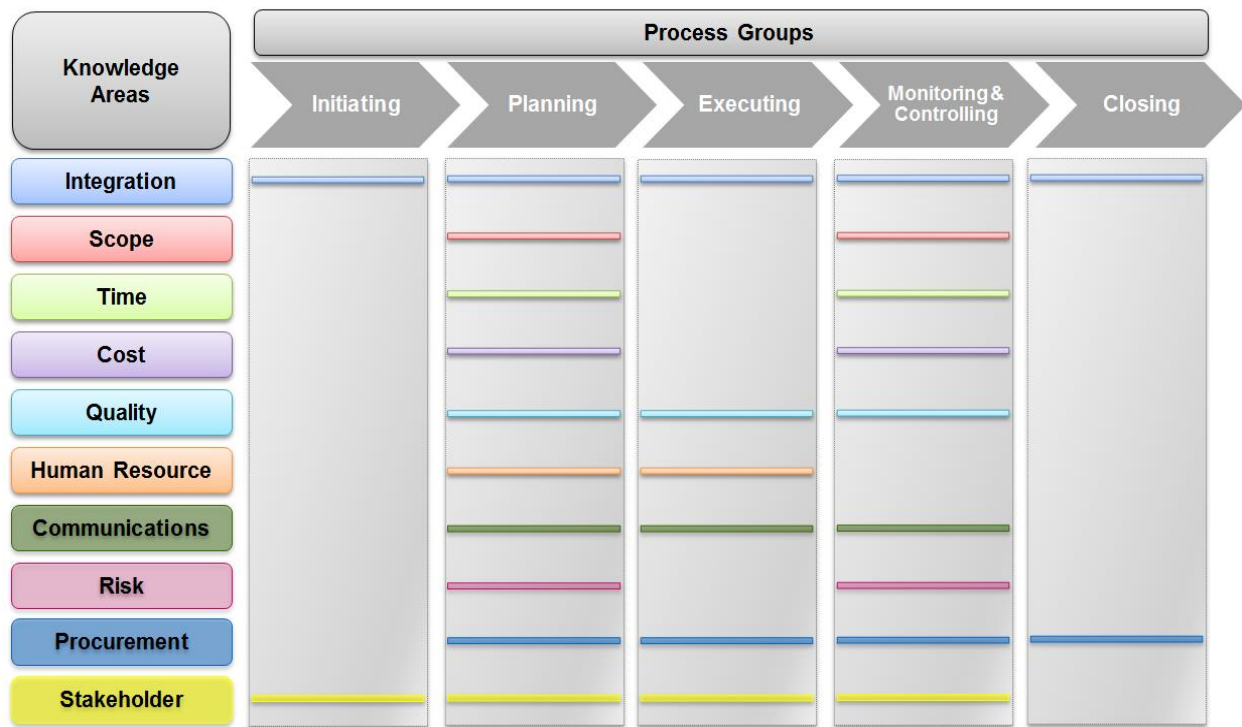


Figure 3. Project management process group vs Knowledge area

Based in the Figure 3, it is easy to visualize that almost all knowledge areas are approached in the steps of planning and monitoring & controlling process making the project ever more integrated. In the execution process, the aspects engaged more actively are human resources team, communications, quality assurance, conduct procurements and stakeholder engagement.

Scope, time, cost and quality are key aspects to reach the goal of the project, where it is expected one final result according to the scope, on time and defined costs, with acceptable quality. Communications and risks can be addressed continuously to keep expectations and uncertainties under control as well as the project in certain direction. Finally, the integration covers the execution of all this aspects.

Knowledge areas represents the main aspects regarded in a project and its management, therefore the required process groups and their processes are guides for applying appropriate project management knowledge and skills during the project. This shows that PMBOK gather, organize and formalize the concepts and best practices that are naturally present in the approach of any good project management.

In this scenario, it is important to remember that the PMBOK guide, as well as their process groups and knowledge areas, are not the bureaucracy of project management, in fact, seeking the implementation the best practices of PMI. For this purpose, knowledge and process described in the PMBOK guide should always be applied or followed for all projects in the company. However, the companies can customize according to their profile and necessity, through definition proper process and strictness level for each one.

4. PRODUCTS DESIGN

The project process is composed of key activities among which we highlight life cycle of product, products design and project management. In the context of products design, the methods are structured to support the logical thinking of designer when it needs understand and solve a project problem. For this support has an efficiently performance is necessary to reach some goals as:

- Development of systemic work methods that allows the search of all possible new solutions or improvement of existing solutions;
- Define selection criteria for technical and economic optimization;
- Define rules, directives and parameters for make a functionally optimized product;
- Gather and document previous, improved and new relevant informations about knowledge applied in the project.

The methodology applied in the products design must be applicable for all the areas, facilitate the work, produce accurate solutions, be didactic and easy to understand, promote inventiveness and knowledge enabling find optimal solutions.

As described by Pahl, *et al.*, 2007, design methodology is a planned procedure that is a result of joint among area project knowledge with cognitive psychology and a know-how of the experience with different applications. For Roozenburg and Eekels (1995), products design consists of method system, in the other words set of procedures, which are applied in the project activities. However, Evbuomwan *et al.*, 1996, define products design as one collection of procedures, tools and techniques for designers during the designing.

The design methodology can be defined as a collection of procedures, methods and techniques, in order to help designers in the activity of product development. Therefore, products design are methods applied in the project development to auxiliary the creation process and its application cannot guarantee the success of the product project, but increase the chances of success of product development. One good result is a consequence of the capacity technique and creative of who decides the problem, being the methodology only one logical support (DELGADO NETO, 2009). According to Delgado Neto (2005), the methodology used to design a product varies from product to product and from company to company.

In the beginning of project many informations are not clearly defined, resulting in the necessity of job tools which supports in the project development, as methodologies. Therefore, to facilitate organization of information, data generation, data analysis and choice of solutions, most of these methods are applied in products design, however it is necessary to follow some sequence of steps development. Usually the first step is the feasibility study and surveying of necessities, then it is done technical surveying and development of possible solutions, last of all the development of chosen solutions.

The design methodology has the feasibility study as the beginning stage of product design, then optimization of the product is the preliminary step, by last the detailed design is the latter stage of product development. The design of a component or system provides for each case, a chronological and methodological development that allows you to create a model common to almost all projects. This consists of a sequence of discrete events and chains, resulting in the following steps represented in Fig. 4. This figure shows the methodology of products design adopted in this paper, with the process of product development, relevant steps, and generated documentation.

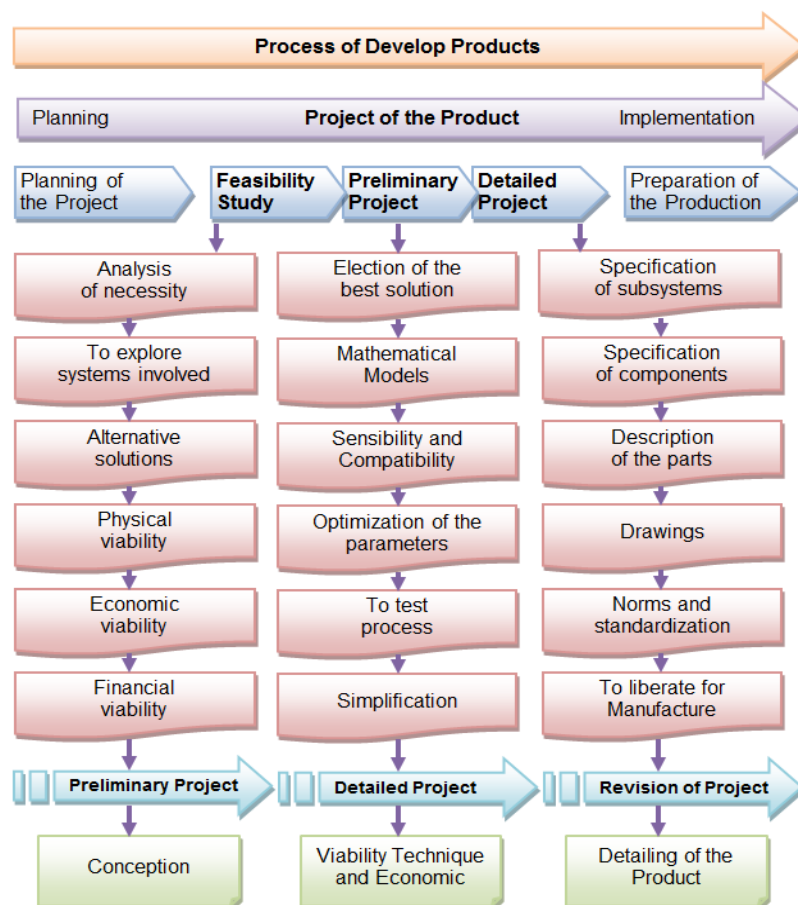


Figure 4. Steps of the products design (DELGADO NETO, 2009)

The step of feasibility study identify the problem and clearly define input data, as well as main observations and constraints imposed on the project. The knowledge of market and customers allows the enhance of designer feeling

about the problem, these characteristics and wish of customers can be convert in engineering parameters through tools of the products design. It should also be highlighted, that the creative process should be exploited widely for generate largest possible number of alternative solutions. The result of this phase it is a set of creative solutions with technical and economic viability.

In the preliminary project, the main objective is analyze the solutions presented in the feasibility study, at this stage are made mathematical modeling, simulation and optimization becoming this decisive step in the project design process. In this moment, all the calculations and dimensioning supports to find the optimal alternative through the numerical simulations, and eventually, is possible to happen the revaluation of the all project or on some steps. One of the key points at this stage is consider properly the important parameters and their functions ensuring that nothing was forgotten, the focus in this step is dimensioning and optimization of functions.

The last stage of this model is the detailed project that involves set of complete draws and specifications of components, assembly and installation draws, mockup or prototypes, layout and definitions of assembly parameters. In this step the solution chosen in the preliminary project will be detailed and tested, therefore the focus of this stage is detailing, definition of tolerances and constructive adaptation.

Each step can be apply different methodological tools such as QFD, Functional analysis, Brainstorming, Method 6.3.5, TRIZ and Morphological matrix and others. These are some of the tools used in the project process and can used in any type of project depending of necessity and profile of company.

5. COMPARISON AND DISCUSSION

The product release in the market is result of efforts, which can taking significant time and involve most of company departments. Overall, it is possible to note that decisions taken in initial phase of project has an important effect on the final result, especially when linking the performance of result with the degree of customers satisfaction, and also when measuring costs of modifications in the projects. Therefore, for strengthen the adoption of adequate practices in products development it is necessary domain the management techniques of resources and constraints, as well as engineering techniques that organize and bring technical data of project.

In this context arises opportunity to establish a discussion about the relationship between concepts of project management and products design, as shown in Fig. 5.

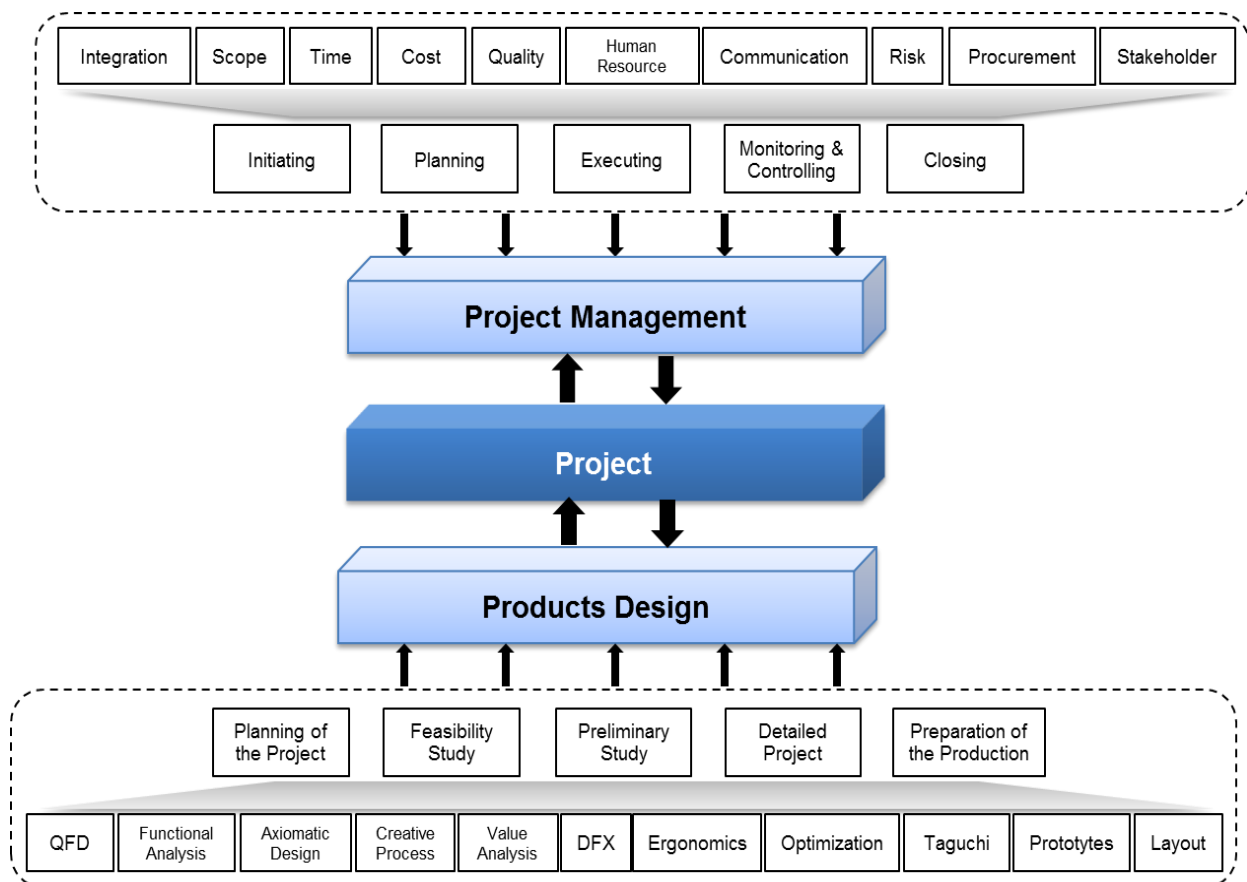


Figure 5. Integration between project management and products design (Adapted: Back *et al.*, 2008)

The integration between project management and products design aims to support more and more decisions in the project environment, making this scenario fewer susceptible to errors. Thereby, the main function of project management is define, prioritize and schedule the activities, even as measure and control costs, time and resources, and encourage work in team and communication with stakeholder. Thus, the project management is very important to integrate people with multidisciplinary characteristics to achieve one objective common and good results into a delimited limit.

Already products design should support the transformation of information from opportunities mapping until production of one solution with technical and economic viability. Thus, tools and methods guide the designer to found a better alternative through orientation of how to do and what to do in the project development.

In the company environment these concepts often are seen in separate way, however should be interesting an integration or union of these as shown in the Fig. 5, that proposes that techniques of project management and products design should be development in parallel and simultaneously throughout the project, for achieve a good progress of project. Thus, this approach allow get gains in the project development and the possibility to promote the integration of knowledge in the company as whole.

These concepts have strong relation in their application even if it intrinsically, because in the practice is possible to find tools and techniques applied in both, for example the FMEA (Failure Mode and Effect Analysis). As the techniques can be used in both, in some cases can result in wrongs learning and interpretations if not properly used.

It is relevant to mention that these methods of products design and project management have different natures, where the first have technical features for the engineering aspects and the second has an essence of administration respectively, due to these definitions they can be seen as separate research programs in the industrial environment as well in the academic.

By the end, it is important to be clear that the products design come to supply the difficulties founded in the project development, because these disabilities are not strongly addressed in the project management. Thereby, when the concepts are applied to complement each other, they may meet enterprises' requirement on the best way, resulting in the better strategic positioning at the market, just because the informations are properly handled and faster.

6. CONCLUSIONS

This study provides a theoretical basis to understand better the scenery of the products design and project management. Through the basic approach is possible to highlight that these concepts are independents but it shares techniques which support the develop project process.

Although this paper is an initial knowledge about this subject, it can be considered a starting point to discuss more about applications of techniques and tools, aiming encourage future studies to supply the necessities of knowledge and applications about the methods of project management and products design, which may follow the complexity and increase of market to create new approaches.

In this paper was possible to observe that the project design and the project management are separate lines of product development and normally are important to apply for success in the product development. Therefore, an integration between then can generate interesting result because one can complement the other.

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8. REFERENCES

- Back, N., Ogliari, A., Dias, A. and SILVA, J. C., 2008. *Projeto integrado de produtos: planejamento, concepção e modelagem*. Barueri: Monole.
- Delgado Neto, G. G., 2005. "Uma Contribuição à Metodologia de Projeto para o Desenvolvimento de Jogos e Brinquedos Infantis". *Dissertação de Mestrado*. Universidade Estadual de Campinas.
- Delgado Neto, G. G., 2009. "Desenvolvimento e aplicação de um programa computacional , para abordagem sistemática de desenvolvimento de produtos e serviços". *Tese de Doutorado*. Universidade Estadual de Campinas, 165 p.
- Dengen, R.J. and Mello, A.A.A., 1989. *O empreendedor – fundamentos da iniciativa empresarial*. São Paulo, McGraw-Hill.
- Evbuomwan, N.F.O., Sivaloganathan, J. and Jebb, A., 1996. "A survey of Design Philosophies, Models, Methods and Systems". *Proc Instn Mech Engrs*, Vol. 210, p. 301-320.

- Formaggio, I.A. and Cauchick Miguel, P.A., 2002. “Estudo inicial sobre a utilização do QFD como ferramenta estratégica no Planejamento de Novos Produtos”. *ENESEP (Encontro Nacional de Engenharia de Produção)*. Curitiba, 2002.
- Grant, K.P. and Pennypacker, J.S., 2006. “Project Management Maturity: An Assessment of Project Management Capabilities Among and Between Selected Industries”. *IEEE Transactions on Engineering Management*, v. 53, n. 1, p. 59-68.
- Marconi, M.A. and Lakatos, E.M., 2010. *Fundamentos de metodologia científica*. 7ª ed. São Paulo: Editora Atlas.
- Meerkamm, H., 2011. “Methodology and Computer-Aided Tools - a Powerful Interaction for Product Development”. In: *The Future of Design Methodology*, Birkhofer, H., (ed.), DOI: 10.1007/978-0-85729-615-3_5, Springer-Verlag London Limited.
- OGC - Office of Government Commerce, 2009. *Managing Successful Projects With Prince2*. London: The Stationary Office.
- Pahl, G., Beitz, W., Feldhusen, J., Grote, K.H., 2007. *Engineering Design: a Systematic Approach*. 3 Ed. Springer-Verlag London Limited.
- PMI - Project Management Institute, 2013. *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*. 5ªed. Project Management Institute, EUA.
- Kerzner, H., 2006. *Gestão de projetos – as melhores práticas*. 1ª ed. Porto Alegre: Bookman, 821 p.
- Roozenburg, N.F.M. and Eekels, 1995. *J. Product design : fundamentals and methods*. Chichester, England: John Wiley & Sons Ltd.
- Sánchez, P.D.M., Gaya, C.G. and Pérez, M.A.S., 2013. “Standardized Models for Project Management Processes to Product Design”. *Procedia Engineering*, Vol. 63, p. 193 – 199.