AN INVESTIGATION ON ORGANIZATIONAL VIEWPOINT CONTRASTING IN THE EXPANSION OF NEW CREATION AND OPERATIONAL REFINEMENT

Management Insight
14(2) 13 - 31
DOI: https://doi.org/10.21844/mijia.14.01.2

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ABSTRACT

aper analyses the relationship between the factors of the organizational segments and their product evolution procedure (PEP). The investigation is carried out in a functionally structured company in which some improvements activities were executed. People from different departments such as engineering, manufacturing and marketing were interviewed. It was found that the perception of improvement is influenced by the respondent's department of origin. The positions held by these individuals in product evolution can better describe his/her own perception about process improvement.

Keywords: - Product innovation, organization hierarchy, matrix structure, improvement ideology

1. Introduction

The product evolution procedure (PEP) deals with an intrinsic dichotomy: it must be creative for new products to open up new market opportunities for the company and must be pragmatic for the technologies dominated by the company. This dichotomy extends to the work of those who design and develop products. The engineer wants to test new technologies and the seller wants new markets, but the manufacturing staff wants something that does not change much the company's fabrication structure. The seller wants new markets, but it is the manufacturing that will have to develop new distribution structures, new suppliers, new partnerships. The project team wants new technologies, but development deadlines commonly push it to use small variations from the one that is dominated by the company. The product manager wants the project outcome to meet the specifications that have been passed to him, but marketing changes the specifications often because the market changes. Top management knows that a project is a result of the commitment between meeting the specifications with a certain degree of quality, meeting the deadlines and controlling the costs of the project and the product. This commitment, however, is not always clearly communicated to managers and project teams.

In this sense, the article articulates two important areas of the study of the PEP: its organizational structure and the improvement of the process. The PEP depends on the conditions of market and technology to which the company is heading.

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However, how do the engineers involved in designing a new product see? And how do people of manufacturing and marketing see? And, within a given project, how do product managers, top management, and technical activities performers see the improvements? Such questions must be arising at time of expansion.

The objective of this study is to analyse how a set of improvements in product development is perceived by the different factors involved in this process.

2. Research method and its context

This article describes the evaluation of an action research paper with a duration of 4 months. The action research focused on improving the product evolution procedure (PEP) of the company in question. The reference to action research adopted a new version of the method proposed by Karlsson (2008), which indicates the phases: diagnosis, action planning, and action evaluation. After performing some improvement cycles, which can be visualized, a final evaluation was carried out, which is inserted in the final step of the research process described by the authors above.

In section 6, the intense changes in the company's PEPs made during the action research are summarized. Such methodology allowed a deepening in the evaluation of results of the work. since, the researcher was responsible for the previous action research and the use of the tool of the holistic case study made possible greater control of the subjective aspects of the evaluation of an action research work, as described Mcniff (2013).

As such, interviews were conducted with a group of people involved in new product designs from different levels of the company and belonging to the three main departments related to the development of new products: engineering, marketing and manufacturing. The Table 2, presented in item 7, shows the number of personnel interviewed: 20 people. The table also shows how the interviewees are divided by functional area and what their role in the company's PEP. Respondents account for 100% of the engineering staff involved in the development of new products, 100% of the heads of the manufacturing departments involved in the development projects, since they are the sector leaders who are most heavily involved in manufacturing and assembly of the prototypes, 2/3 of the marketing staff involved. since most of the sales personnel work directly in the field, not participating in marketing activities and decisions related to the design of new products.

The sample covered 100% of the project leaders, 78% of the functional managers involved, half of the company's top management and 100% of the technical staff involved in the projects. It is important to note that project leaders play a dual role in the company's PEP, they participate in others as performers of technical activities. The comments on the other projects were disregardedfor the purpose of drawing up the charts presented in section 7 of this paper. In addition to the group surveyed, statements regarding the improvement of the company's PEP were submittedand the respondents answered based on the following scale: -2, totally disagree; -1, I disagree; +1, agree; +2, I totally agree. The zero of the scale presented in the graphs exposed in section 7 was achieved only when the personnel data were cross-referenced by the group surveyed. In the event that the researcher considers that he or she did not know if a particular improvement occurred or not, his answer was considered null, not entering any value in the making of the means presented in the graphs that go from Figure 4 to Figure 11.

The theoretical framework of the work is presented below.

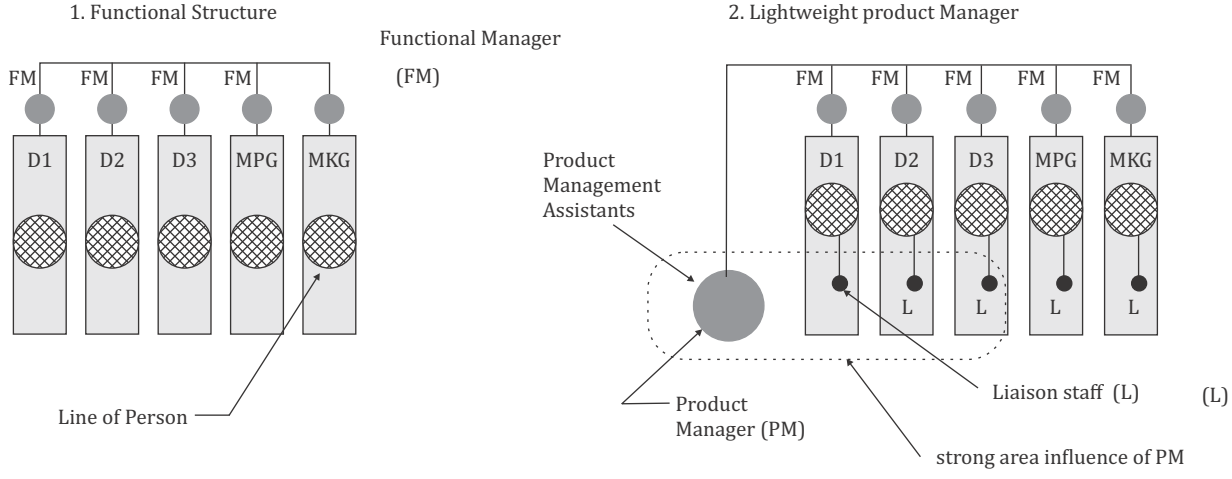
3. Organization of the product development process

The authors closely discussed the organizational structure that a company establishes for its PEP and the operations involved in the process.

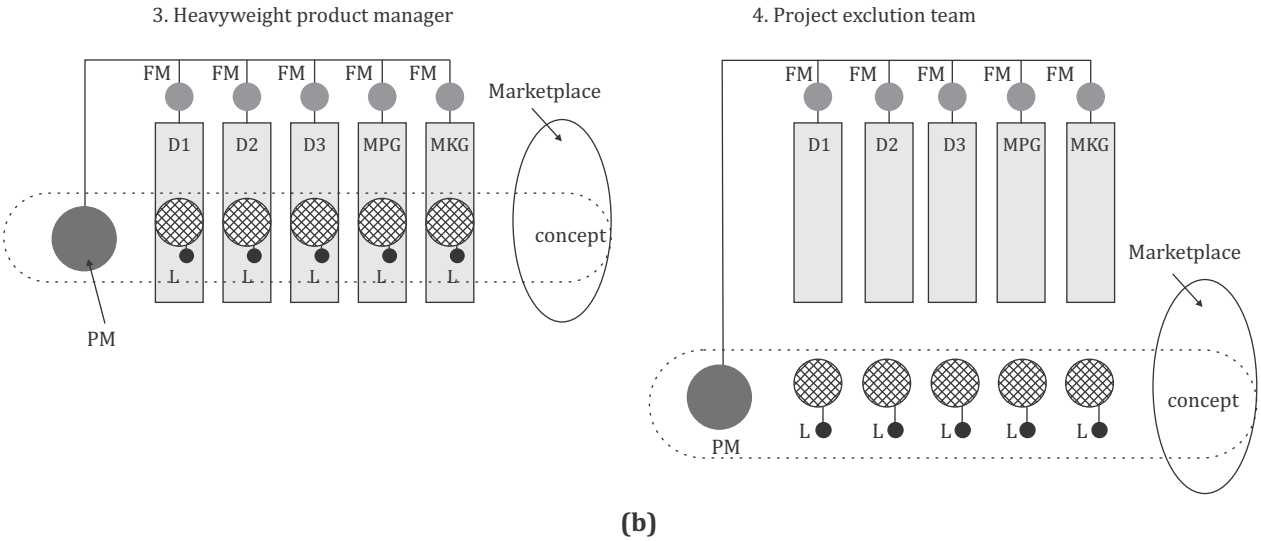
In Clark (2005), there is a well-founded discussion of what the authors call formal and informal dimensions of leadership and organization." The authors argue that the effort to organize the PEP is based on finding solutions to two basic problems: (1) how to design, construct and test parts and subsystems so that each element achieves a high level of technical performance; and (2) how to achieve high degree of product integrity, since parts and subsystems are commonly designed separately. The integrity of the product would have two dimensions. Internally, it would mean the harmony with which the parts function when united. Externally it would mean the degree to which the experience in using the product as a whole meets consumer expectations.

From the organizational point of view, according to the authors, technical performance is related to the degree of specialization of the functional areas of the company, while the integrity of the product is related to the degree of integration with which the company develops products. For example, European sports car companies of high standard, which manufacture them in small, almost handmade lots, emphasize functional areas with a high degree of technical expertise.

Analysing automotive companies, the authors came up with four basic forms of product development organization, which are presented in Figure 1.



(a)



(b)

Figure 1. a & b Four modes of development of organization.

The functional structure illustrated in Figure 1 is used to emphasizespecialization, while the integration of the development effort is established by procedures, rules, detailed specifications, etc. The other structures present the figure of the product manager whose function varies mere coordinator of the engineering effort in the light-weight structure to the effective controller of the resources allocated to the project, in the case of the heavy-weight structures and the project team. Additionally, in these last structures, the product manager is responsible for maintaining the concept of the product throughout the PEP, which strongly influences the possibility of maintaining the external integrity of the product.

Finally, Clark (2005) point out that there is an important dependence on the internal integrity of the product in relation to the company's capacity to manage its suppliers. Wheelwright and Clark (1993), Clausing (1998), and Ulrich (2016) explicitly use the model proposed by Clark and Fujimoto, described above. PMBOK (1996) models a series of organizational structures by which most companies manage their projects. The pattern adds to Clark and Fujimoto's (2005) analysis, a weak matrix structure that is intermediate between the functional and the light-weight structure.

The PMBOK presents what it calls "... main project-related characteristics of most organizational structures", which consolidate a number of important elements in the design of the organizational structure of development in a given company. These characteristics are presented in Table 1.

It can be considered that the product manager described by Clark (2005) is the project manager of the PMBOK when the project considered is the development of a new product.

Nonaka (1994) present an interesting discussion about the form of organization that they consider more adapted to the processes of knowledge creation, among which the PEP can be positioned. According to the authors, this structure can be called "hypertext organization" being "composed of interconnected levels.

The business system would characterize the level at which normal day-to-day operations are performed, while the knowledge base incorporates the company's vision and organizational culture to release tacit knowledge and technology to make explicit knowledge available. The project team is responsible for the effective development of the product. According to them, the main feature of hypertext organization is the ability of members to change their context. In the language of Clark (2005) and the PMBOK, the hypertext organization is a matrix structure.

The major organizational units involved in product development projects are illustrated in Table 1 as described in Clark (2005), Wheelwright (2011), Clausing (1998), Cooper (1995) and Ulrich (2016).

Table 1(a). Influence of the organization structure of the projects according to the PMBOK.

	Functional	Matrix			Projected
		Weak matrix	Lightweight	Heavyweight	
Manager's authority of project	A little or none	Limited	Low to moderate	Moderate to high	High to almost total
Percentage of staffallocated in time integral to the project	Virtually none	0-25%	15-60%	50-95%	85-100%
Allocation of project manager	Part-time	Part-time	Full-time	Full-time	Full-time
More common roles for the project manager	Coordinator/ leader of project	Coordinator/ leader of project	Manager/director of project	Manager of project and programme	Manager of project and programme
Administrative support to the project manager	Part-time	Part-time	Part-time	Full-time	Full-time

Table 1(b). Organizational units in functional structures

Items	Responsibilities
Marketing	It plays an important role in all of the aforementioned structures. Respond to requirements of consumers, market tests and marketing and sales plan.
Engineering	Responsible for product design and product engineering in functional structures. In other structure, engineering provides human resources in the different technological areas
Manufacturing	Process design in the sense of process engineering. Try-out. Identification and management of Providers.
Top Management	Responsible for product portfolio management, either at the strategic level or in the so-called gates. Responsible for the company's development structure.
Manager functional	Responsible for allocating resources to projects and monitoring results achieved by their subordinates in functional and matrix structures.
Team development	A team of about 20 people who develops the product. It's the core of the project in matrix and projected structures.
Manager of product	He is responsible for the planning and execution of the project and for the development and maintenance of product design. The scope of these functions is defined in Figure 1.

It should be noted that in Table 1 there are two different types of organizational units. There are the departments of the company, that is, the functional areas most strongly involved in the PEP: engineering, manufacturing and marketing. In functional companies these units are the main factors involved in the PEP. on the other hand, organizational units that represent important elements in the company's development structure, whose roles are relevant mainly in matrix and projected structures.

For example, the functional manager has a rather intuitive role in functional structures: managing his or her technical team and getting them to meet the company's goals. In matrix structures, this function is divided with the product manager and totally passes to the latter in the projected structures. The role of senior management in the PEP was gradually clarified in the 1990s until the formalization of portfolio management in the stage-gate model, in which its role is central in balancing, maximizing value and aligning projects with the strategy of the company (Cooper 1995).

The commitment of top management, especially at go / kill decision points, and the adoption of multidisciplinary teams are pointed out by Cooper and Kleinshmidt (1995) as the main drivers of the performance of leading companies in development. The importance of multifunctional teams is confirmed by Griffin (1997), who also diagnoses that leading companies use team-focused reward mechanisms that are more linked to public recognition than to financial returns from team members of successful projects. In Cooper (1998), the organizational aspects are approached from the point of view of the availability of the necessary resources for the new projects by the top management of the company. According to the author, the commitment of adequate resources to the project increases the marketing success and profitability by about 45%. The following are some studies whose focus was explicit in some elements of the organization for the PEP.

Authors analyse the impact of strong leadership throughout the project on the success of new products and note that while this practice reinforces the performance of the PEP in the company, it does not have a significant impact on the marketing success of the products. Khurana (1997) analyse the role of the project team, the project manager, the project monitoring committee, and senior management in the activities related to the survey of market requirements and the planning of project activities. Gruner (2000) analyse the impacts of increased customer interaction across a new product and verify that there is a greater likelihood of technical product success, but there is no positive impact on the organization of effort within from the company.

Sosa (2003) analyse the alignment of product structuring as subsystems and the division of the project between work groups. In conclusion, the authors point out that product modularity has a strong influence on the degree of integration between functional areas in a new product design. According to study the influence of the organizational integration of a given company on the results of the new products, such as profit expectations, sales potential and success in markets already addressed and new to the company. The results show that organizational integration as a whole is more impacting in profits, and the same is true when considering only the internal integration of the company (its departments and project teams). When analysing the integration of the company with customers and suppliers, the greatest impact is on the sales volume of the new products.

The authors note that, although there arestrong corporate supplier partnerships, there are in

practice a set of barriers that hinder them, such as: (1) management's emphasis on competition between suppliers for more advantageous contracts; (2) central government impositions on subcontracting alternatives open to local management; (3) resistance of the project team regarding the integration of engineers of contracted companies; and (4) lack of trust among companies about their cost structure.

The authors identified that the incorporation of knowledge generated in the market, manufacturing and other departments of the company in a given project is the main influence of the cognitive aspects on the PEP result. The authors construct the concept of "team intelligence" through which they explain the success stories of the researched sample.

Girard (2004) use the GRAI methodology and UML Language adapted to the coordination activities of development projects. Barreto (2008) propose a tool to support human resources planning activities involved in software development projects. The tool uses a list of skills and profiles that must be continually updated and allows you to balance cost, time, resource allocation, and project size forecasts.

It is verified, therefore, in the primary bibliography established in indexed journals that the authors who analyse the organization of the PEP tend to study it trying to understand the drivers of success in new products linked to organizational aspects such as internal integration of the departments of the company, or with clients, and with suppliers.

4. Improvement in product development

The concept of improvement was popularized from the Japanese experience of management based on kaizen events (Imai, 1986) and later on with total quality management programs that were disseminated throughout the West. Consolidated concepts such as the PDCA cycle is based on the idea of continuous improvement (Gryna, 2001). The concept of process reengineering was used in the early 1990s as a counterpoint to continuous improvement in providing a framework for making drastic changes in business processes, which would result in an overall improvement in the performance of the "re-interviewed" process ".

Subsequently, the theories of change management allowed to integrate the references of continuous improvement and drastic change in a consistent way. Nowadays so-called maturity models, such as Capability Maturity Model Integration (CMMI), are strongly based on continuous improvement theories.

Although the benchmark of continuous improvement has been developed based on manufacturing processes, there has been a strong effort to apply this approach to the PEP, highlighting the CMMI model (Chrissis 2009) that seeks to integrate development of hardware and software in a common framework based on levels of maturity and capability. The difficulty of applying continuous improvement methods to the PEP is analysed by Caffyn (1999). The author points out that the intangibility, the inherent creative process, the need for standardization as a basis for process improvement and the lack of performance indicators are the main difficulties encountered in applying the improvement frameworks to the PEP.

The use of performance indicators as a means of assessing the results of PEP improvement activities is not very present in the bibliography. However, analysed in isolation, the performance indicators are widely used by the authors of PEP. According to Cooper (2009), the balancing of the product portfolio and its adequacy to the company strategy, two of the main objectives of portfolio management, to be implemented, would

need to be systematically managed through a set of indicators. The indicators suggested by the authors are intended to make predictions about the output of the product and its adequacy to the company's strategy.

The Figure 2 shows the frame of reference used by Clark (2005) to analyse the business performance of the automotive sector based on the establishment of a link between the performance of the PEP and the company's goal to launch new products.

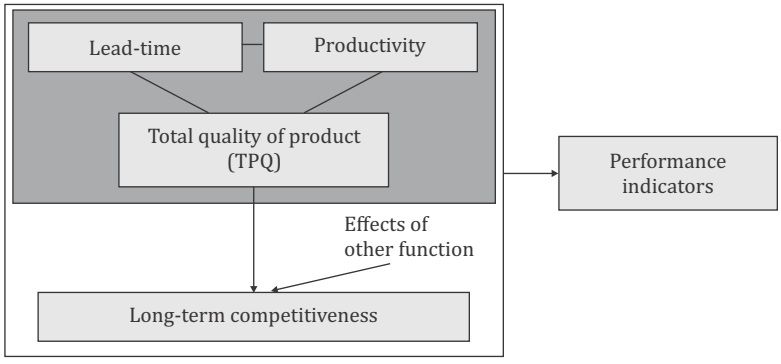


Figure 2. Performance of product development

TPQ is defined as the extent to which the product satisfies the consumer's requirements, whether related to objective attributes (engine power, for example) or subjective (aesthetics, style, feel in the steering wheel, etc.). The lead-time is defined as the measure of how fast a company can move from concept to market. Considering the beginning of a project at the beginning of the concept development, lead time is the time required to define, design and introduce the product in the market. Productivity, in short, is defined as the level of resources required for the project to move from the concept to the commercial product, which includes working hours, materials used in prototypes, and any equipment and services used.

The authors developed a series of metrics that allowed to analyse the performance of the PEP in the companies surveyed, as well as its correlation with the competitive result of these. Among the metrics used, we have:

To measure lead-time: " lead-time of planning by project", " lead-time of engineering by project", as well as " lead-time per phase of PEP";

To measure perceived quality of the product: percentage of purchase repetition and product score in a quality rating performed by experts;

To measure the quality of product conformity: number of technical failures per year;

To measure the quality of the project: opinion of experienced designers weighted with commercial values of the costs of the analysed products;

To measure productivity, the engineering hours spent in companies were used; and

To assess the level of global competitiveness of the companies surveyed, the authors raised data on the growth of the companies' market share.

The study by Clark (2005) was the main analysis of PEP based on the use of performance indicators since it encompassed the main industry of consumer durables of today and touched

companies from all continents. Other localized studies focused on the use of performance indicators applicable to PEP, among which are the studies by Griffin (1996).

From a theoretical point of view, these criteria are sometimes represented by the PEP performance indicators themselves, an observable fact in companies with a more structured measurement of performance in new products. At other times, a criterion reflects a person's perception of improvement, which may even meet the objective values measured by the indicators. In Kaplan (2009), the performance criteria mentioned here are referred to by the author as "performance objectives" and are characterized by cause-and-effect relationships: if a given action is performedthen a given objective will be met.

Therefore, the causal relationship sought is: to verify if there was perceived improvement in performance criteria as a function of the improvement actions summarized in section 6.

5. Characterization of the Product Development Process in the researched company

The company in which the work described here was carried out was founded in 1930 as a respected high-tech company. Originally from United states having worldwide manufacturing units also in India. At the time of its inauguration, the company worked with the areas of special thin films and industrial laser applications, having subsequently entered the defence, medical ophthalmic and space markets.

Among the products developed by the company, they have:

Industrial area: laser meter for tire control and laser multiport;

Medical area: ophthalmic and dental surgical microscopes, digital retina and photocoagulating laser for retinal surgery;

Defence: optical components and laser detection systems for Indian aeronautics, laser pointing and guiding units for the Indian army, etc..; and

Space area products: complete subsystems for capturing and processing images of the Earth to integrate environmental monitoring satellites.

The company adopts different production strategies for its product lines, according to the classification of Winch (2001). There is a catalogue product line available for production and sale. These products, however, are not available in stock and are produced according to the order closing. Medical, scientific and manufacturing equipment is produced in this philosophy that sets up on-demand assembly (ATO) systems. There is another product typology that is sold as a project through contacts made by marketing and engineering departments. A supply proposal is closedand the device is then designed, prototyped, tested, approved and delivered to the customer. This type of manufacturing is characterizedas order engineering (ETO).

The Figure 3 shows the chart of the searched company.

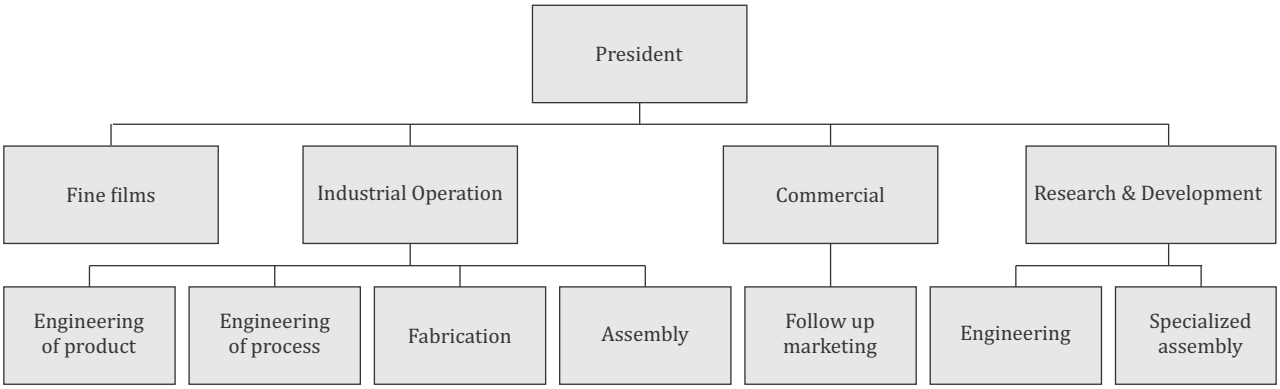


Figure 3. Organization chart of the searched company

The company is made up of four departments, two of which may be considered engineering divisions, a commercial department and a manufacturing department. The department called "thin films" is responsible for the development and manufacture of optical films for the treatment of commercial glasses and for the development of optical filters used in diagnostic and ophthalmic ophthalmic devices. This division comprises independent product and process engineering departments that provide specialized services for the firm's PEP.

The research and development (R & D) department is responsible for the design of ATO, MTO and ETO equipment. It is composed of an engineering group consisting of mechanical, electronic, software and physical engineers and a specialized assembly group composed of technicians in electronics and mechanics, which is responsible for the integration of the defence equipment developed, as well as, by the assembly of development prototypes. In space and military projects, assembly, integration, testing and delivery of the units produced, after approval of the products, are carried out by the specialized assembly team. Projects of the type ATO and ETO are commonly born within this department.

The commercial department maintains an after-sales follow-up of the product and organization of fairs and marketing events. Its responsibility is to propose new projects of ATO type medical products and to monitor the degree of customer satisfaction with respect to these products. The ATO projects begin with a market study and are then discussed by the board before being passed on to R & D for the equipment to actually be developed.

The "industrial operations" department manages the whole process of acquisition, manufacture, assembly and shipment of the products developed in the company. In addition to manufacturing operations (manufacturing and assembly), this division comprises the product engineering and process engineering departments. While R & D is responsible for designing innovative products for the company, product and process engineering deals with making incremental improvements aimed at reducing manufacturing and assembly costs and introducing the product into the company's fabrication structure.

When the design of a new ATO-type product is initiated, marketers specify the product and give a brief description to the R & D department. Within R & D, a "design leader" chosen in "engineering" is established. In addition, responsibilities are assigned to other members of "engineering" and "specialized assembly" to form a project team. The project leader distributes the work tasks and

interfaces between the project and the R & D director. It is responsible for meeting deadlines, specifications and a possible cost goal for the product. There is, however, no budget specified for the project.

6. Improvements made to the Enterprise Product Evolution Procedure

Over the course of about three years, the company's PEP underwent an intensive work of improvement in a research documented action. The work focused on the following aspects:

Product documentation: Techniques were systematized for the design and architecture of the products developed. Through these artefacts were produced documents of engineering, manufacturing, assembly, PCP, quality control and technical assistance.

Project management: a project planning and monitoring method was implemented based on timelines and work division structures. Project management committees were organized for the equipment developed in the space area.

Manufacturing operations: based on the documentation developed, training was carried out with the manufacturing and assembly personnel. The process of assembly, integration and testing of medical equipment was refined along with the manufacturing staff.

The description of the work to introduce these improvements is beyond the scope of this article. It is, however, important to highlight that the work allowed the ISO 9001: 2000 certification of the company's project area, and the Foods and Drugs Administration (FDA) and the adequacy of the PEP of the company to the rigid requirements of the aerospace projects, which is regulated by European and NASA standards.

7. Improving the Performance of the Product Development Process

The Table 2 presents the group's profile researched to raise their awareness as to improve the PEP at the end of the work mentioned in the previous item. The table shows the functional areas of origin and the roles of those surveyed in the company's PEP.

The performance criteria used were selected based on the possibility of becoming performance indicators for the PEP, according to the areas illustrated in Figure 2 (deadlines, quality and productivity): accuracy of planning deadlines, improved monitoring and cost control, improved timing control, easy access to project information, ease of integration of new designers, degree of change in product requirements, reduction of manufacturing department claims, and reduction of customer complaints. The performance criteria were submitted to the respondents by means of the statements in the graphs of Figures 4 to 11. In the vertical axis of the graphs, the scale of agreement or disagreement, presented in section 2, measures the perception of improvement regarding the affirmations. The responses were tabulatedand the means of each indicator were extracted for each group. The mean and standard deviation of the general improvement - considering all the analysed criteria - perceived by the group were also calculated only as a way of providing analytical insights about the data obtained.

Table 2. Profile of the interviewees in the second MRM validation phase in the functional area

Total	Engineering	Manufacturing	Marketing	High direction	Manager function	Project leaders	Tech guy
20	14	4	2	3	7	5	5

The Figure 4 shows the overview of the respondents as the degree of improvement of the PEP. It is observed that the criterion of performance considered more positive in the growth of the PEP of the company due to the improvements applied was the "capacity to integrate new people to the projects". The "accuracy of time estimates" and "deadlines control" were the criteria with the lowest perception of improvement by the interviewees.

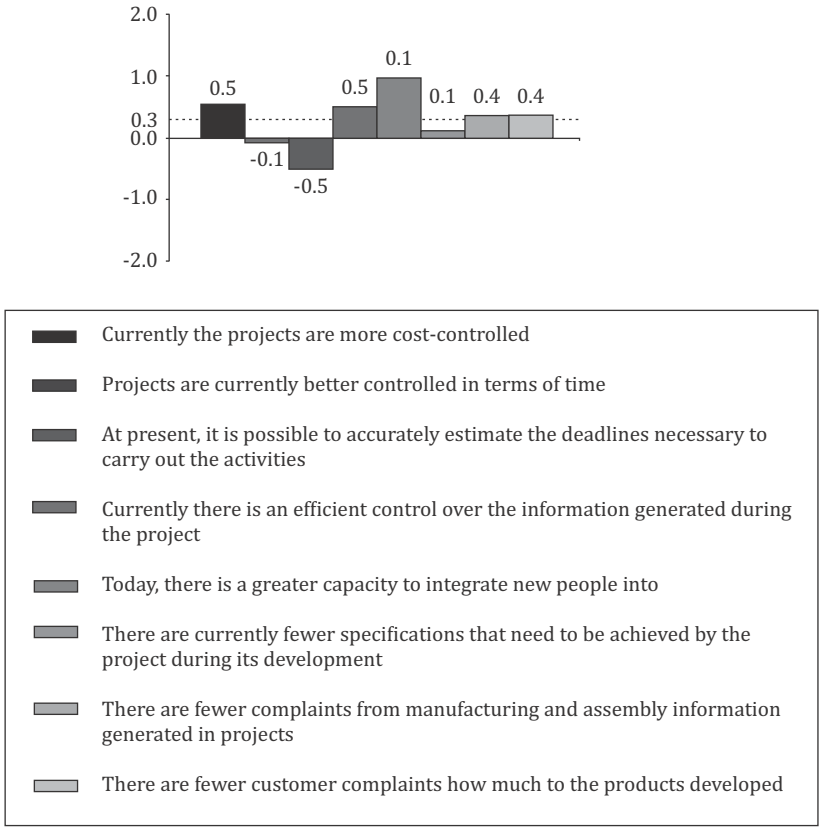


Figure 4. Degrees of improvement of performance criteria researched

The distribution of responses in general presents a mean of 0.3 (as shown in the figure 4) and a standard deviation of 0.4. These values were used to verify the degree of significance of the extra-group responses, and the criteria with significant differences in relation to the general distribution are discussed throughout the presentation of the following graphs.

The Figure 5 shows the perception of improvement of the company's engineering departments, i.e. the R & D department and the staff allocated to the product engineering sector of the department of industrial operations. It is observed that for this public, there is still greater agreement on "integration capacity" and less on the "accuracy of deadlines".

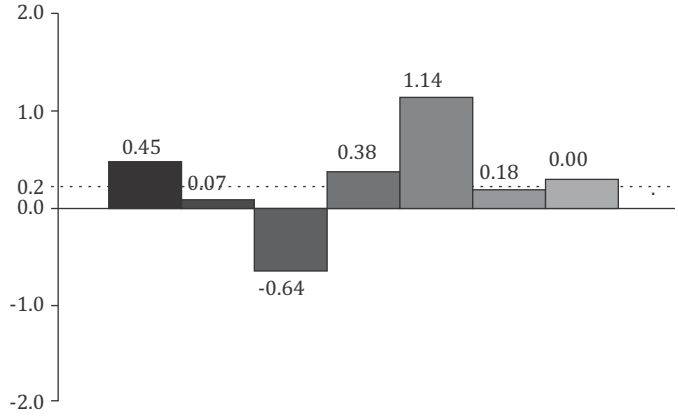


Figure 5. Degrees of performance according to engineering opinion

The Figure 6 shows the perception of improvement in the company's manufacturing staff here considering all divisions of the department of industrial operations, except the product engineering. We observe a different perception from that presented by engineering. Manufacturing staff believes there is significant improvement in "cost control," "project information control," and "customer complaint reduction." Regarding the disagreements, there is a profile closer to that of the previous graphs: the criteria related to deadlines are considered the most problematic, being significantly negative for the manufacturing personnel.

It is important to note that manufacturing staff understands that there has been a decrease in the number of their complaints about the projects, corroborating with engineering opinion (Figure 5).

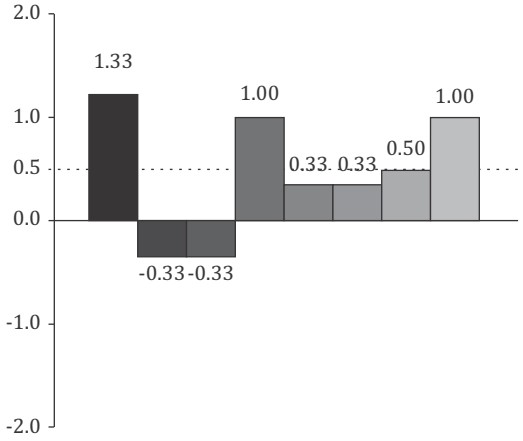


Figure 6. Degrees of performance according to the opinion of the manufacturer

The Figure 7 shows the perception of improved personal marketing. There is a great difference in relation to the two previous groups. Marketing believes that projects are poorly tracked in terms of deadlines and costs. This behaviour may be due to the fact that sellers are pushing for the reduction of project deadlines; by reducing project cost, which lowers sales volume targets for investment amortization - lowering top management pressure for more products to be sold; and the increase in margins, which implies reducing product costs, increasing the possibility

of the seller bargaining with the product price with potential customers.

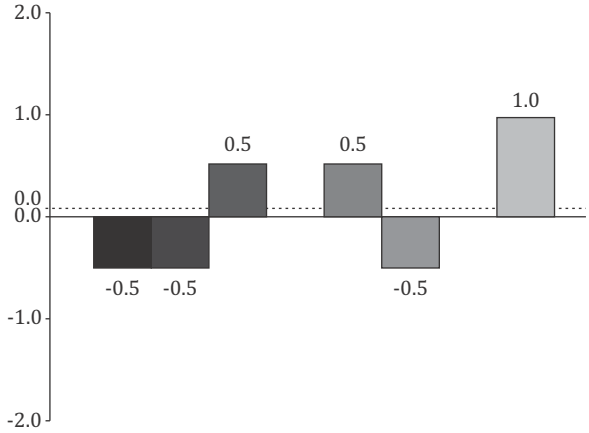


Figure 7. Degrees of performance according to marketing opinion

Marketing was the only group that considered that there is greater accuracy in estimating project deadlines - even though it is not a criterion with a perception of significant improvement when compared to the general distribution of respondents (Figure4) - which may be related to the fact of being the sector responsible for establishing deadlines for medical projects. They consider, therefore, that the term problem is more related to the lack of time control (activity performed by engineering) than to the inaccuracy of forecasts and targets. Marketing staff further considers, in accordance with Figure 7, that there is greater capacity of integration of new people in the projects - although not significant - and believes that there was reduction of customer complaint with the new products of the company.
It intrigues the fact that marketers perceive, in a significant way, that there has been "no less specification change" of the products, since the change in specifications originates from marketing and both manufacturing and engineering considered that there was a reduction in the change in product requirements after projects started - but they do not perceive a significant improvement in this indicator. Since the company does not maintain a product requirements management system, it can be hypothesized that, although the volume of requirements changes is still large, there is a reduction from a previous moment in the company. In addition, it is likely that at an earlier time there was a greater number of influences in the company who brought design requirements, which is currently carried out only by the director in charge of the marketing department, who was interviewed and for whom there was an increase in specifications.

In summary, analysing the data of Figure 5 together with Figure 6 and Figure 7 , it can be verified that the deadlines have not been considered and well managed, but there are improvements in their respective areas: engineering, the control of information and the integration capacity of new designers; the manufacture, as to the reduction of the claims of itself in relation to the engineering and of the clients in relation to the equipment delivered; and marketing, as to the reduction of customer complaints and accuracy of estimates of deadlines for projects. Therefore, the data demonstrate a strong tendency to defend the origin department of the respondent in their responses regarding the improvement of the PEP.

From Figure 8, the results are discussed according to the role of the interviewee in the PEP. The

Figure 8 shows the graph with the opinion of senior management.

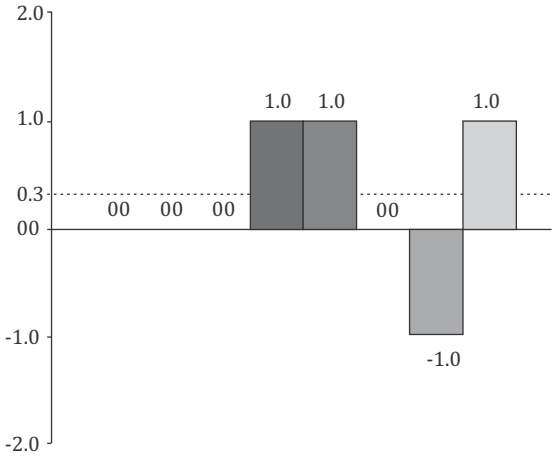


Figure 8. Degrees of performance according to top management

Top management perceives problems with manufacturing complaints, however, it considers that there is less volume of customer complaints and that there is more control over the information generated throughout the projects. It also considers that there is a greater capacity to integrate new people into projects. It can be hypothesized that greater control of project information allows for easier integration of new people into projects. It is important to note that senior management does not consider that there has been an improvement in the management of project deadlines and costs.

The Figure 9 shows the degrees of agreement and disagreement perceived by functional managers. Unlike senior management, functional managers consider that there has been improved cost control and deadlines - although for the latter the perception of improvement is not significant. This can be explained by the fact that the company adopts a functional structure and, therefore, delegates to the functional management the management of deadlines and costs of the projects.

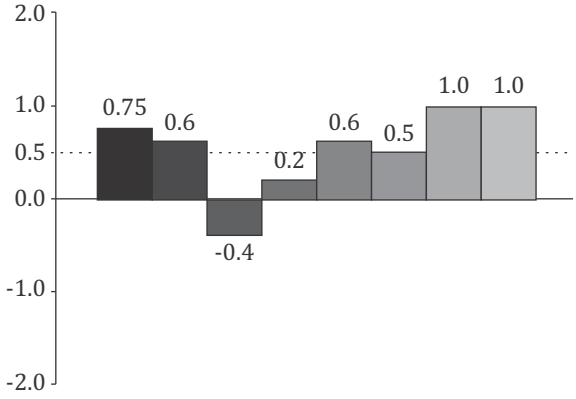


Figure 9. Degrees of improvement according to the opinion of the functional managers

The accuracy of estimated timeframes is the only aspect in which there was disagreement among functional managers, being significant in relation to the general opinion of the interviewees (Figure4). It is interesting that top management, which is responsible for allocating time goals to projects, does not disagree with the improvement of this indicator, while functional management considers this negative aspect in terms of improvement. That is, it may be suggested as an analysis of these data that the deadlines to be followed by functional managers are considered unrealistic by them. They manage the deadlines to meet the estimates, but they cannot. Senior management then estimates that deadlines are not well managed (Figure 8).

The Figure 10 shows the project leaders of agreement-disagreement profile. Since they have technical responsibility for the project, but do not manage them since the company adopts functional structure, these elements are the most pressured throughout the projects of new products. The pressure is reflected in Figure 10 by the degrees of disagreement regarding manufacturing (non-significant) claims and customers and by the degree of disagreement regarding timing accuracy and its control, in both cases the most negative values of all analysed. It is noteworthy that this group, made up of people from engineering, presents the lowest average perception of improvement among all the others.

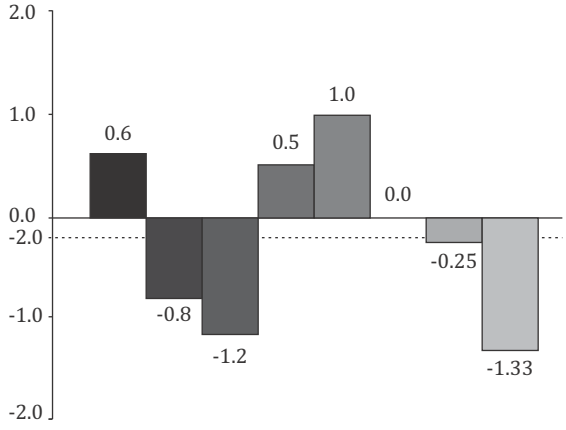


Figure 10. Degrees of performance according to the opinion of the project leaders

Project leaders are aware that there has been improvement in information control throughout the projects - but not significantly, and that there is a significantly greater ease of integrating new members into the project teams. This aspect emphasizes the leaders in view of the need to add other people to the projects in the moments of completion of important stages and greater pressure in their activities. Cost control is also considered positive, though not significantly.

Finally, Figure 11presents the degrees of improvement perceived by the project teams. In this group, we find the most positive perception identified during the research, which was related to the integration of new people into the projects, an aspect that directly affects their ability to migrate from one project to another over time, something fundamental in functional structure adopted in the company. There is non-significant agreement on the other aspects surveyed. For example, the project team considers that there is more efficient control over the information generated in the projects, which can be explained by the fact that these factors are responsible for assembling and testing the prototypes of the new products and, consequently, are direct users of the project. design documentation generated by

engineers. Whereas the project team is responsible for transferring the product assembly and testing process to the manufacturing departments; the perception illustrated in Figure 11 regarding the reduction of manufacturing and customer complaints is something that works against your interest: "... I trained, the staff works better, I taught how to test and a better product arrives at the customer."

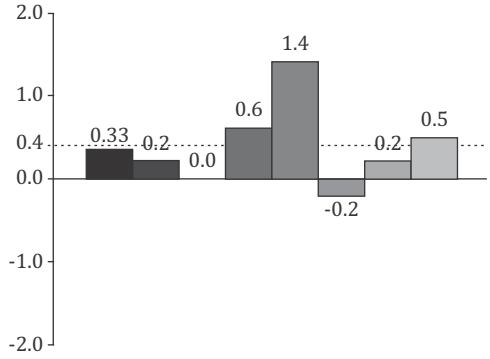


Figure 11. Degrees of performance according to the project team's opinion

Again the accuracy in estimating deadlines is considered to be of little improvement, and, corroborating with the opinion of marketers, the project team disagrees that there has been any degree of improvement in terms of reducing changes in product specifications, a disagreement compared to the overall result of the interviewees (Figure4).

8. Conclusion

This article analysed the influence of the functional sector and the role played by a given actor in the product development process on the perception of improvement about this process.

Improvements were made in the PEP of the company surveyed to formalize project planning and to better document the product to the manufacturing departments and to register with regulatory agencies. It was verified through the interviews that there was an unprecedented effort for the company to facilitate the transition of the project between engineering and manufacturing. As the company has chosen to adopt a functional structure and this transition has always been quite traumatic, a strong emphasis has been placed on both the documentary aspect and the promotion of meetings, trainings and joint work to reduce the functional barriers between these departments.

Reduction in the number of manufacturing complaints, which was verified, in the opinion of the company's top management. Regarding customer complaints and the modification of design specifications, there was no prior expectation as they were areas that were not addressed in the implementation of improvements.

As mentioned, when describing the improvements implemented, an effort was made to plan the project deadlines. It was hoped that there would be a perception of improvement in deadlines, a hypothesis not proven by the data, which showed that the control of deadlines and, especially, the realization of estimates of deadlines, are considered deficient or worsened aspects in the company's PEP.

The data presented from Figure 4 to Figure 11 show that the perception of improvement of the PEP in the company depends strongly on the position of the interviewee in his or her

organizational structure. Engineering personnel emphasized the ability to integrate people into the designs, manufacturing emphasized the reduction of customer complaints, as well as, for different reasons, marketing personnel. The same behaviour can be observed in the stratification related to the respondent's role in the company's PEP.

However, the data also show that the respondent's role in the company's PEP overlaps and alters the vision of improvement of a particular functional area over PEP performance parameters. This can be seen in the comparison between the engineering concordance-mismatch profile graph (Figure 5) and that presented by the project leaders (Figure10) and by the project team (Figure11). Both leaders and project team are allocated in the same functional area, however, when analysed as a department (Figure 5), they present a profile that easily distorts them from marketing and manufacturing; and when stratified based on the roles they develop in the PEP, there is a large comparative difference in terms of perception of improvement among them (Figures 10 and 11) with variations that cannot be explained by the functional area in which they are framed, but in function of their responsibilities and, therefore, of what is charged throughout the projects, as presented when discussing each chart.

The implication of the study is that, whether in conducting academic research type survey or multiple case studies, whether in carrying out activities aimed at monitoring the PEP performance in a particular company, it should be noted the functional area of the respondent and role within the PEP. Ultimately, this means that the respondent's interest in the company's PEP performance is decisive in their response to improving this process.

From a business point of view, the study showed that the "perception of improvement" construct used here demonstrates how PEP organizational units incorporate the idea of improvement, understanding it from their particular point of view and giving a differentiated meaning to the results achieved with the work of improvement itself. The analysis of these perceptions may additionally allow to establish strategies of action on the groups involved in the PEP to minimize obstacles to the changes necessary to rationalize and increase the efficiency and effectiveness of this process in a given situation.

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