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Project portfolio adjustment and balance: a case study in the chemical sector

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Abstract

This paper aims to understand the adjustment stage in the project portfolio management, highlighting their relationship with the processes of categorization and balancing. The research is qualitative, and adopted the longitudinal case study approach. The research carried out in a Brazilian chemical company. Several sources of evidence were collected through interviews, documents and data from enterprise systems. To understand the project portfolio data from 1000 projects were collected and analyzed, in the period 2001 to 2005. The results indicate that more attention is given to the selection stage, neglecting the adjustment stage. The adoption of balancing tools highlighted gaps and sources of imbalance in the project portfolio, promoting discussion among decision makers regarding the bias introduced by the criteria in the selection stage and raising the need to introduce a systematic adjustment and balance. It was observed that without a proper project categorization, it would be difficult to promote the balancing analysis.

Keywords

Portfolio management. Project selection. Balance. Portfolio adjustment. Bubble chart.

1. Introduction

The essence of strategy is to keep organizations competitive throughout discontinuance periods, which implies a dynamic implementation process with multiple variables (PRIETO; CARVALHO; FISCHMANN, 2009). Thus, strategic alignment is fundamental to transform strategies into actions. The connection between the strategy and the selection and implementation of initiatives occurs through the execution of projects, with project portfolio management (PPM) being responsible for this alignment (BUYS; STANDER, 2010).

The phase of project selection involves the adoption of adequate classification criteria, so that similar projects can be compared (AGRESTI; HARRIS, 2009; JOLLY, 2003; LAGER, 2002; SHENHAR, 2001). However, depending on the techniques and criteria adopted, this phase may be a source of unbalancing. As suggested by several authors, obtaining a balanced portfolio regarding value, size, risks, deployed technology, and innovation level are indispensable requirements which may demand several feedback loops and adjustments throughout the selection phase, until a balanced composition of project portfolio is achieved (BITMAN, 2005; CARON; FUMAGALLI; RIGAMONTI, 2007; CHAO; KAVADIAS, 2008).

In addition, the adjustments may take into consideration, for instance, the interdependence and sequencing between projects, which allows the chosen portfolio to bring better results to the organizations. Different models are proposed in the literature in order to address this matter (ANGELOU; ECONOMIDES, 2008; BITMAN; SHARIF, 2008; COITINHO, 2006).

Despite the growing number of academic papers on project portfolio management, organizations are apparently not ready to manage their portfolios. Many publications discuss matters such as: large number of projects for a limited amount of resources; inadequate decision on whether to carry out or block projects – decisions taken with no availability to reliable information; and large amount of projects of little strategic importance. Some sources mention

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the level of uncertainty as a critical issue on project portfolio management. All these problems result in a poor performance of project portfolio, with the selection of projects of low impact, very long product launch time, and failure rate above the accepted level (GOLDRATT, 1998; ELONEN; ARTTO, 2003; COOPER; EDGETT; KLEINSCHMIDT, 2000; BUYS; STANDER, 2010).

The main objective of this study is to understand the adjustment phase in the context of project portfolio management (PPM), emphasizing its relation with the balance and classification processes. The field research was developed in a national capital-intensive organization of the chemical sector.

This article is structured in 6 sections. Section 2 shows the theoretical framework that supported this research. Section 3 presents the main methodological aspects of the field research. The results of the case study and the discussion of the field research are presented in sections 4 and 5, respectively. Finally, section 6 brings the conclusions and recommendations.

2. Project Portfolio Management (PPM): theory review

The relevance of the alignment between the business strategies of organizations and their project portfolios has been a growing object of studies. Consequently, portfolio management has been playing a role of strategic importance, as suggested by several authors (ROUSSEL; SAAD; ERICKSON, 1991; COOPER; EDGETT; KLEINSCHMIDT, 1999, 2000, 2001; BUYS; STANDER, 2010; OSAMA, 2006; LYCETT; RASSAU; DANSON, 2004). In Brazil, the theme of project portfolio management has also presented growing interest (MORAES; LAURINDO, 2003; RABECHINI JUNIOR; MAXIMIANO; MARTINS, 2005; MIGUEL, 2008; MAYRINK; MACEDO-SOARES; CAVALIERI, 2009; CASTRO; CARVALHO, 2010a, b; PADOVANI; CARVALHO; MUSCAT, 2010). According to Buys and Stander (2010), one out of three attempts of strategy implementation fails, because project or innovative activities are not separate from routine activities, and also because the project portfolio is not aligned to the strategy of the organization. Moreover, the authors contend that the deployment of projects fail mainly because there are too many projects selected for limited available resources, and also because the priorities of projects often change. On the other hand, studies by Osama (2006) concluded that the performance of research and development (R&D) projects is influenced by the fine alignment between individual initiatives and organizational strategy.

Nevertheless, the successful implementation of portfolio management is not a trivial task; because it comprises technological and market uncertainties; the negotiation of almost always tight resources between different areas of the company; constant changes due to market instability; the adoption and use of adequate criteria for classification, selection, prioritization and sequencing of projects aiming to align the portfolio with the organization's strategy (VARMA et al., 2008; MAVROTAS; DIAKOULAKI; KOURENTZIS, 2008; MIGUEL, 2008; EISENHARDT; BROWN, 2000; COOPER, 2006; COOPER; EDGETT; KLEINSCHMIDT, 1999, 2001; PADOVANI, 2007; PADOVANI; CARVALHO; MUSCAT, 2010). According to McDonaugh III and Spital (2003) the periodic evaluation, blocking the projects that are no longer interesting to the organization and reallocating the resources at greater value-added projects, is a success factor in project portfolio management.

Archer and Ghasemzadeh (1999) analyzed various methods of portfolio management and suggested a structure which comprises since the periodic selection of project proposals until the review of current projects, as shown in Figure 1.

Now, the portfolio management standard proposed by PMI (2006) is structured in two process groups: alignment and monitoring & control. The aligning process group consists of seven processes: identification, categorization, evaluation, selection, prioritization, portfolio balancing and authorization. The monitoring & controlling process group encompasses: portfolio periodic reporting and review and strategic change.

This article focus on the categorization process portfolio balancing process as suggested by PMI (2006), integrated in the portfolio adjustment (highlighted in grey in Figure 1)

In the portfolio adjustment phase, the decision-makers perform a critical analysis of the proposed portfolio concerning its size (amount of resources required), risks and benefits, and ensure its balancing. As a result of this analysis there may be looping, in case the decision-makers deem necessary to alter the selected portfolio.

We chose to study this phase since there is greater availability of studies on tools and techniques for selection and prioritization of projects, as well as on allocation of resources and portfolio optimization (COOPER; EDGETT; KLEINSCHMIDT, 1999, 2001; COOPER, 2006; MIGUEL, 2008; TRAPPEY et al., 2009).

In order to better understand the adjustment phase, it is important to discuss the concepts of categorization (or classification or typology) and balancing.

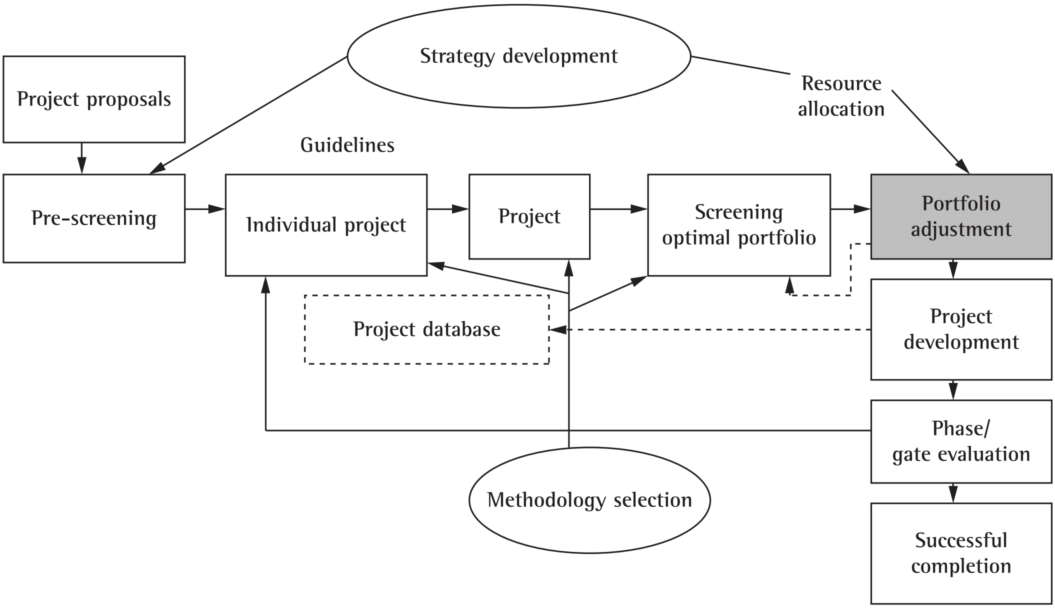

Figure 1. Structure for the Project Selection of a Portfolio. Source: Archer and Ghasemzadeh (1999).

Not all portfolio management models suggest the categorization phase. Some authors contend that in order to be better assessed projects must be grouped in categories with specific resources and compete for these resources (WHEELWRIGHT; CLARK, 1992; ARCHER; GHASEMZADEH, 1999; DYE; PENNYPACKER, 2000; PROJECT..., 2006). Padovani, Carvalho and Muscat (2010) propose an initial dispute of budgetary resources inter-categories, and only after the sharing of the general budget, the projects compete for intra-category resources. Dye and Pennypacker (2000) corroborate this point of view, they understand that only similar projects shall be compared and that, in order to do so, there must be a definition of the quality of resources to be allocated in each category. On the other hand, Cooper, Edgett and Kleinschmidt (1997) argue that the organization owns a limited amount of resources in general, so the competition for the same resources will occur regardless of typologies or classifications.

Yet, not only the dispute for resources presents pros and cons regarding categorization, there are also the managerial aspects. Artto and Dietrich (2004) emphasize that different types of projects have distinct importance from the strategic point of view, and each type requires a specific management approach. Shenhar (2001) states that project classification systems are used to categorize a phenomenon or a mutually exclusive and exhaustive group through a series of discrete decision rules. Classification is needed so that one can compare and contrast similar projects. Each organization should consider the most important attributes and what suits best to classify the projects (ARCHER; GHASEMZADECH, 1999; CARVALHO; RABECHINI JUNIOR, 2007). Dye and Pennypacker (2000) reinforce that the most adequate dimensions to a certain class are not necessarily the most adequate to the other classes. The dimensions suggested to classify projects vary widely among authors.

Some authors suggest that the classification be focused on the purpose of the project (ARCHER; GHASEMZADEH, 1999; ARTTO; DIETRICH, 2004; CASTRO; CARVALHO, 2010a). Archer and Ghasemzadeh (1999) exemplify this approach, they propose 6 classes of projects (projects realized under contract; projects of R&D, engineering and marketing of products; projects of development and construction of capital/facilities; projects of information systems; management projects; and maintenance projects); similar classification is given by Artto and Dietrich (2004) and Padovani (2007) in 4 classes (maintenance, R&D infrastructure, data processing and engineering). Castro and Carvalho (2010a) conducted a survey in Brazilian companies and concluded that most organizations adopt the categorization of projects (74%). The most frequent purpose classes were: projects of development of new products and projects of information technology development - both present in 71% of the sample, followed by projects of organizational change, 61%.

It is also possible to classify projects in terms of their characteristics. Shenhar (2001) believes that the ideal typical classification of projects have many attributes, among them the size, the structure and the adopted strategy. According to McFarlan (1981), a project can be classified in 3 dimensions: size, experience with the technology used, and structure. Agresti and Harris (2009) propose a classification for engineering systems in 4 dimensions: keep-a-job, get-a-job, do-a-better-job and get-smart. These classifications, in general, have the purpose to define distinct routes of project management according to the characteristics of the types of projects.

Some authors present dimensions related to innovation. For example, Wheelwright and Clark (1992) adopt, in the case of product development projects, the following: derivative projects, platform projects, rupture projects, R&D projects and alliance & partnership projects. In a more recent study, Shenhar (2001) proposes a classification of projects based in 4 levels of technological uncertainty and three levels of uncertainty concerning scope definition. Lager (2002) suggests a similar classification model, with 3 levels of innovation for technology (low, when the technology is already known and proven; medium, when it is an improvement; and high, when it is completely new) and 3 levels related to the technology of processes used in the production system of the organization (low, when it can be used in an existing plant; medium, when it requires modifications in the plant or additional equipment; and high, when it requires a new process and a new production unit). Specifically on the type of innovation, there are several classifications such as: incremental or radical innovation (UTTERBACK, 1994), autonomous or systemic (CHESBROUGH; TEECE, 1996), support and rupture (CHRISTENSEN; OVERDORF, 2000). In short, these classifications use the following as dimensions: complexity, uncertainty, novelty level, technology type, technology attractiveness, innovation type (WHEELWRIGHT; CLARK, 1992; LAGER, 2002; JOLLY, 2003; CARVALHO, 2009).

Jolly (2003) makes a compilation of the literature and produces an extensive list with 32 criteria to cluster technology projects according to their technological competitiveness and attractiveness. The author comments that it is difficult to work with all criteria to select portfolio projects, so he proposes a scale of weights elaborated as from an opinion survey with a group of executives from important processing companies in the world. The most important criteria of the survey, which impact on matters of technological competitiveness, found by Jolly (2003) are: technology impact on competitiveness matters; market size per technology; range of applications per technology; gap of performance x alternative technology gap; and intensity of the competition. It is also observed that there is a demand of project classification in the strategic dimension, assessing its level of alignment and the impact on competitiveness (MIKKOLA, 2001; JOLLY, 2003; PROJECT..., 2006).

The ability of companies to promote technological changes and integrate forthcoming opportunities among several sources such as procurement technology, products and process development, incorporating and capitalizing the gains of new technologies, is also a critical process in portfolio management (ADLER; FERDOWS, 1990). However, it is not enough to classify the projects, it is necessary to balance the company's portfolio according to the more relevant classes for analysis in a given context of decision-making. The literature remarks the importance of reaching a balance between the portfolio of projects in several aspects such as: balancing between revolutionary and incremental projects, balancing between product innovation and process innovation, balancing between risk and opportunity, and balancing between short term and long term (BITMAN, 2005; CARON; FUMAGALLI; RIGAMONTI, 2007; CHAO; KAVADIAS, 2008; ROUSSEL; SAAD; ERICKSON, 1991; COOPER; EDGETT; KLEINSCHMIDT, 1997, 1998, 1999, 2001; ARCHER; GHASEMZADEH, 1999).

One of the most used methods to analyze the balancing of portfolio is the bubble diagram or portfolio map (COOPER; EDGETT; KLEINSCHMIDT, 2001; MIKKOLA, 2001; LAGER, 2002; ROUSSEL; SAAD; ERICKSON, 1991). One of the most well-known configurations of the bubble diagram is the one where risk and benefit are allocated in the axes, both with two levels (high and low), which constitute four quadrants (pearls, oysters, white elephants, and bread & butter), while the size of the bubble represents the expenses of each project (COOPER; EDGETT; KLEINSCHMIDT, 2001). Now, Mikkola (2001) suggests that the axes be competitive advantage and consumer's benefit, both with two levels also (high and low), making up four quadrants (star, failure, fashion and snob). Roussel, Saad and Erickson (1991) work with a greater number of levels in the two axes: technology maturity (with 4 levels) and company's competitiveness (with 5 levels). Lager (2002) shows two other options of the bubble diagram: the first uses the dimensions of investment values and Economic Value Added (EVA), which generate four quadrants (strategic, marginal investment, heavy/platform investment, and support); the second diagram suggested by the author uses the dimensions of innovation for the world and the company, also creating four quadrants (technology transference, optimization opportunities, radical & risk, and competitive & cheap).

In short, in the bubble diagram, the projects are represented by bubbles or balloons in graphs of up to four parameters subject to analysis, represented by the two axes X and Y, plus the size and color of the bubble. Also, as mentioned before, it is common to divide the area formed by the axes X and Y into four quadrants or more regions, which represent the classes or types according to the dimensions analyzed.

The literature alerts to some advantages of the adoption of the bubble diagram, such as: the dynamics of projects is disclosed; the necessities and opportunities of future developments are evidenced, as well as the gaps resulting from the portfolio unbalancing; the strengths and weaknesses of each project are highlighted at the analyzed dimensions; the relative placement of the projects in the diagram enables an easy understanding of the evaluation process by non-technical managers; and consensus is encouraged. On the other hand, there is a series of difficulties in the analysis of technological interdependencies and the identification of indicators to ensure the appropriate project analysis is also difficult (COOPER; EDGETT; KLEINSCHMIDT, 1997, 1998, 1999, 2001; ARCHER; GHASEMZADEH, 1999; MIKKOLA, 2001).

Based on the discussion presented in this section, Figure 2 shows the synthesis in the theoretical framework. In it we emphasize the relation between the categorization and balancing of projects – important processes for the portfolio adjustment phase.

3. Methodology

As mentioned in the introductory section, the purpose of this study is to understand the adjustment phase in the context of project portfolio management (PPM), remarking its relation with the categorization and balancing processes.

The performed research makes use of the qualitative approach, with the adoption of longitudinal case, as recommended by Voss, Tsikritsis and Frolich (2002). In order to carry out this study, a survey protocol was initially prepared defining the following: the data collection techniques; the script of interviews; the set of questions to be used; the general rules and procedures for its conduction; and the indication of the origin of information sources. Over the data collection period, 14 people involved in project activities at the organization were interviewed, including project managers from different categories. The script of the interview addressed the main points of the theoretical framework (see Figure 2).

The interviews were planned based on the information obtained through the analysis of the questionnaires previously filled out with the data from the projects; the interviewees were key staff members from the chosen organization.

The chosen unit of analysis was a large Brazilian company from the chemical and petrochemical

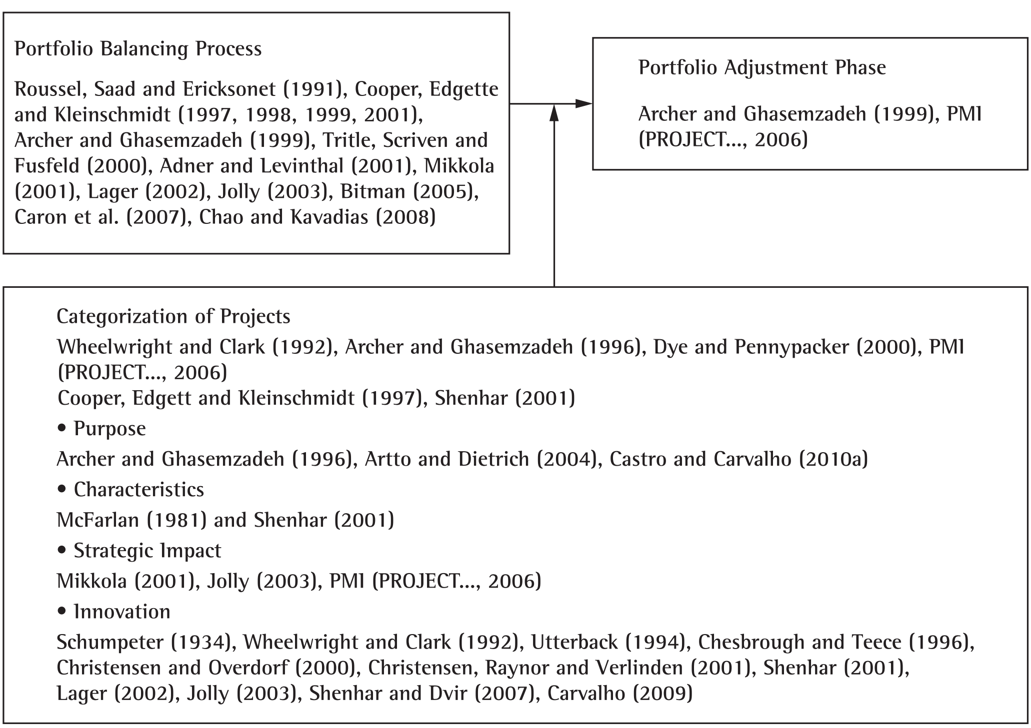

Figure 2. Synthesis of the theoretical framework.

sector – for the permission granted to the data collection and the conduction of interviews throughout all the study period.

Two main research sources were used for the data collection: consultation to the systems database of management projects (integrated to the company's existing management system - Enterprise Resource Planning ERP, Oracle and Baan), and to the organization's investment data from strategic planning documents and procedures. Nearly 1,000 projects from the time period between 2001 and 2005 were analyzed, collecting data from the system as well as from the interviews with managers.

The data collected from the company's systems were used to categorize the projects according to purpose and characteristics, as suggested in the literature. The first analysis was the categorization of projects according to purpose, as suggested by Artto and Dietrich (2004), whose synthesis is shown in Chart 2. The categorization of projects was also done through different graphs of the histogram type, in order to characterize the company's project portfolio, with approved investment, in terms of its evolution concerning the total amount of projects and the plant, type and characteristic of projects; as well as to make a comparative analysis between estimated values and spent values by characteristic of investment per year (see Figures 4-11).

In order to analyze the portfolio balancing, three types of bubble diagrams were elaborated considering, in the axes, the dimensions suggested in the literature by Roussel, Saad and Erickson (1991) and Lager (2002). The diagrams were built with a sample of projects taken from the database. For the selection and classification of projects in the dimensions and levels for the construction of the diagrams, it was used information collected in interviews conducted specifically for this analysis with the company's project managers and board. The selection criteria adopted were the following: impact on portfolio as perceived by respondents; representation regarding the categories of projects by purpose; and economic impact, Economic Value Added – EVA indicator. The selected projects were started as of 2004, since before that the company did not adopt EVA as a tool to select and execute portfolio projects. The graphs were built in two distinct periods: 2004 and 2005. From the first - 2004, 11 projects were selected according to the mentioned criteria (see Figures 12-14). For the second period – 2005, as the amount of projects in the company increased, the sample was enlarged to 41 projects (see Figures 15-17).

The first bubble diagram was elaborated according to the suggestions by Roussel, Saad and Erickson (1991). (see Figures 12, 15). These authors adopt in the technology maturity axis – the X axis (horizontal) - 4 levels (embryonic, growth, maturity, and decline) and in the company's competitiveness axis – the Y axis - 5 levels (weak, stable, favorable, strong, and predominant), while the size of bubbles represents the value of investment and the colors represent the different projects.

Another type of bubble diagram was constructed as suggested by Lager (2002), allocating the value of investment in the X axis (horizontal) and the EVA in the Y axis (vertical). The duration of projects, in this case, is represented by the area of the bubbles. Annual reports of the company and information given by the employees during the interviews were used for the elaboration of this diagram. The colors of the bubbles represent the several projects according to the different classifications adopted by the studied enterprise. This diagram was classified in 4 quadrants defined as: "strategic", "marginal investment", "heavy investment (platform)", and "support" (see Figures 13, 17). The quadrant of strategic investments represents projects of high investment and EVA, and therefore, high profitability. The quadrant of heavy investments represents high investment projects whose EVA is low. The quadrant of marginal investments represents projects of low investment, but with high EVA. Finally, the support quadrant represents projects of low investment and low EVA. In both quadrants - platform investments and support, there is some fragility due to the low EVA, and projects of these quadrants tend to have their priority reduced.

As a complement of financial analysis, it was adopted the second diagram suggested by Lager (2002), whose dimensions are: innovation for the world (X axis) in three levels (low – proven, medium – incremental – high – change of paradigm); and innovation for the company (Y axis) also in three levels (low – existing plant, medium – modification in the existing plant, high – new plant). The quadrants of analysis are: technology transference, optimization opportunities, radical & risk, and competitive & cheap (see Figures 14, 16).

4. Case study results

The target enterprise of this study is domestic, private, belongs to the chemical and petrochemical sector, with its head office located in Sao Paulo. It is one of the largest chemical companies in the country operating in the domestic and international markets, with 7 industrial units in Brazil and 4 abroad. Its revenue surmounts 1 billion dollars/year, with 2% being annually invested in research and development. Such enterprise belongs to a large domestic holding company whose annual revenue reaches US$ 13 billion.

The enterprise's total headcount in Brazil is around 1,600, with 12% devoted to the research and development (R&D) and engineering (Projects) areas.

As shown in Figure 3, there are many entries to new projects submitting to the portfolio of the studied organization, with demands coming from areas such as: sales; main customers; marketing, which is in charge of the elaboration of the periodic market research; and 'New Businesses', which studies patents, technologies, and analyzes acquisition opportunities.

The projects that comprise the company's portfolio are classified by the company in 16 different dimensions according to their nature, type and characteristic. The nature can be Operational or Strategic. The type can be: Simple acquisition of goods or services (Type A); Substitution of existing equipment or repairs on existing systems (Type B); and Implantation of equipment, installations, systems, units and plants, according to specific engineering projects, construction services and industrial mounting (Type C). The Characteristic is related to the main purpose of the investment, as in Chart 1.

The approval and control of strategic projects differ from projects of operational nature. The first, strategic projects, are approved by the shareholders, who analyze risk, market, competition, technology, range of applications, relation with the company's main business, besides the Return on Investment (ROI) and the Economic Value Added (EVA); being individually controlled regarding compliance with budget, timeline and scope. Normally, such projects have dedicated teams whose structures are designed.

In the case of investments of operational nature, the company's board receives - at the end of the budgetary period - the 'book' with the list of all proposed investments, tiered by production unit, characteristic and type, with individual description of each investment, purpose, proposed physical and financial schedule with the respective monthly and total outlay forecast, justification of investment, ROI, and EVA. Based on this information the board discards the projects reckoned as lower priority, considering the investment cap freed by the shareholders for the financial year. The cuts are assessed by the management involved, who can substitute some projects by others they consider of higher priority. After the revision of the cuts, the portfolio of projects of the following financial year is officially approved. Throughout the year, extra-budgetary investments are many times proposed, interfering with the priorities and schedule already planned. Such projects, approved during the year, are added to the portfolio, and no new meeting with the executives occurs for priority reevaluation, analysis of possible changes in scope, and impacts on budget or schedule. At the end of the year, the rendering of accounts on the situation

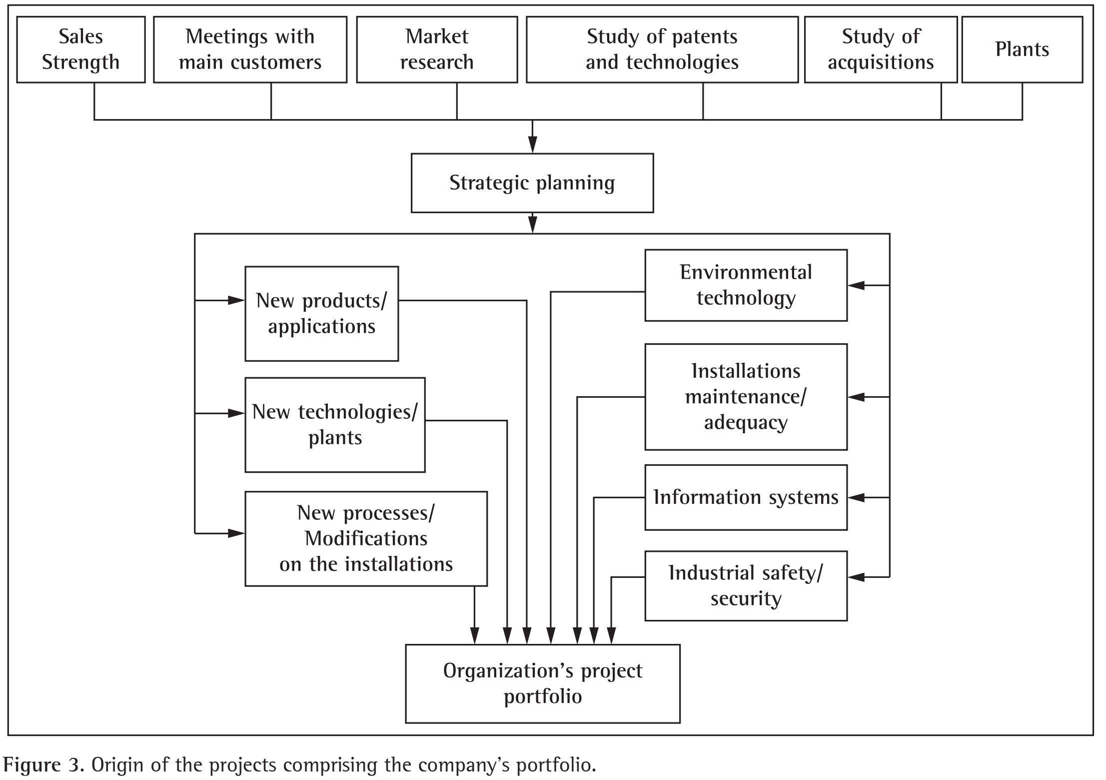

Figure 3. Origin of the projects comprising the company's portfolio.

Chart 1. Classification of projects according to their characteristics.

Characteristic of the investment	Description
CP – Capacity expansion	Projects of capacity expansion of the current product line.
NP – New products	Investments aiming the release of new products.
CR – Cost reduction	Investments whose implantation results in production cost reduction through the change in production cycles, the use of less onerous items, etc.
AD – Administrative	Investment without assets not related to informatics, manufacturing and/or logistic.
EC – Environmental control	Investments whose implantation aims to meet the requirements for environmental protection
IF – Informatics	Investment in software, hardware and other computer assets.
SS – Industrial safety/security	Investments aiming to guarantee the operational safety and to safeguard the fixed assets and staff security.
QS – Quality	Investments in the improvement of product quality.
LS – End of lifespan	Investments aiming the substitution of fixed assets due to wearing or obsolescence.
VS – Viability preliminary studies	Investments destined to the execution of viability studies of new businesses that will be accounted on deferred assets.
MD – Modernization	Investments in industrial automation and/or substitution of items with obsolete technology.

of the approved projects for the financial year is offered to the board. On that same occasion, the action plans of each area for the following year are presented. That is the only time when projects are assessed – verifying which ones were successful and which had problems, but then it is too late for any corrective actions. There is no clear rule to define the priority of a project compared to other. Resource constraint is not considered. Theoretically, priority projects are those of strategic nature, followed by the operational projects of greater financial return, those involving industrial safety or product quality; but in practice, all approved projects are claimed by their respective areas at the same urgency level.

4.1. *Characterization of projects*

During the time of the study the analyzed company had only 8 projects of strategic nature. The enterprise has few projects of this nature in its portfolio, 1 or 2 per year, which are generally long term (implantation deadline over 18 months). Even being accurately followed, it was observed that the deadlines were not met for the concluded strategic projects, with the execution time being longer than expected. From the point of view spent values, they were lower than the estimates. According to the coordinators of these projects, there were changes in scope when they were already in the industrial mounting phase.

In order to analyze the operational projects with no conclusion distortions, the authors had to propose a reclassification of the organization's projects, as recommended by Artto and Dietrich (2004), shown in Chart 2.

For the new classification proposed, projects with characteristics LS, EC, SS and MD were clustered and named "Maintenance Projects". This designation was used due to the fact that these projects are normally implanted by the maintenance areas of the industrial units, last less than a year, and have complexity ranging between medium and low. The projects characterized by the company as CR were incorporated into one of the existing classifications according to the description of their scope, once there was a superposition between CR, LS and MD, which, in general, lead to cost reduction.

Projects previously classified as QS or LS, whose scope comprehended laboratory equipment/installations, were reclassified as "R&D Infrastructure Projects". The following projects are included in this new classification: purchase and installation of new equipment for new applications, substitution of existing obsolete equipment, and refurbishing and modernization of R&D installations.

"Projects of Informatics (IF) or Projects of IT" are another class of projects of the company. In this class, the following are predicted: acquisition and implantation of market software, development and implantation of specialized software, acquisition of spare parts and replacement pieces and adequacy of hardware infrastructure through the purchase and substitution of computers, printers, scanners, enlargement of communication links between units, and adequacy of the capacity networks of the different sites.

Finally, the projects of characteristics CP, VS and NP were grouped forming the classification "Engineering Projects". The following are inserted within this type: acquisitions of new plants, joint-ventures/partnerships, licenses, building of new units, enlargement of units (REVAMPs), and modifications in existing plants in order to improve product quality and debottlenecking. Such projects contribute to the company's growth as well as to the increase of the product mix. Technology sale and minority participations are also a part of "Engineering Projects"; these projects are strategic because they contribute to the company's image in

Chart 2. Reclassification of the Organization's Projects.

Classification proposed	Classification of the company	Description	Place of application
Maintenance projects	LS – End of lifespan	Investments aiming the substitution of fixed assets due to wearing or obsolescence	Industrial installations
	EC – Environmental control	Investments whose implantation aims to meet the requirements for environmental protection	
	SS – Industrial safety/security	Investments aiming to guarantee the operational safety and to safeguard the fixed assets and staff security.	
	MD – Modernization	Investments in industrial automation and/or substitution of items with obsolete technology	
	CR – Cost reduction	Investments whose implantation results in production cost reduction through the change in production cycles, the use of less onerous items, etc.	
R&D infrastructure projects	QS – Quality	Investments in the improvement of product quality	R&D laboratories
	LS – End of lifespan	Investments aiming the substitution of fixed assets due to wearing or obsolescence	
Informatics projects	IF - Informatics	Investment in software, hardware and other computer assets	Industrial installations R&D installations Administrative installations
Engineering projects	CP - Capacity expansion	Projects of capacity expansion of the current product line	Industrial installations
	NP – New products	Investments aiming the release of new products	

the domestic and international markets, favoring future trading, and are also likely to result in new products. The internal technological developments that collaborate with growing and innovation also fit into "Engineering Projects". The designation "Engineering Projects" derives from the fact that these types of project are implanted by the engineering area of the company, being projects of medium and high complexity with timeline longer than a year.

The company's annual project portfolio had about 200 projects in 2001, and this figure had been reduced to 140 projects by 2005.

From the reclassification of the organization's projects proposed in Chart 2, a histogram was elaborated - presented in Figure 4 - showing the project portfolio evolution by characteristic from 2001 to 2005. The data were collected from the organization's investment management systems. There is a tendency of the reduction of maintenance projects, with the amount being reduced from 158 in 2001 to 69 in 2005. The engineering projects have changed baselines along these five years, from around 20 to 30 between 2001/2002 to above 40 between 2004/2005. The IT projects had a slight increase in 2002, but since 2003 they have been experiencing a downward trend. Finally, as it can be seen in Figure 4, since 2002 the number of R&D infrastructure projects has remained around 20.

The development of the company's projects is shown with another cut in Figures 5-7, where the stratification of the data presented in Figure 4 was made, by type of project, into main subtypes. Figure 5 shows the total amount of R&D infrastructure projects executed between 2001 and 2005 - how many are related to repair of installation, how many refer to equipment purchasing, and how many concern improvement of installations. It is noted that the majority of projects are of equipment purchase and installation, followed by projects of installation improvement. Figure 5 reflects the company's concern in keeping its R&D installations updated and adequate to meet the demands for new products and applications, and in how to support its domestic and foreign customers.

Table 1 shows the company's engineering project portfolio by subtype yearly. It is verified that most of the organization's projects are related to the improvement of installations and the debottlenecking of production units (REVAMPs). It appears that, over the 5 years analyzed, the company has directed its efforts to the fulfillment of projects with known technology and existing plants, with low innovation level. However, especially as from 2004, it was noted an increase on the amount of projects of other types, such as: joint-ventures/partnerships, new technology, acquisitions, and licensing; implying a move towards a raise in innovation level.

Figure 6 shows the maintenance projects tiered by subtype yearly. This graph supplements the information obtained in Figure 4, showing where there has been a reduction in the number of maintenance projects. It can be verified that in 2001 the organization invested considerably in modernization/automation and in the substitution of end-of-lifespan equipment. Starting that year, there has been a trend towards the reduction of investments in maintenance; supposedly because

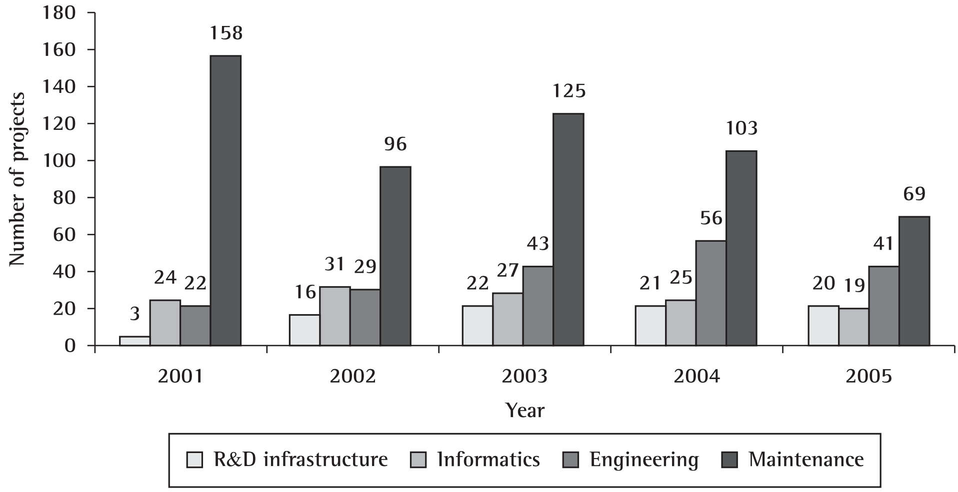

Figure 4. Evolution of the amount of projects by characteristic per year. Total.

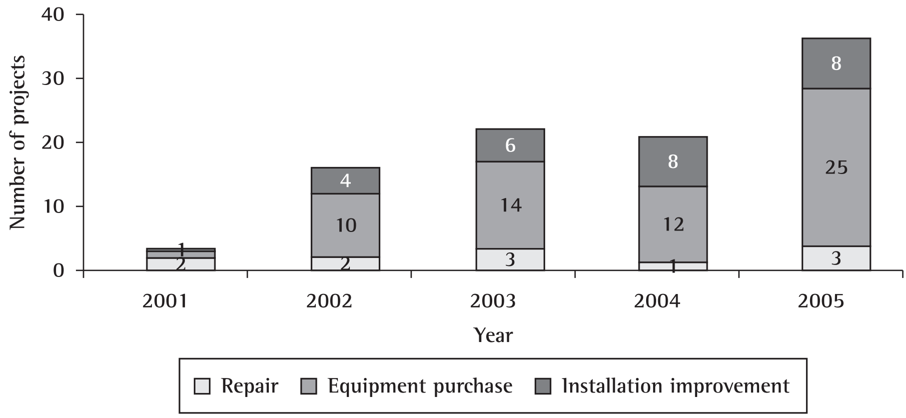

Figure 5. Evolution of the amount of R&D infrastructure projects per year.

Table 1. Evolution of the amount of engineering projects per year.

Engineering projects					
	2001	2002	2003	2004	2005
REVAMP	7	10	14	11	12
Management improvement	1	1	1	0	0
Installation improvement	11	12	22	34	17
Building of new plants	1	1	2	2	3
Acquisition	2	4	2	4	2
Licensing	0	1	0	1	2
Minority participations	0	0	1	1	0
New technology	0	0	0	2	4
Joint ventures	0	0	1	1	1
Total	22	29	43	56	41

a great part of the main items in the units were still new and, therefore, did not need investment in the following years. The modernization strategy boosts the company's investment in engineering projects, since it shares its maintenance human resources with those projects. Figure 6 also shows a growing concern with industrial safety items between 2001 and 2003.

Finally, Figure 7 highlights the composition of the company's IT project portfolio. It can be seen that most IT investments are directed to infrastructure, with a reducing trend in the number of projects. This figure confirms the company's policy of not prioritizing the informatics projects of its portfolio, aiming to maintain the operation of the existing installations, but not motivating projects in this area.

Another way to analyze the project portfolio between 2001 and 2005 is by making a comparison between the estimated and real values over this period of time. Figures 8-11 - elaborated based on the data collected from the budget system and the control system for paid and committed investment values – present the values estimated and effectively paid out over the 5-year period, considering the new classification adopted for the projects, proposed in

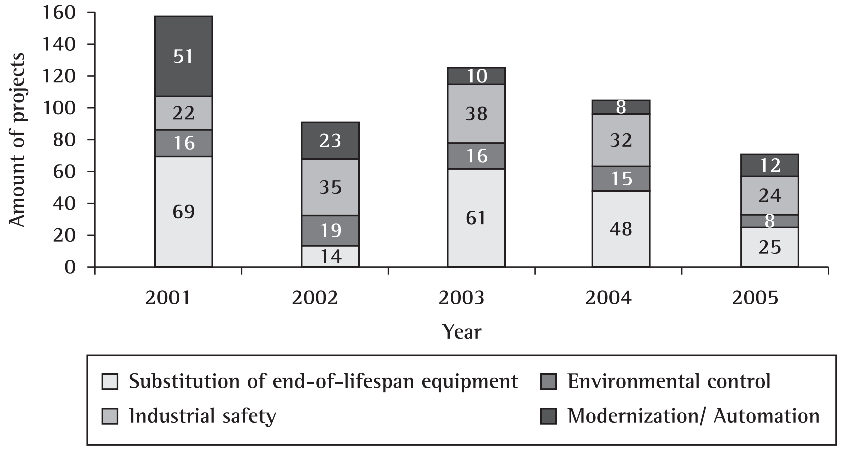

Figure 6. Evolution of the amount of maintenance infrastructure projects per year.

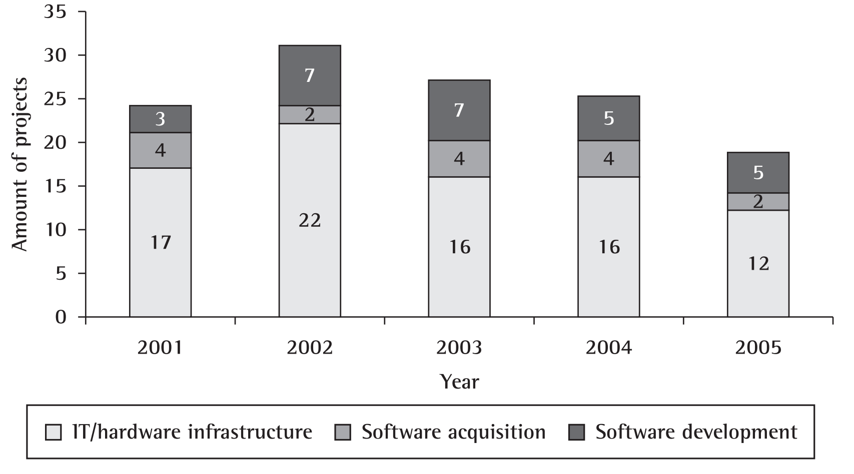

Figure 7. Evolution of the amount of IT projects per year.

Chart 2: R&D infrastructure, Engineering, Maintenance, and Informatics (IT).

Figure 8 shows that, for R&D projects, the greatest outlay is directed to the project subtype that occurs in greater number, i.e., equipment acquisition. It is also possible to observe that in the 3 project subtypes: repair, acquisition and improvement; the estimated value is much greater than the one actually paid out. This fact leads to believe that there is lack of execution capacity for projects; due to lack of human resources to conduct them, estimate error, delay in the outlay resulting from delay in the execution, or delay in the execution due to change in scope. All these problems were predicted by Elonen and Artto (2003), Padovani (2007), Cooper, Edgett and Kleinschmidt (2001) and, according to managers, actually occur in the organization. The fact that the organization does not comply with the planning of outlays implies loss of revenue, because the value reserved to the outlays is not applied or used in other projects with better return for the company. On the other hand, delays in projects where funds were raised through financing need to be justified before the funding bodies.

Figure 9 presents the comparison between estimated and real values for each engineering subproject. Like the R&D Infrastructure Projects, the estimated values are greater than the real outlays. In this case, a big deviation in the licensing subtype projects is observed. This occurred because projects of this type were in their initial implantation phase, and only the installments related to the purchase of technology had been paid at the time, with no expenses with the purchase of equipment, what would have represented much greater outlays.

Thus, it is verified in the information contained in Figures 8, 9 that, due to the deviation between the estimated values and the real outlays, shareholders and funding bodies ended up being negatively affected by

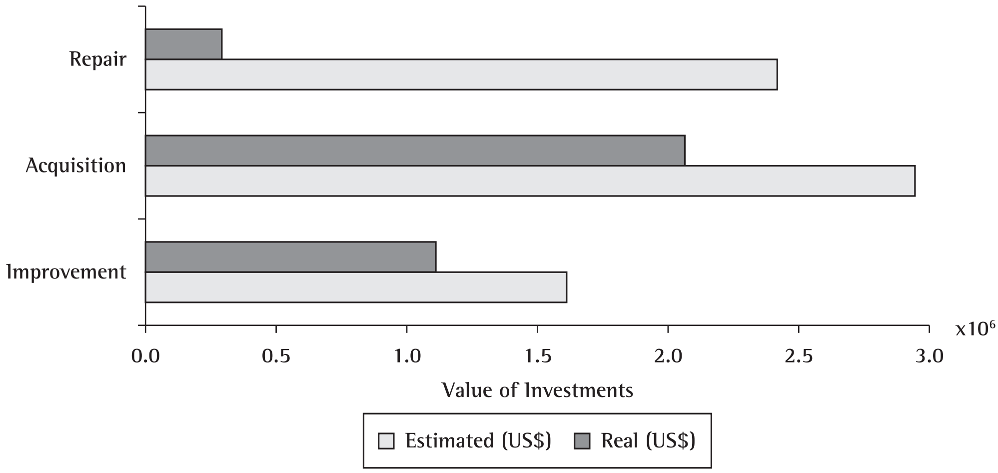

Figure 8. Values accumulated for R&D infrastructure projects: estimated × real.

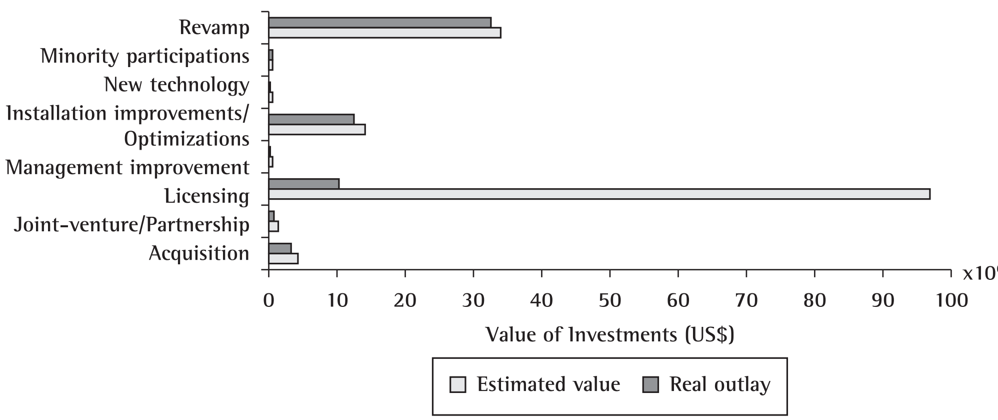

Figure 9. Values accumulated for engineering projects: estimated × real.

the decisions taken by the project managers in terms of changes in scope, or other actions that impacted the outlays of current projects.

Contrary to the observations made for the R&D and engineering projects, in the maintenance projects presented in Figure 10, it can be noted that the real outlays are almost always greater than the estimates. Information granted by managers during the interviews remarked that instead of controlling each project individually, the control is done only over the approved values. So, adding up the estimated values and the outlays over the 5 analyzed years, the figures are approximately the same, with deviation in the individual outlays of the projects. This remark reflects the way the management process of operational and low value projects is realized in the organization, previously presented.

Lastly, Figure 11 shows the comparison between estimated and real values for the IT projects from 2001 to 2005. It can be seen that package software acquisitions are the IT projects that involve the greatest value. It is noticed that, in this case, as well as in the R&D infrastructure and engineering projects, the estimated values are greater than the real values actually spent. The probable cause of this difference is not necessarily the lack of execution capacity of the projects but rather the lack of prioritization. In interviews with the IT area staff and analyzing the projects proposed over these 5 studied years, it was noticed that at any market fluctuation where the company visualizes a trend in sales setback, the first projects to be paralyzed are the IT ones.

4.2. *Balancing of projects*

In order to analyze the balancing of the organization's project portfolio under the perspectives of technology, innovation and investment, 3 bubble diagrams were elaborated.

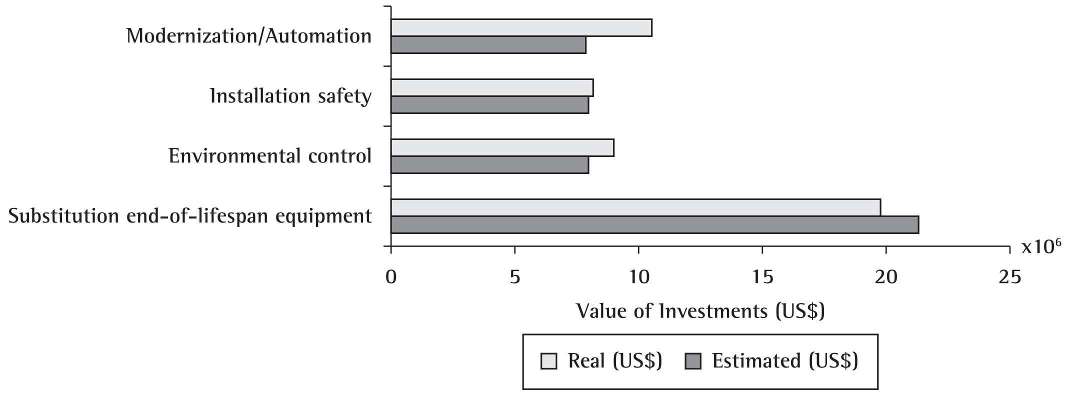

Figure 10. Values accumulated for maintenance projects: estimated × real.

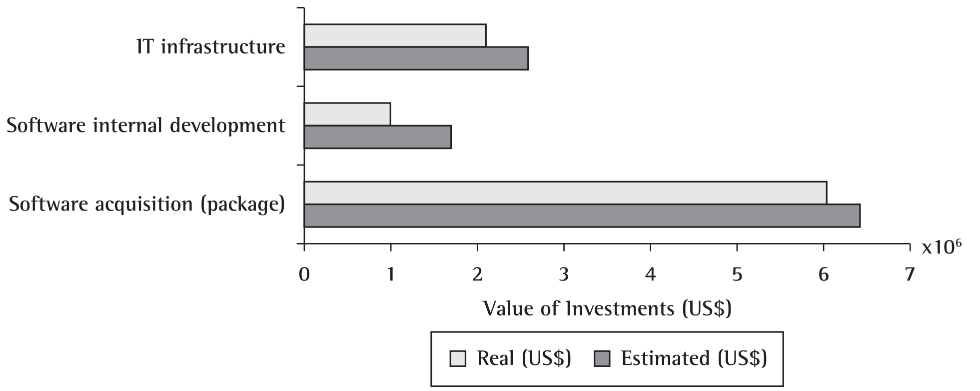

Figure 11. Values accumulated for IT projects: estimated × real.

The diagrams in Figure 12 were developed regarding the maturity of the technologies deployed, the competitive position and the innovation level. Figure 12 shows the projects considering the parameters of technology maturity stage, as well as the organization's competitive position in technological terms. Figure 14 shows how portfolio innovation projects behave in relation to the market and the organization's point of view. The financial perspective of the portfolio is analyzed in Figure 13 taking into account the concentration area of investments, when observing the risks involved and the business leverage, supplementing the information shown in Figures 8-11.

The data used to design the diagrams of Figures 12-14 refer to the organization's "engineering projects", with approved investment, of operational nature, executed in 2004. This period was chosen for data collection because the enterprise started to use Economic Value Added (EVA) as a selection criterion for project portfolio as from that date – this information was not available in the previous periods. It is noteworthy that in 2004, only 11 out of the 56 projects presented in Figure 4 contained information on EVA and could be analyzed. The colors of bubbles represent the different projects chosen for analysis, while the bubble sizes represent the value of the approved investment.

Figure 12 shows the profile of projects, with approved investment, of the analyzed company, as proposed by Roussel, Saad and Erickson (1991). In this diagram, the probability of success was allocated on the vertical axis and the life cycle phases (embryonic, growth, maturity, and decline) were allocated on the horizontal axis. One can verify that most projects are in the region between growth and maturity, and also that such projects lie between the competitive position strips of 'sustainable' and 'predominant'; with the company being in a comfortable position in the short term. It can be inferred that the executives of the analyzed organization prefer to work with projects that carry high success probability.

Nevertheless, in terms of balancing, it is observed that the lack of projects in the embryonic phase may depict a loss of continuance in the long term.

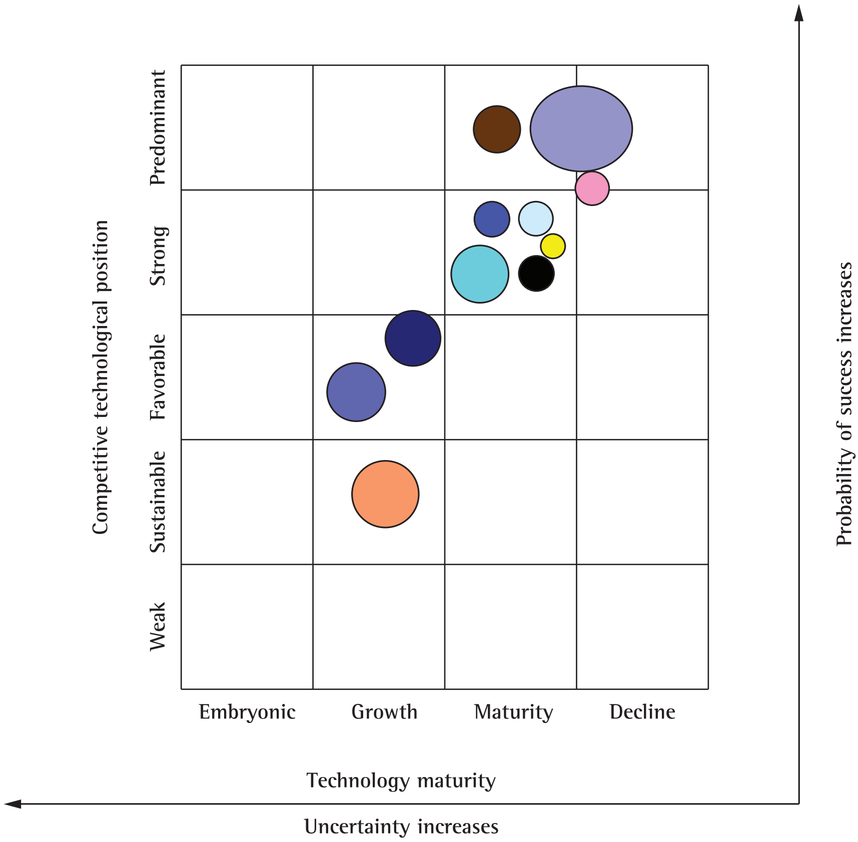

Figure 12. Success Probability × Life Cycle Phase. Source: Roussel, Saad and Erickson (1991) and Company's data (2004).

Figure 13 shows a bubble diagram that was designed with the same group of projects of Figure 12, allocating the investment value on the X axis (horizontal) and the EVA on the Y axis (vertical). As previously commented, the duration of projects is depicted by the bubble diameter and the colors of bubbles represent the different projects according to the internal classification of the studied enterprise. Observing this figure, one can identify four regions, which represent the role of the projects in the portfolio balancing. Such regions were named as: "Marginal Investments", "Strategic Investments", "Platform Type Investments" and "Support". The "Strategic Investments" quadrant represents projects with high investment value and EVA, and consequently, high profitability. The "Platform Type Investments" projects are of high value, but low EVA, representing projects which will support the business for future ventures, but which, alone, do not bring return. The "Marginal Investments" projects are those with low investment value and high EVA. Finally, the quadrant of "Support" projects concentrates initiatives of low investment and low EVA, related with optimization activities and operation maintenance. Observing Figure 13, one can perceive that most of the company's projects are located in the regions of "marginal investments" and "support". There is only one strategic project and there are no platform type projects. The depicted distribution leads to the conclusion that the enterprise privileges projects of short duration with low investment value and high return on invested value (ROI). There is no balance in the organization's project portfolio.

The combined analysis of Figures 12, 13 suggests that the company prefers to keep a conservative position, having no inclination to work in high-risk environments, concentrating on safe short term gains.

Figure 14 shows the balance of each portfolio project according to process innovations at world level compared to the innovation with respect to the enterprise's productive process. As it can be seen, almost all projects are related to optimization and technology transference. The matrix analysis by Lager (2002) in Figure 14 confirms what has already been observed in Figures 12, 13; the analyzed company uses as strategy working with projects of known technology and low risk, giving preference to optimization projects to increase its profitability. It is also possible to verify that the company's portfolio – for the studied period

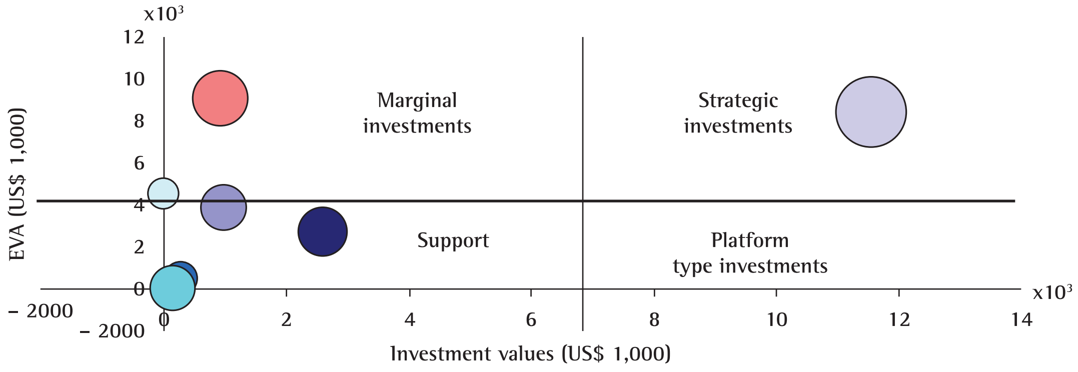

Figure 13. Analysis of the Company's Operational Investment Profile. Source: Lager (2002) and Company's data (2004).

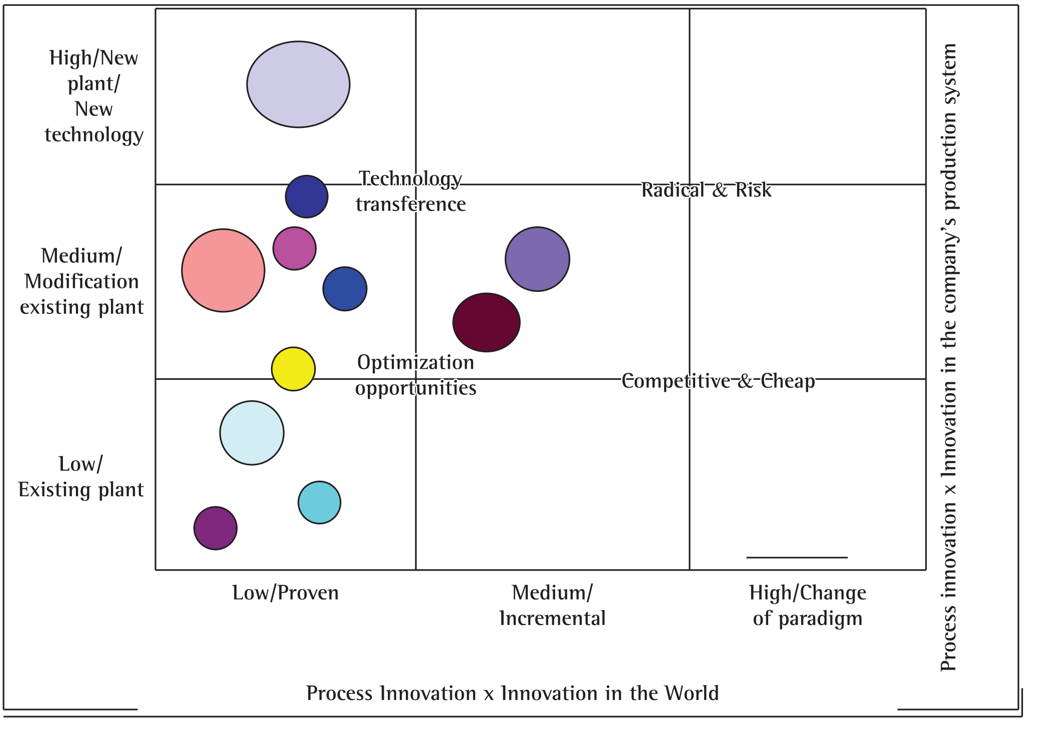

Figure 14. Process Matrix for the Classification of Innovation Level in Industry. Source: Lager (2002) and Company's data (2004).

and the adopted cut - is characterized as "systematic", of "support" and "incremental", when the innovation level of the projects is analyzed (CHESBROUGH; TEECE, 1996; CHRISTENSEN; OVERDORF, 2000; UTTERBACK, 1994).

The same analysis depicted in Figures 12-14 was performed for the 41 engineering projects, with approved investment, in implantation in 2005, and presented in Figure 4. The repetition of the analysis had the purpose to verify the existence of distortions due to the low number of projects assessed for the 2004 period, and also to observe any changing trend in the projects profile over time. Such analysis is shown in Figures 15-17. This analysis was performed only for the "engineering projects" because it is a more representative sample for the evaluation of technology maturity, company's competitive position, innovation profile and investments profile, and not representative of maintenance, IT or R&D infrastructure projects. Only the "Engineering Projects" have the EVA calculated and presented together with the investment justification.

Thus, Figure 15 shows the profile of the company's engineering projects approved for 2005. There are a total of 41 projects represented by the color of the bubbles. As noted earlier, through Figure 12, the majority of projects lie in the growth and maturity regions. However, contrary to what was shown in Figure 12, Figure 15 shows some projects in the embryonic phase.

As for the competitive positioning of the enterprise, the same conclusions reached before are valid, that is, the company's projects are in its majority located in the strip involving a competitive position between sustainable and predominant. This positioning gives the company some comfort in the short term. About the probability of success, it is noticed a change in the scenery: the company started taking more risks, with the existence of a high value project, where the value is represented by the size of the bubble in an intermediate strip of success probability.

Through Figure 16 it is possible to make an analysis identical to the one made with Figure 13, but for the projects of the subtype "Engineering Projects" approved in 2005. In this diagram, as proposed by Lager (2002), the company's portfolio projects are represented by the color of the bubbles, the diameter of the bubbles is given by the value of the investment. It can be seen that most projects lie within the strip of low technological innovation and medium process innovation, with most projects related to the modification of existing plants. This finding coincides with what has already been presented in Table 1, where most engineering projects refer to improvement in the installations and REVAMPs.

Nevertheless, the analysis of the engineering projects from 2005 allowed us to identify projects where the process innovation is high, with high technology innovation at all levels, that is, low and proven, medium and incremental, and change of paradigm. These are the cases of the following projects: building of new plants with new technology; partnership and licensing; acquisition of new plants; and new businesses. Projects of low process innovation with incremental technology innovation or change of paradigm were not observed in this dataset since they do not require investment. For the studied enterprise, these projects encompass projects for the exploration of new markets for products, processes and existing plants; or for the development of new applications for products, processes and existing plants.

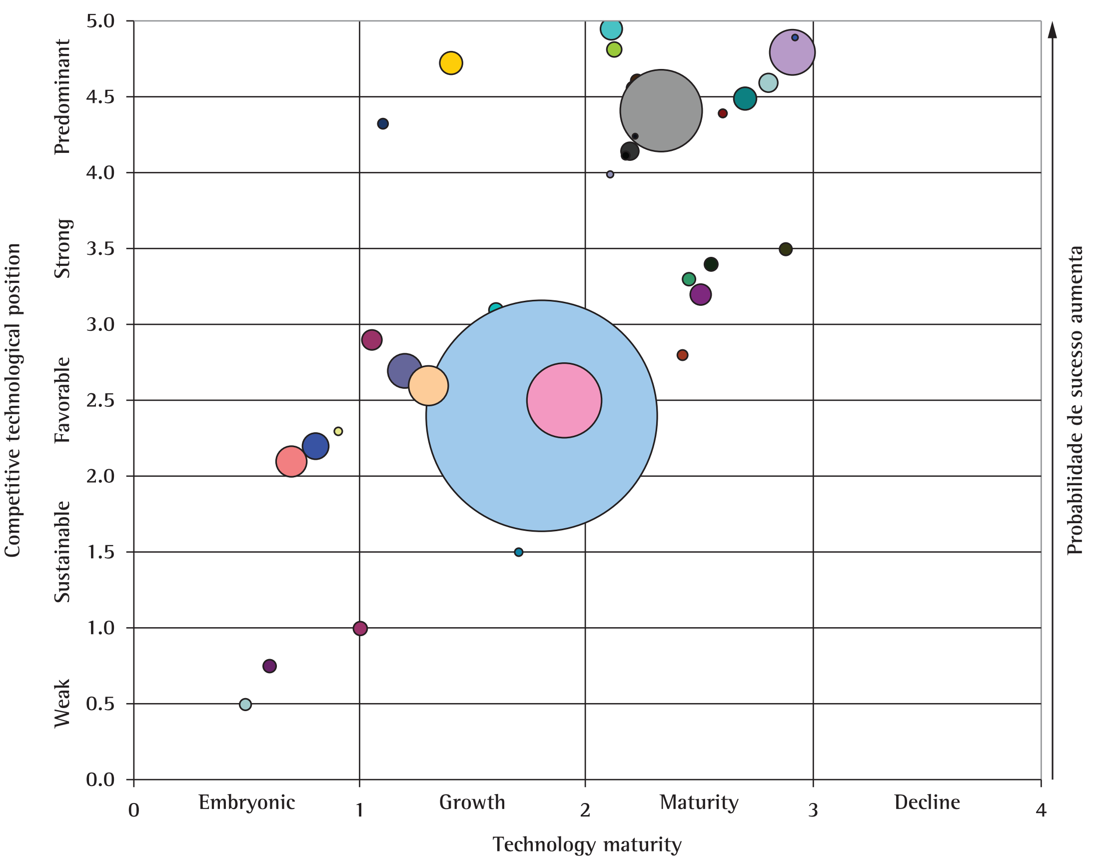

Figure 15. Probability of Success x Life Cycle Phase. Source: Roussel, Saad and Erickson (1991) and Company's Data, Engineering Projects (2005).

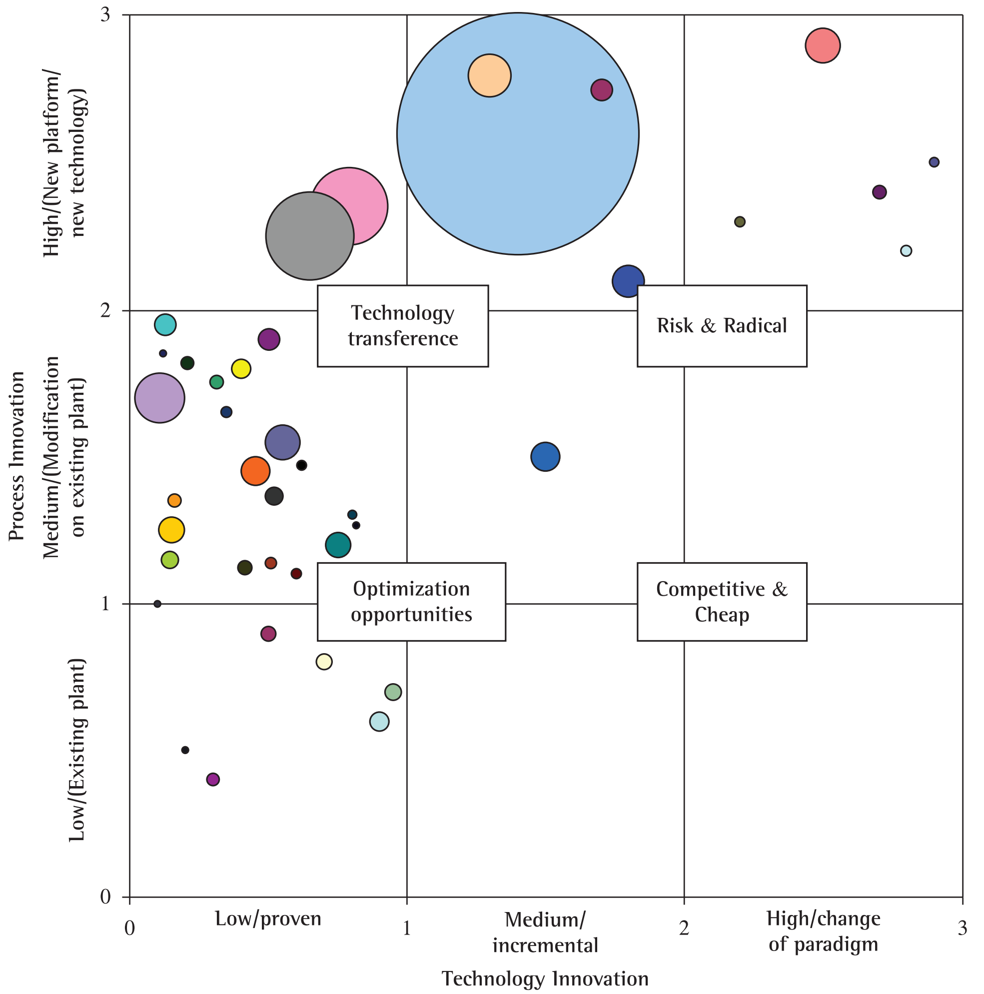

Figure 16. Classification of the Organization's Stage of Technological Development. Source: Lager (2002) and Company's data, Engineering Projects (2005).

Finally, Figure 17 shows the profile of projects with approved investment of the subtype "Engineering Projects". It shows a bubble diagram where the diameter of the bubbles represents the estimated duration of the projects, while the colors of the bubbles identify each of the 41 analyzed projects, for the year 2005. Values of investments in US$ dollars are allocated on the horizontal axis (X axis) and the EVA of projects are allocated on the vertical axis (Y axis), also in US$ dollars.

The analysis of matrix by Lager (2002) presented in Figure 17 shows the same results of Figure 14, previously analyzed for the projects in 2004, with approved investment, that is, there are no projects with Platform type investment and most of them are concentrated in the quadrant of support type projects.

4.3. *Results of the interviews*

One of the points highlighted by the staff responsible for the monitoring of the investments and coordination of the engineering projects during the interviews was the fact that the priority of projects was frequently altered due to pressure of the commercial area, what affected the execution sequence, planning and allocation of resources. According to the interviewees, deadlines are unilaterally negotiated by the commercial area, without the evaluation of human resources restrictions for the execution of projects or the interdependency between approved projects.

According to the interviewees, the alteration of the scope of projects is also common. They say this occurs because such projects are prematurely initiated, without a more detailed evaluation, and because of

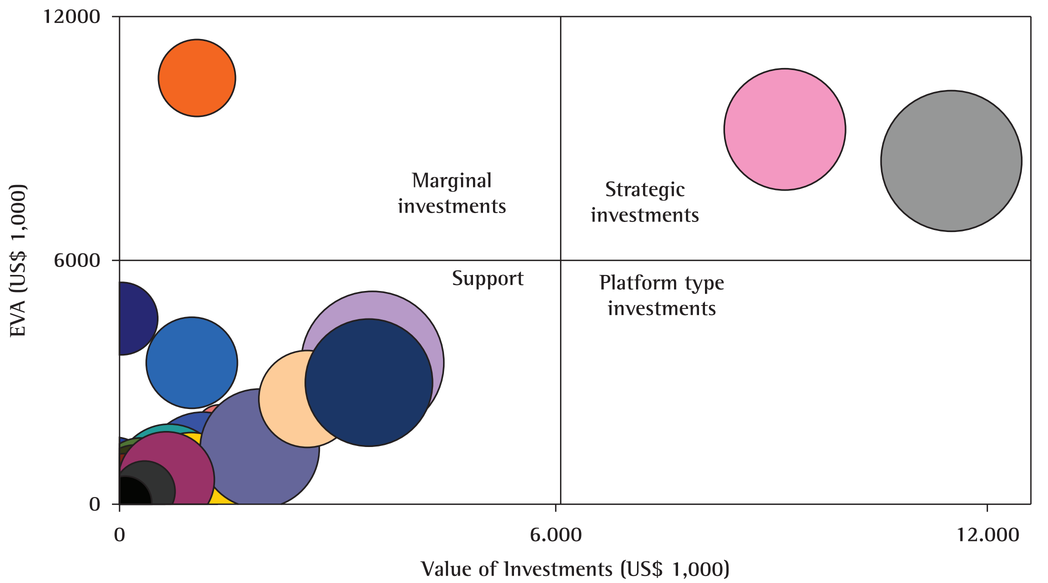

Figure 17. Profile of Investments - "Engineering Projects". Source: Company's data (2005).

that a lot of uncertainties are present at the moment of decision. Another important piece of information is that extra-budgetary projects are included in the portfolio of approved projects, with no reassessment of the ongoing projects, increasing the amount of projects to be executed throughout the year, for the same available resources.

Another emphasized point refers to the dimensioning of the project implantation team, which is considered small for the amount of projects approved. At the time of the interviews, this team consisted of 3 implantation coordinators at the head office and 12 engineers of different expertise sited at the plants. In addition, it was appointed as a critical issue the fact that the implantation team was not dedicated, sharing its time between project implantation activities and routine tasks of the maintenance area in the plants.

5. Discussion of results

Comparing the results from the field research to the theoretical framework, it was observed that the enterprise has the concern to align its projects with the strategy, as recommended by Prieto, Carvalho and Fischmann (2009) and Buys and Stander (2010). This fact can be verified in the separation of investments classified as strategic for more detailed and individualized accompaniment. Yet, the enterprise does not make use of portfolio management methodologies to guarantee the alignment between the organization's business strategy and its project portfolio, as recommended by Roussel, Saad and Erickson (1991), Cooper, Edgett and Kleinschmidt (1999, 2000, 2001), Buys and Stander (2010), Osama (2006), Lycett, Rassau and Danson (2004), Miguel (2008), Castro and Carvalho (2010b) and Padovani, Carvalho and Muscat (2010), among others.

According to the interviews (see section 4.3), the teams share their time between project implantation activities and industrial maintenance, which can be one of the reasons for the delays in the implantation of projects and budget deviation presented in Figures 8-11, leading to flaws in the implantation of strategy, as discussed by Buys and Stander (2010).

Other important situation discussed by Buys and Stander (2010) and found in the organization studied is the amount of ongoing projects. Figure 4 shows that the organization, for the studied period, had a portfolio of nearly 200 operational projects a year, which can also contribute to the failure in the implantation of projects due to the existence of too many projects selected for limited resources available, leading to a loss of focus, with priorities being altered every so often, what the literature calls 'syndrome of super allocation of resources' (ENGWALL; JERBRANT, 2002). The strategic projects, despite occurring in small number, with detailed planning, execution and accompaniment, suffer with scope variations, which hinder the compliance with timelines and estimates.

The collection of information about the company through the consultation of the databases of projects and the interviews has revealed that the management of the selected projects is done by two basic criteria:

financial and strategic. There are no clear prioritization rules for the projects that comprise the portfolio, as a result, there are frequent changes in scope, and problems with schedule delays, overflow of estimated values and post-implantation quality. Such problems are cited in the literature in the work of McDonaugh III and Spital (2003).

The information collected in the studied company and presented in this analysis denotes the lack of a portfolio management process in this organization. Several key aspects on portfolio management were not found in the decision-making process for short time actions. There is no methodology for the selection and prioritization of "operational" nature projects; neither a systematics to revise the list of ongoing projects and to give a feedback, as suggested by Archer and Ghasemzadeh (1999) and PMI (PROJECT..., 2006). This may be the source of some problems pointed out by the interviewees, such as schedule delays, loss of competitiveness and profitability, and budget overflow.

Regarding the categorization of projects, it can be observed that the organization classifies its projects using strategic impact criteria, that is, using the criterion 'nature of project': strategic or operational. The enterprise also adopts a classification by purpose, named in the company as type of project (A, B or C) and in relation to their characteristics, explained in Chart 1. Such classifications are in accordance with the literature, according to Wheelwrigth and Clark (1992), Archer and Ghasemzadeh (1999), Dye and Pennypacker (2000), PMI (PROJECT..., 2006), Artto and Dietrich (2004), Castro and Carvalho (2010a), McFarlan (1981), Shenhar (2001), Mikkola (2001) and Jolly (2003). However, it was possible to notice that the company does not characterize its projects under the innovation criteria, as recommended by Wheelwrigth and Clark (1992), Chesbrought and Teece (1996), Christensen and Overdorf (2000), Shenhar (2001), and others.

A matter to be observed is that, although the studied enterprise had a systematics for project classification, there was the need to propose a reclassification of projects for this study due to the fact that some categories presented superposition, causing distortions in the analysis and conclusions. The new proposed classification for the portfolio analysis is, apparently, more consistent with the reality of the enterprise.

The analysis of results of the case studied with the theory evinces that the enterprise uses project selection criteria, as proposed by McFarlan (1981), in relation to size and technology understanding.

Neither the structuring of the adjustment phase, nor the use of the technique of portfolio balancing was identified in the studied organization. This study made use of the bubble diagram in order to evaluate the company's portfolio of engineering projects, verifying the balancing, or not, in terms of deployed technology maturity, competitiveness, investment value and return, and innovation level of projects as suggested by the literature (LAGER, 2002; ROUSSEL; SAAD; ERICKSONET, 1991).

The use of the matrix proposed by Lager (2002) to assess the portfolio of the organization at issue according to Figures 13, 14 showed that most of its projects are located in the quadrants of low and medium risk, being of the type optimization of opportunities and of technology transference. The technology matrix proposed by Roussel, Saad and Ericksonet (1991), presented in Figure 12, showed that the enterprise uses the strategy to execute only projects with low and medium risk, high return on investment, and whose technology is known; and it was possible to notice, since 2005, a movement towards investing in the long term and in projects of higher risk (see Figure 15). This strategy characterizes the uncertainty of the economic scenario of the country in the studied period and will probably affect the company in the long term. In that period, as far as technology maturity is concerned, a movement is observed from the final stages of the lifecycle (maturity and decline) to the intermediate ones (growth and maturity), although there are few projects in the embryonic phase in both analyzed periods.

Regarding the classification by type of innovation, the company's portfolio presented little change in the studied period. The combined analysis of Figures 15-17 indicates that, although the enterprise has as characteristic to work in an environment where technology is known, giving preference to the optimization projects, there is a movement in relation to the 2004 data, previously analyzed, in the sense of innovating more and taking more risks. It is noticed, however, that the lack of platform type projects still remains.

It was possible to note a change in the company's strategy with respect to its project portfolio from 2004 to 2005, pointing to the dynamic character of portfolio management and to the difficulty to successfully implement it, due to the constant negotiation of scant resources because of market turbulence, as described by Eisenhardt and Brown (2000).

The implementation of portfolio balancing techniques, through the elaboration of distinct bubble diagrams that analyzed the projects from different angles suggested in the literature (LAGER, 2002; ROUSSEL; SAAD; ERICKSONET, 1991), demonstrated the unbalancing originated by a selection profile based on projects strategically aligned and more conservative, with lower risk. The bubble diagrams elaborated in different periods have highlighted the dynamics of project portfolio as suggested by Mikkola (2001). Furthermore, other advantages listed in the literature (COOPER; EDGETT; KLEINSCHMIDT, 1997, 1998, 1999, 2001; ARCHER; GHASEMZADEH, 1999; MIKKOLA, 2001) were pointed out by the interviewees, such as the ease of understanding of the diagrams by all decision-makers, evincing the unbalancing of the graphic form and appointing the weak and strong points of projects in several dimensions, and not only in the criteria used in the selection phase.

6. Conclusions

This work discusses the adjustment phase of portfolio management, a theme still little explored in the literature. Also, in practice, it was observed that greater attention is directed to the selection phase, neglecting the adjustment phase, which perpetuates some unbalancing over time, such as the conservative bias in terms of technology, in the studied enterprise.

It was observed that the adoption of tools for balancing, especially the bubble diagram, from various configurations suggested in the literature, revealed gaps and sources of unbalancing in the project portfolio. The use of the bubble diagram promoted an important debate among decision-makers concerning the bias introduced by the adopted criteria in the selection phase, raising the need to introduce a system of adjustment and balancing.

The discussion regarding the categorization of projects, a controversial topic in the literature, brought about important elements into project portfolio analysis. Without an adequate categorization of the company's projects, based on dimensions backed in the literature, it would be difficult to promote the balancing analysis, once the projects need to be categorized in advance for further analysis in the bubble diagrams. The classification, however, is no easy task, considering that the more subjective dimensions, like type of innovation or strategic impact, arouse discussions among decision-makers.

The studied enterprise still does not have a mature portfolio management, being strongly focused on the selection phase, showing important gaps in the allocation and adjustment phases, when compared to the structures proposed in the literature. Nevertheless, the project portfolio analysis of 5 years revealed the beneficial potential of the systematic adoption of the procedure for portfolio adjustment and balancing.

In this regard, although presenting some limitations inherent to the methodological option adopted - presenting a single case, what limits the possibilities of generalization of results - this work brings about some interesting insights that can be useful to several enterprises that are in the implementation phase of project portfolio management, especially of engineering projects and capital investments. As a suggestion for future studies, it is recommended the exploration of other relevant dimensions, such as the interdependency between projects and the interdependency of project resources; in general, this theme is addressed in the literature of allocation of resources, but it may be incorporated to balancing and adjustment analyses. Also, the enlargement of empirical basis for possible generalization is recommended as a future research agenda.

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