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SIX SIGMA PROJECT: The Portfolio Management PERSPECTIVE

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ABSTRACT

The purpose of this paper is to propose the portfolio management framework for Six Sigma projects, identifying the main stages and stakeholders. A literature review enlightens different aspects of project portfolio management. These different perspectives were brought into a Six Sigma, Project and Portfolio Integrated Framework (SSP&PIF). Further, two case studies from health care and IT sectors are presented. The empirical data are gathered from 12 interviews of selected stakeholders in companies, as well as participant observation and documentation. The framework helps to understand six sigma projects portfolio, in multiple levels simultaneously. The cases revealed that in the company that implemented Six Sigma based on the project management methodology, supported by the PMO, the projects portfolio move toward a more strategic perspective. However, there were several gaps in the projects portfolio in both the studied companies.

INTRODUCTION

Several authors highlighted that project prioritization and selection, as well as project reviews and tracking, is critical to the success of Six Sigma. Moreover project portfolio management can link Six Sigma to business strategies (Carvalho, 2002; Antony and Bañuelas, 2002; Kumar and Antony, 2008; Antony et al., 2008; Kwak and Anbari 2006; Johnson and Swisher 2003).

This article aims to assess the project management perspective of Six Sigma Program. A literature review enlightens different aspects on how project management field can influence the Six Sigma approach. These different aspects were brought into a Six Sigma, Project and

Portfolio Integrated Framework (SSP&PIF). In this sense, two cases from health care and IT sectors are presented.

1. Six sigma and project approach

Six Sigma was created by Motorola and became a widely-used framework (Mitchell, 1992; Harry, 1998; Harry and Schroeder, 2000). However, McAdam and Lafferty (2004) caution that what organizations call Six Sigma varies significantly, especially for those that simultaneously adopted other improvement programs.

Several authors corroborate that one of the most distinctive aspects of Six Sigma is the strategic vision (Harry, 1998; Klefsjö et al., 2001; Sanders and Hild 2000; Connor, 2003; Snee, 2004; Antony et al., 2008). However, this is a controversial issue, the companies surveyed by Antony and Bañuelas (2002) considered less important “linking Six Sigma to business strategy”. Another controversial issue is the Six Sigma training; while for companies surveyed by Antony et al. (2008) it was considered less important, Davison and Al-Shaghana (2007) identified it as one of the organizational significant success factors. Similarly, statistical thinking and the structured method are mentioned as distinctive aspects of Six Sigma (Basu, 2004; Snee and Hoerl, 2002; Ingle and Roe, 2001; Pande et al., 2001; Snee, 2004; Choo et al., 2007; Zu et al., 2008). Three Six Sigma characteristics represent statistically significant differences from other quality methods, according to an empirical research, which are: “the Six Sigma role structure, the Six Sigma structured improvement procedure, and the Six Sigma focus on metrics”, according to Zu et al. (2008, p. 641-642)

The performance metrics is another important characteristic in Six Sigma. It shows multiple levels, and can be characterized as customer-oriented metrics or financial metrics. Further, performance can be related to task strategies, commitment and effort, persistence and direction (Schroeder et al., 2008; Linderman et al., 2003). Goela and Chen (2008) link the metrics to business process reengineering (BPR). While, DeFeo (2000) link return on investment (ROI) and Six Sigma projects, which are achievement-oriented.

Another important Six Sigma characteristic is still little studied, the project perspective. This article presents Six Sigma as a way to manage quality by project.

1.1 Project and portfolio management as critical success factors

Project and Portfolio Management are critical success factors in Six Sigma context. Several authors emphasize project prioritization and project selection, as well as project reviews and tracking as success factors (Antony and Bañuelas, 2002; Cheng, 2009; Ray and Das, 2010; Sharma and Chetiya, 2010). Other authors also emphasize project selection and leadership as critical to the suc-

cess of Six Sigma (Schroeder et al., 2008; Kumar and Antony, 2008), as well as project management and project performance (Linderman et al., 2003; Johnson and Swisher, 2003; Kwak and Anbari, 2006; Zu et al., 2008). However, companies face difficulties and obstacles in the Six Sigma projects selection, considering its strategy alignment, as well as in the leadership commitment with this activity, as suggested by Gijo and Rao (2005).

An important Six Sigma characteristic is its projectized structure linked to both the strategic-level and operational-level.

The structured improvement procedure that differs Six Sigma from other approaches in the quality field is characterized by standardized and disciplined implementation through projects in the operational-level (Antony and Bañuelas, 2002; Zu et al., 2008). Further, Six sigma emphasizes the specific goals for each project, which reinforce Six Sigma focus on metrics and return on investments (Harry, 1998; Linderman et al., 2003).

Many manufacturing companies have implemented a six sigma program, but more recently service organizations have also adopted such a program. There is a lack of studies that focus on the six sigma implementation in service industries and it is an important research issue as identified by Nonthaleerak and Hendry (2006). Some authors argue that in the service sector the strategic perspective and the project perspective are considered key success factors, such as: linking Six Sigma to business strategies, maintaining a focus on customers, project management ability, executive leadership and top management commitment, organizational infrastructure and selection and prioritization of projects (Antony, 2004; Schroeder et al., 2008; Miguel and Carvalho, 2011).

Performance monitoring is considered a key aspect for project performance (Starbrid, 2002), as well as frequent and effective communication of project results to all stakeholders. The corporate officers were generally in charge of Six Sigma efforts, providing “a hierarchical structure where leaders (Champions) initiate, support, and review key improvement projects; Black Belts then serve as project leaders who mentor Green Belts in problem-solving efforts (Barney, 2002b; Sinha and Van de Ven, 2005”, as cited in Schroeder et al., 2008, p. 540).

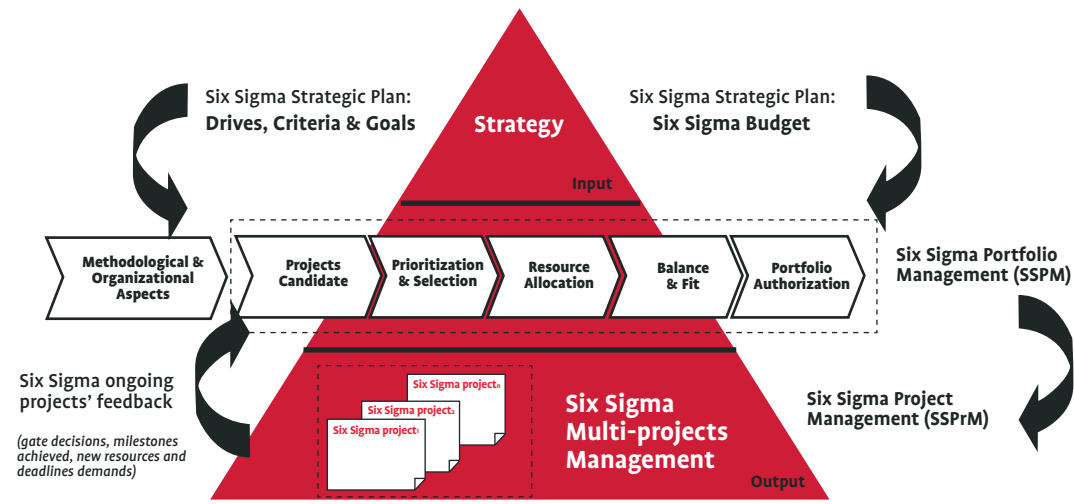


FIGURE 1. Six Sigma Project and Portfolio Integrated Framework (SSP&PIF).

The project activity is linked with the strategic level with portfolio management level and with the operational level with the ongoing projects management. The alignment between projects and strategy is identified as one of the critical factors to the successful implementation of Six Sigma, since the projects selected should reflect the strategic needs (Cheng, 2009). It suggests a top-down approach to Six Sigma, in contrast with other quality programs with bottom-up approaches (Schroeder et al., 2008). On the other hand, some authors mention the involvement of process owners and Six Sigma role structure members as black belts on project selection and their frequent and effective communication during the ongoing project execution, which also suggests the existence of bottom-up decision and communication flows (Van Iwaarden et al. (2008).

The Six Sigma portfolio management process is discussed by several authors (Snee and Rodebaugh, 2002; Schroeder et al., 2008), but there is a lack of comprehensive frameworks. The Six Sigma portfolio management processes proposed are, in general, focused on projects selection stage, and inspired in development funnel and stage-gate models (Clark and Wheelwright, 1993; Cooper et al., 1997). For instance, some authors suggest project funnels to filter out Six Sigma projects that do not have financial or strategic implications (Carnell, 2003; Snee and Hoerl, 2002); while others suggest tollgate reviews of ongoing Six Sigma projects.

Many studies about Six Sigma portfolio management specifically deal with project selection methods as mentioned (Snee and Rodebaugh, 2002; Kahraman and Büyükoçkan, 2008; Su and Chou, 2008; Büyükoçkan and Öztürkcan, 2010, Yang and Hsieh, 2009). The project selection methods proposed involve techniques such as: Analytic Network Process (Büyükoçkan and Öztürkcan, 2010), Delphy fuzzy Method (Yang and Hsieh, 2009), Analytic Hierarchy Process (AHP) (Su and Chou, 2008) and Fuzzy AHP (Kharaman and Büyükoçkan, 2008).

It can be noticed that several criteria are applied to select Six Sigma projects such as: strategic alignment (Harry, 2006; Schroeder et al., 2008; Pande et al., 2001; Harry and Schroeder, 2000; Antony and Bañuelas, 2002; Snee and Rodebaugh, 2002; Gijo and Rao, 2005); customer needs (Pande et al., 2001; Bertels and Patterson, 2003; Goe and Xie, 2004); return on investment (Pande et al., 2001; Harry and Schroeder, 2000); impact on structural problems in key process; unconformities with unknown cause (Pande et al, 2001; Snee and Rodebaugh, 2002); short-term projects (Snee and Rodebaugh, 2002; Harry and Schroeder, 2000).

Based on the literature review and empirical research, the main aspects of Six Sigma project perspectives was brought into a Project and Portfolio Integrated Framework, presented below.

2. Six Sigma Project and Portfolio Integrated Framework (SSP&PIF)

The SSP&PIF includes the connection between three organizational levels, which can be applied by organizations and managers during Six Sigma (SS) strategic plan, Six Sigma portfolio management and Six Sigma (SS) project management and execution (see Figure 1).

2.1 Strategic Level

The strategic level, on top, provides the inputs from the SS strategic plan, deploying the strategic drivers, the strategic vision in terms of technology and market, the key decision criteria, the strategic goals and the resources available to the round of portfolio decision planning (see Figure 1).

In general, some improvement programs occurs concurrently with Six Sigma in an organization, such as: quality awards (Malcolm Baldrige, National Prize for Quality and

The Deming prize) (Shankar, 2003), ISO 9001:2000 (Shankar, 2003; Carvalho et al., 2007; Pinto et al., 2008), lean management (Arnheiter and Maleyeff, 2005; Shah et al., 2008; Chen et al., 2010), and business process reengineering (BPR) (Goela and Chen, 2008). Thus, some competition for resources occurs but also some synergy that should be managed in a strategic level.

Six Sigma requires a strategic perspective as discussed above, which encompasses: top leadership commitment (Ahire et al., 1996); a common leadership vision (Dow et al., 1999), and senior managers' participation (Douglas and Judge, 2001).

Pande et al. (2000) and Anthony and Bañuelas (2002) state that leadership support comes from the strategic alignment, which allows to link projects with key processes, products and customers, and its effect on competitiveness.

In the jargon of Six Sigma projects, to ensure that resources are well allocated, the SS strategic plan should identify what is critical to quality (CTQ), which can be viewed in both internal and external perspectives. Once the company knows what is critical to quality, it should promote Six Sigma projects to achieve world class performance, systematically reducing the processes variability. The external perspective comes from the strategic environmental analysis, threats and opportunities analysis, as well as technology and consumer trend scenarios. The main trends must be translated, in Six Sigma level, in key customers and other stakeholders' needs (Voice of Customer- VoC), and then deployed in quality characteristics, known as external Critical to Quality (CTQ_{ex}). On the other hand, the business process perspective allows identifying the main process, whose critical parameters can be improved with impact on competitiveness, known as internal Critical to Quality (CTQ_{in}). The CTQ_{in} can also arise from unconformities identified in other improvement programs as ISO 9000 and ISO 14000 standards, which are the source of new six sigma projects in several studied companies.

Another important input from the strategic-level refers to the structure of decision-making.

In order to decide the Portfolio Management Committees and the stakeholders involved, the firm needs to balance several aspects. For example, a company with several business units in different industries may demand several decision committees, while in less diversified firms and/or with a

horizontal decision structure a single portfolio committee is quite possible (Carvalho and Rabechini, 2011)

In general, decision-making committees involve people from top management, but also from a Six Sigma role structure.

The members of Six Sigma role structure are classified in hierarchical levels, according to their commitment with Six Sigma and their skills in the quality field, adopting a nomenclature similar to martial arts to refer to the quality specialists, the so-called belts (Barney, 2002; Sinha and Van de Ven 2005; Schroeder et al., 2008). In addition to these belt experts, the SS role structure has the champion, in general, a senior executive who performs many functions in the Six Sigma program.

Different types of Six Sigma role structures were identified, and the most common cited was the three level structure, composed by champions, black belts and green belts (Barney, 2002; Sinha and Van de Ven, 2005; Schroeder et al., 2008). Carvalho et al. (2007) also identified, in Brazilian large size companies, a 4-level structure, with an additional master black belt level, and a 6-level structure with several kinds of belts (white, yellow, green, black and master black belts) and the champion. In some companies the master black belt plays the champion's role.

Depending on the Six Sigma role structure adopted by the company, some members can participate in the decision-making committees. Very often the champion and the master black belts participate in the decision forum, the so-called Six Sigma Portfolio Management Decision Committees (SSPMC). The black belts participate, in general, when the master black belt does not exist.

The target audience of Six Sigma gate meeting, on the bottom position of SSP&PIF framework, is broader than SSPPM Committee, as expected. It encompasses part of the SSPPM Committee, only the members from SS role structure. Other belts can participate, especially the green belt, and also the process owners, both involved with ongoing SS projects (see Figure 2).

2.2 Six sigma portfolio management (SSPM) level

The Six Sigma Portfolio Management (SSPM) level is composed by six stages: methodological and organizational aspects, project candidates, prioritization and selection, re-

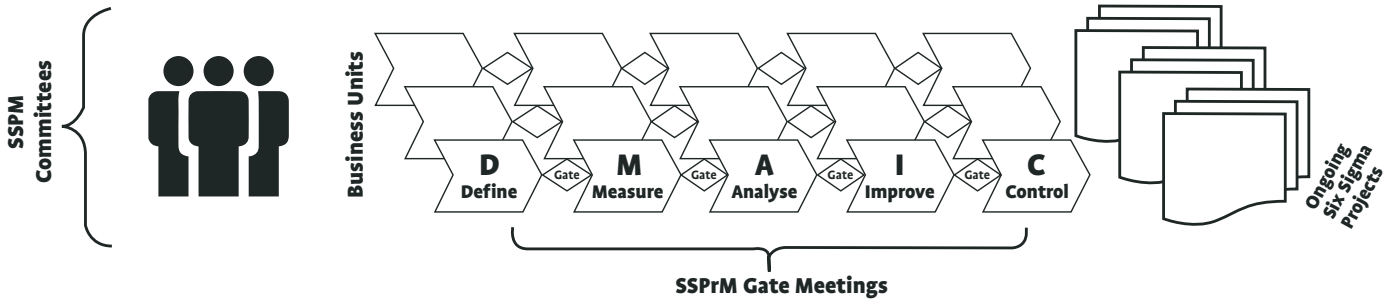


FIGURE 2. Decision Committees.

source allocation, balance and fit, and portfolio authorization (see **Figure 1**).

As intermediate-level, SSPM receives inputs from the strategic-level and also from the SSPrM. The strategic-level provides the SS strategic plan and the decision-making structure.

The SSPM is driven by the SS strategic plan, which encompasses criteria, goals and Six Sigma budget and other resources available; while SSPrM provides Six Sigma ongoing project feedbacks, such as: gate decisions, milestones achieved, and new demands for resources and deadlines.

This SSPM can be viewed as a development funnel, as discussed earlier in this article, once several filters are applied in each stage, reducing the alternatives by killing ongoing projects and/or new project proposals; but it is not a sequential process, since there are several feedback loops, during this 6-stage process detailed below.

2.2.1 Stage 1 – methodological and organizational aspect

This stage precedes the periodic dynamic portfolio management represented by stages 2 to 6 (see dotted area in Figure 1). Stage 1, methodological and organizational aspects, defines the methodological choices, concerning tool and techniques to be applied in each stage, as well as the organizational support and database infrastructure to the decision process.

In stage 1 the periodicity of the portfolio management cycle is also defined, which should be in line with the planning horizons of the organization. As Six Sigma projects are in general short-term (4-6 months), the periodicity should not be more than 3 months.

It is important to note that stage 1 should not be standardized for the whole company; each SSPM committee can define distinct methodology and organizational support that best fits the business unit profile of the stakeholders' needs.

For each stage from 2 to 6, the methodological tools, techniques and reliable source of information should be provided.

From the literature review some tips were found (Archer and Ghase-mzadeh, 1999) to design the project portfolio methodology as well as the main pitfalls to be avoided (Elonen and Artto, 2002), as shown in **Table 1**.

2.2.2 Stage 2 – project candidates

In stage 2 the list of project candidates is established, i.e., the new project proposals and the ongoing projects, to be analyzed in the next iterative decision round from stage 3 to 5. Further, it should provide enough information about the new proposals and ongoing projects.

In stage 1, a standardized new project proposal should be designed, and also the SSPrM-level should provide a standardized project performance report. This standardization is important, supplying enough information on key parameters for the decision-makers, allowing comparison between projects.

In addition, the committee must map whether there is inter-dependency between the projects and proposals because that information is relevant to the decisions of subsequent stages. According to Fu-Chien (2002), projects in a portfolio are often related, there are four types of inter-relationships: technical or exits; cost or resource use, impact or benefits, and serial when time factors are considered in selecting the portfolio.

These standard proposal forms and standard Project reports are filled for all candidates. More than that, in this stage is important to study the proposals and ongoing project achievements, and request additional information if necessary. Perhaps, at this point, some proposals and ongoing project should not be part of the candidate list, considering whether they meet or not the established criteria. The decision in this stage can be killed or reconsidered in the next cycle. The goal is to reduce the number of proposals in subsequent stages and kill projects and proposals that are clearly deficient. See the whole stage 2 flow in **Figure 3**.

2.2.3 Iterative decisions rounds – Stages 3 to 5

The selection and prioritization stage, resource allocation stage, and balance and fit stage have different objectives, however it has various interactions and in fact can be understood as iterative decision rounds. Thus, the flow described in **Figure 4** is the most complex in the SSPM-level, because it is necessary to look at the whole, in different perspectives!

Stages 3-5 follow into a logical sequence, first select, and then allocate resources according to the priorities, but when it reaches stage 5, Balance and Fit, some source of unbalance or misfit can be identified and a new feedback decision loop can be processed, returning to the earlier stages.

In all these stages the technique and tools are prescribed in stage 1. These decision tools such as operational research and multi-criteria methods can be applied, as discussed in section 2.2.

Although it occurs in a short period of time in the decision-making forums, this step requires a commitment to an iterative process which seeks to converge and reach consensus among the committee members. Stage 6, portfolio authorization, is the simplest. It formalizes the portfolio approved. For new selected projects, project managers are assigned and resources allocated. For ongoing projects, managers are notified if their project was aborted or if there are any changes in resources, deadlines and other relevant parameters.

2.3 Six sigma project management (SSPrM) level

The SSPM-level outputs, specifically the list of authorized projects and resources available, give the guide lines to Six Sigma Project Management (SSPrM) Level that manages the Six Sigma ongoing projects.

Explicitly involving stakeholders in the project management can help to deal with different expectations and mitigate them. Thus, managing stakeholders' expectations will enable

to encourage project acceptance. Thus, for new Six Sigma projects selected, it is important that the project manager assigned schedules a kick off meeting in order to present the project scope, resource constraints and assumptions. This meeting involves members of the SS role structure (master black belt, black belts and green belts), but also other project stakeholders, such as the process owners.

After the kick off meeting the SS project and charter is undertaken, must have goals and capability index target to be reached, and also the benefits (hard and soft money in SS jargon). The project charter is fundamental to the SS project management, once it provides the right understanding of the project scope and the main project milestones in order to promote an efficient use of the available resources.

If the company has a project management office (PMO), the project management, performance reporting and databases maintenance can be supported by the PMO. However, there are the members of the SS role structure during the SS gate meetings that maintain the SS project reviews and tracking.

Thus, it is important to design and maintain a database of reliable information of the also ongoing projects and lessons learned and best practices that can be systematized in a common virtual storage area by the PMO or the quality area, depending on the structure of the company. This database is crucial to the quality of reporting for SS projects. It should be linked with team members, who are the key sources of status information for SS project managers.

In order to ensure good project reviews and tracking, the Six Sigma, Project and Portfolio Integrated Framework SSP&PIF are structured in gates in SSPrM-level. The reviews and tracking gates can vary according to structured method Adopted for Six Sigma; in general, the Define, Measure, Analyze, Improve and Control cycle (DMAIC) process improvement and SS is Define, Measure, Analyze, Design and Verify cycle (DMADV) for

Tips	Pitfalls
<ul style="list-style-type: none">- Strategic evaluation of the projects;- Clear pre-evaluation project criteria;- Applying standard parameters for project evaluation;- Applying flexible methods that allow the stakeholders to feel comfortable;- Evaluation of interaction among projects and resource sharing;- Periodic evaluation of portfolio,.	<ul style="list-style-type: none">- Lack of connection between the strategy and project selection- Poor portfolio.- Reluctance in killing projects;- Lack of focus- The over resource allocation syndrome- Exclusively prioritizing quick and easy projects,- Excess of information and unreliable information for decision-making process- Choice of projects based on stakeholders' power.

TABLE 1. Portfolio Management: tips x pitfalls.

new product / service / process design, known as the Design for Six Sigma (DFSS), however there are some variations (see **Figure 5**).

In each phase of the structured method adopted for Six Sigma, the teams have to perform several steps and apply tools and techniques (see for instance Pande et al., 2001, Breyfogle, 1999, Harry and Schroeder, 2000), and achieve some deliverables, according to the project charter.

The gate is a checkpoint that can lead to the following decisions: go to the next phase, feedback loop to perform changes in the previous phase, or even kill the project. The number of gates can vary according to the structured method adopted for Six Sigma. The decisions are made in the SS gate meetings (see **section 3.1**).

3. Research methods

In order to develop an understanding of Six Sigma project and portfolio perspective, a qualitative case study approach was adopted, because of the exploratory nature of this research problem. To develop the case studies, guidelines from the literature were followed (Eisenhardt, 1989; Voss et al., 2002; Eisenhardt and Graebner, 2007). The multiple-case approach adopted yields a more robust and generalizable theory than single-case. It is based on the in-depth analysis of two cas-

es, in which the empirical evidence is triangulated by multiple sources, within-case and cross-case analysis, and combined with the role of the literature.

As suggested by Eisenhardt and Graebner (2007), the case selection was based on theoretical sampling (not random or stratified), thus, the selected companies are good representatives of the service sector in Brazil, they were six sigma users for over 2 years and they were willing to be interviewed.

Two companies from different service industries that had implemented Six Sigma are presented, one in health-care (hereafter referred to as HCC) and the other in information technology industry (hereafter referred to as ITC). The main characteristics of the cases are summarized in **Table 2**.

Data collection was multifaceted and included several sources of information, including interviews that involved 12 people, observations and analysis of documents, for over a year, as suggested by the literature (Bonoma, 1985; Eisenhardt, 1989; Eisenhardt and Graebner, 2007). The professionals responsible for the six sigma program, project management area and top management were interviewed using a semi-structured protocol. In the first part of the instrument, basic data on quality management and project management in the organization were gathered followed by the main issues in six sigma implementation and the six sigma project perspective. Interviews

	ITC	HCC
Service sector	Information Technology	Health care
Number of employees	2,500	14,600
Origin	American	Brazilian
Annual revenue (US\$)	437 million	80 million
Professionals interviewed	1 Senior manager 1 PMO coordinator 2 black belts 2 green belt	1 Division director 1 Quality Manager 2 black belt 2 green belt

TABLE 2. Characteristics of the cases.

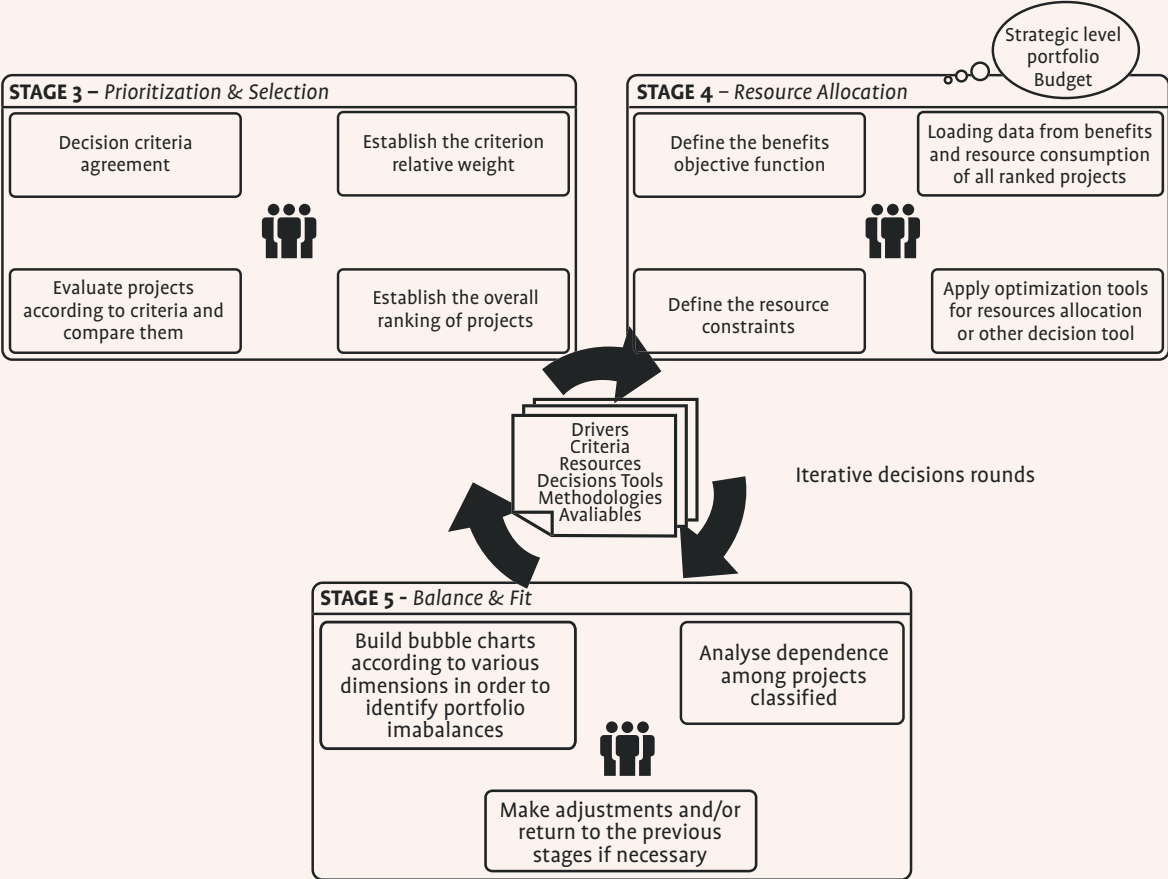


FIGURE 4. Iterative decision rounds.

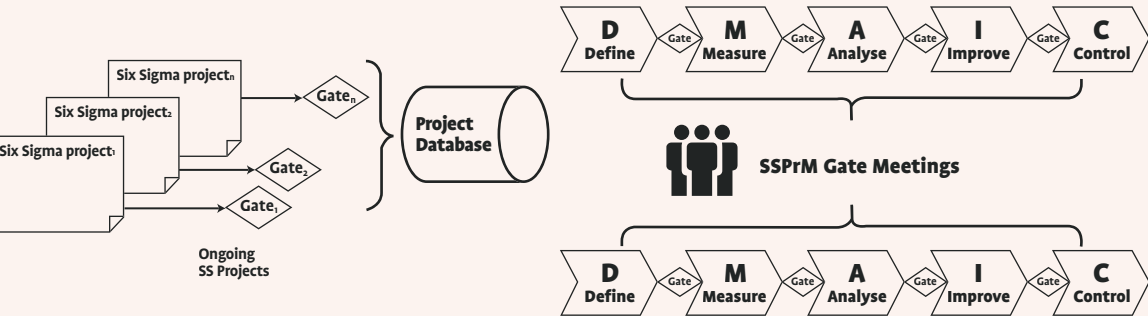


FIGURE 5. Decision Committees.

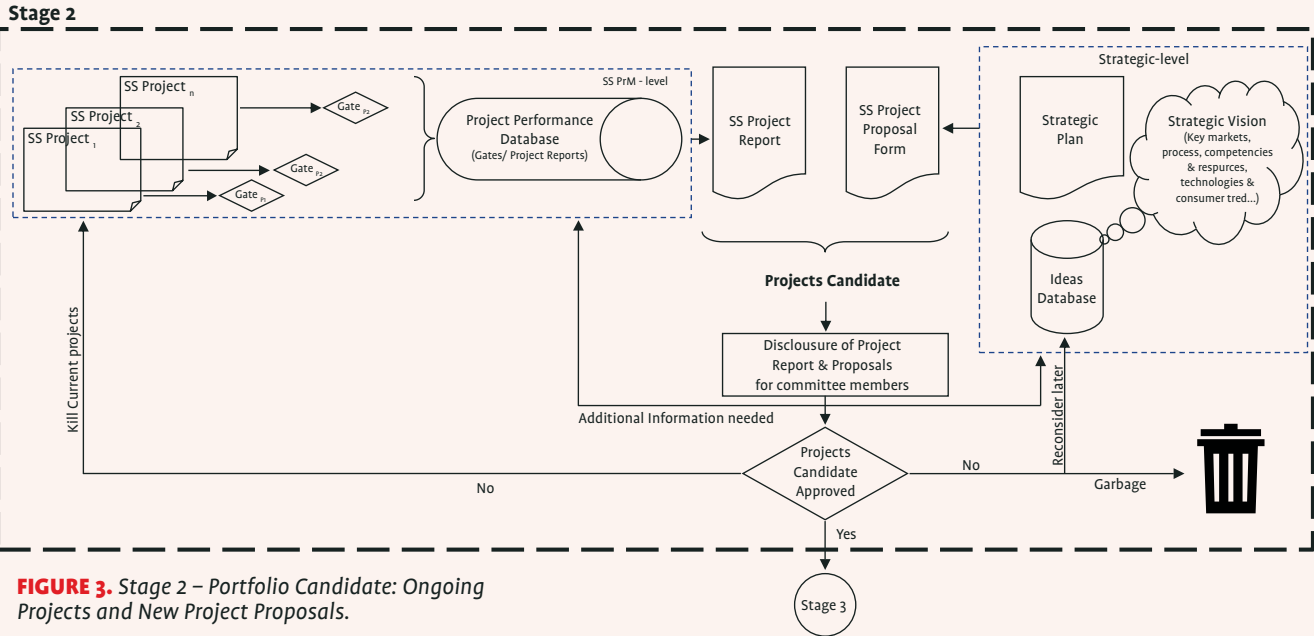


FIGURE 3. Stage 2 – Portfolio Candidate: Ongoing Projects and New Project Proposals.

	HCC	ITC
Programs implemented	ISO 9000, ISO 14000	ISO 9000, CMMI, PMBOK
Six sigma implementation (year)	2008	2003
Six Sigma role structured	Champion Black Belt Green Belt	Champion Black Belt Green Belt
Structured Six Sigma methods	DMAIC	DMAIC, DMADV
Source of new proposals	ISO 9000, ISO 14000 audits	CRM

TABLE 3. Comparison among the cases.

	HCC	ITC
SS Strategic plan	X	XX
Methodological and Organizational Aspects		XX
Project Candidate	X	X
Prioritization and Selection	X	XX
Resource Allocation	X	X
Balance and Fit		X
Portfolio Authorization	X	X
Project review and tracking		XXX

TABLE 4. SSP&PIF: Comparison among the cases.

were tape recorded and then transcribed for content data analysis.

4. Case Studies

The results are divided into two parts: a summarized description of each case followed by a case cross-analysis. It emphasizes the key aspects of SSP&PIF (summarized in section 3).

The healthcare institution (hereafter referred to as HCC) was founded in 1944. It has three branches: hospital (3), six research institute (6), and education and training centre (3) in the Health Sciences. HCC has several

international certifications in quality management (ISO9000), environment management (ISO14000) and in the Healthcare field. Six Sigma is not an institutional methodology and is used in some sectors, mainly in laboratory division.

The Information Technology Company (hereafter referred to as ITC) has three business units: cards, risk and customer. The first encompasses the processes of registration, issuing cards and billing, processing payments and other transactions. The risk area is responsible for credit analysis, authorization, fraud and collections. The business process area deals with all processes related to customer relation-

ship management (CRM). ITC applies project management models (Project Management Body of Knowledge-PM-BoK; Capability Maturity Model-CM-MI). In ITC Six Sigma is also not an institutional methodology and is used in some sectors, mainly in IT project development.

In ITC, Six Sigma was implemented in the early 2000s, while in HCC it is quite new, once it was implemented in 2008. Other interesting differences between these companies is that in HCC the Six Sigma is strongly linked with ISO9000 and ISO14000 systems and is managed by the Quality area, while in the ITC it is linked to project management methodologies and

managed by the PMO. Thus, it can be concluded that in HCC, the Six Sigma is integrated to other Quality methodologies applied and in ITC it belongs to the Project Management area. For this reason, in ITC the project and portfolio management perspective are better structured than in HCC.

In HCC the source of new project proposals are the audit reports of ISO9000 and ISO14000 systems that are prioritized according to their risk scores, applying Failure mode and Technique Analysis (*FMEA*). On the other hand, in ITC the new proposals come from strategic planning, strongly linked with customer relationship management (*CRM*).

Both HCC and ITC use SS role structure in three levels: champion, black belt and green belt. The black belts are full-time improvement specialists and the green belts are part-time. The champion in both is a senior manager that sponsors the SS projects providing the support and insuring the availability of project resources. In ITC, the champion is the director of the customer area, while in HCC the champion is from the laboratory division. **Table 3** summarizes some aspects of the Six Sigma in HCC and ITC.

In both HCC and ITC several gaps could be identified in the project and portfolio management perspective. In ICT, SS project gate meetings are performed after each DMAIC phase. The audience is the three members of the role structure and at least one stakeholder from the customer area. The project proposals come from the strategic plan and the CRM. The Six Sigma is also linked with CMMI. The project selection is performed by the members of the role structure, but they use ad hoc methods.

In HCC, there are no SS project gate meetings and the project teams are autonomous. The project selection is performed by the members of the role structure, ISO9000 and ISO14000 manager and the laboratory board. The two cases are now compared considering the key aspects of SSP&PIF, as shown in **Table 4**.

5. Conclusion

The new framework SSP&PIF helps to understand SS projects in multiple levels simultaneously. It represents a

future development agenda for project and portfolio perspectives in Six Sigma.

From the results, some facts can be pointed out. The Brazilian companies studied have implemented Six Sigma from different bases. In HCC the Six Sigma program was implemented considering the existing quality and improvement programs, which helped with the implementation, however it got stuck in the improvement cycle in between the operational and tactical levels. On the other hand, in ITC the Six Sigma was implemented based on the project management methodology, supported by the PMO. For this reason, in ITC the SS projects move toward a more strategic perspective. There were several gaps in the project and portfolio in both companies studied.

Implementing the multilevel approach is not easy. It requires commitment and leadership engagement from all stakeholders. Further, it involves processes and organizational changes.

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