

Innovation and improvement in facilities management and its impacts on Brazilian companies

Inovação e melhoria na gestão de facilidades e seus impactos sobre as empresas brasileiras

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Abstract

The purpose of this paper is to characterize changes in facilities and their impacts on the performance of some kinds of organizations in Brazil. The research followed a literature review on innovation and quantitative analysis from a survey answered by 49 facility managers in 2009. The results showed that technical and organizational changes in facilities are focused on continuous improvements that impact directly the operational efficiency factors – productivity, quality, and environment – and indirectly impact the financial resources – profit. With a factor analysis it was possible to observe the formation of clusters, which can be named as changes in facilities which support business productivity, sustainability, quality, and profitability. There is limited research material on change characteristics and impacts on facilities, especially concerning Brazilian companies with a significant representation in the BRIC group (Brazil, Russia, India, and China). Clusters indicate that improvements and innovations in facilities come from lower costs, increased assets, and infrastructure lifecycle of organization support, empowering managers for making decisions. The identified technical and organizational changes were adopted mostly in an informal and tacit way, which allowed the creation of new services and products in facilities, and generated a continuous cycle that encourage improvements and innovations.

Keywords: Facilities, innovation, continuous improvement, operational performance, Brazil

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Resumo

O objetivo deste artigo é caracterizar as mudanças em facilidades e seus impactos no desempenho de alguns tipos de organizações no Brasil. A pesquisa seguiu uma revisão da literatura sobre inovação e análise quantitativa de uma pesquisa respondida por 49 gestores de facilidades em 2009. Os resultados mostraram que as mudanças técnicas e organizacionais em facilidades estão focadas em melhorias contínuas que impactam diretamente os fatores de eficiência operacional – produtividade, qualidade e meio ambiente – e indiretamente impactam os recursos financeiros – lucro. Dentro de uma análise fatorial, é possível observar a formação de conglomerados, que podem ser designados como mudanças nas instalações que sustentam a produtividade dos negócios, a sustentabilidade, a qualidade e a rentabilidade. Os conglomerados indicam que as melhorias e inovações em facilidades vêm da redução de custos e aumento de ativos e do ciclo de vida da infraestrutura de apoio à organização, capacitando os gestores para a tomada de decisões. As mudanças técnicas e organizacionais identificadas foram adotadas principalmente em um ambiente informal e tácito que permitiu a criação de novos serviços e produtos em facilidades, gerando um ciclo contínuo para incentivar melhorias e inovações.

Palavras-chave: Facilidades, inovação, melhorias contínuas, desempenho operacional, Brasil

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INTRODUCTION

Several authors (DRUCKER, 1986; SCHUMPETER, 1961; BOLWIJN; KUMPE, 1990) cited innovation as a critical activity for all companies in a competitive context, since it guides the company strategy, directs the allocation of resources and influences the performance indicators. Innovation, according to Schumpeter (1961), is the introduction of a new product, process or a qualitative change in an existing one. Industries with a strong competitive environment and accelerated growth in emerging countries like Brazil have turned their attention not only to their products but also to improving their internal processes. High investments in R&D are not sufficient to ensure the success of new products, so the competitive edge of organizations would not be related only to large differences in technological knowledge, but by how each one improves their internal processes to implement a new product (QUINELLO; CASTRO, 2007). This condition emphasizes that the role of core functional and outlying areas in building an innovative environment can change and push the organization's performance. How do outlying areas responsible for the infrastructure of facilities, which are outside the traditional R&D (Engineering-Manufacturing-Marketing) axis, participate in this innovative environment? Is it possible to think about products with no sales scale processes, even if they are rudimentary? And what about the cases without everyday changes in infrastructure lifetime? Are they real? A survey conducted with 49 Brazilian companies investigated the studies on behavior changes in facilities, analyzed the stakeholders view and the impact of operational performance in organizations. Two research hypotheses that answered the study objectives were identified: H₁ - changes in facilities impacted positively the operational efficiency variables; and H₂ - changes in facilities had a partial impact on the market performance variables.

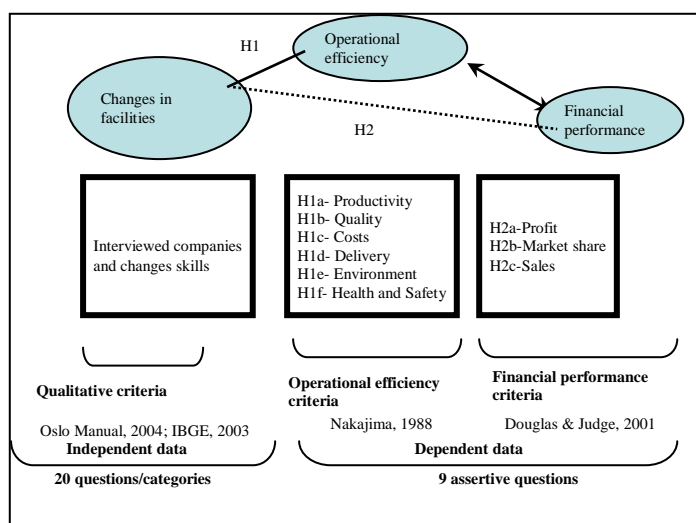
RESEARCH METHODS

This quantitative research involved a survey conducted with companies with a formal Facilities department in Brazil. The study made use of ABRAFAC's¹ database, which is focused on facilities' activities and has over 500 registered companies from several sectors of economy. The research had a non-random, convenience sample (COOPER; SCHINDLER, 2003). The 163 facilities professionals (approximately 32% of the sample) filled a semi-structured questionnaire designed after a research model (Figure 1).

¹ Brazilian Facilities Association.

The questionnaire comprised 20 classifying questions about the respondent, the company, and the change, and nine assertive questions about the impact of the change. Each respondent came up with a significant change that occurred in the facilities under his responsibility over the past two years and in which he had an active participation and contribution to make it happen. The questionnaire was adapted from the Oslo Manual (2007), Kaynak (2003), Nakajima (1988) and Douglas & Judge (2001), since it can be considered a legitimate and tested data collection instrument under similar conditions.

Figure 1 - Model and research hypotheses



Source: Authors

As a general rule, according to Cooper and Schindler (2003), it requires at least five times more observations than the number of variables. Therefore, when analyzing nine categories that make up the dimensions of operational efficiency and financial performance there should be a minimum sample of 45 observations. Due to the nature of the scales and the sample size, this research resulted in non-metric data. In other words, it was a non-parametric statistical analysis. The scale used to measure the degree of impact of the changes in H1 and H2 variables was Likert (1 - very negative, 2 - negative, 3 - neutral 4 - good, 5 - very positive). To obtain the correlations between independent variables and the level of ordinal measurement (nine assertive questions), Levin (1987) recommended the Kruskal-Wallis or Kendall. According to Corrar et al. (2007), the factor analysis is one of the interdependence multivariate techniques in which all variables are simultaneously considered in order to study their inter-relationship and clustering. We used this technique to analyze the (efficiency and financial) impact and its relationships and the possible formation of clusters.

IMPROVEMENTS AND INNOVATIONS IN FACILITIES

According to Hegaru (2008), facilities are broadly defined as built spaces where people, materials, and machines are driven together for a particular purpose. In operations or production strategies, the facilities management area is not explicitly represented but appears in an area called structural decision. In other words, it is responsible for capacity, equipment, and technologies required for the production process (MAIA et al., 2005). According to Tompkins and White (1984), the facilities' areas are responsible for well-defined stages in the lifecycle of an asset: in the determination of a company's location, in the definition of the functional layout, in the maintenance of the asset and in the decommissioning and reuse of assets (although the latter two were not mentioned by authors). Decisions about an organization's facilities may also generate inertia in decision-making since the choice of a particular long-term facility design may generate increased risks and uncertainties if the wrong choice is made.

In Brazil, facilities is relatively new and controversial subject within the operations and services management in both academic and professional environments. The difficulty for its consolidation and legitimization is maybe due to the absence of research in this area, the lack of consolidated professional associations (the Brazilian Association of Facilities - ABRAFAC was founded in 2004), the absence of professionals interested in reporting their experiences, the generalization of the term, the lack of norms for the activity, the inexistence of academic training, the high costs involved or even facilities professionals working informally in the activity (QUINELLO, NICOLETTI, 2006; ALEXANDER, 1996).

Shohet and Lavy (2004) highlight three paradoxes identified in international literature: 1. Facilities are recognized as a strategic area in organizations but their professionals work at operational levels; 2. It aims at being part of a vital position in organizations although services are largely outsourced; 3. Its purpose is to manage change within the organizations, but it is often a reactive activity. Anyway, in terms of resources, according to Weise et al (2008), the facilities industry has a turnover of approximately US\$ 50 billion a year in Brazil.

Regarding the origins of changes in facilities, whether they are innovations or improvements, Nutt (1999) points out that they occur through tasks and operations, problems and techniques, ideas and concepts or scope and context. Mansharamani

(2005) suggests that these areas have two basic types of innovations: 1. Demand-side, characterized as innovations in services and products focused on meeting the clients' requirements, and thus increasing the organization's profitability; 2. Supply-side, dealing with the innovation in processes and concerned with the increase in production efficiency and operating margins. Changes that are not exactly focused on market success are little discussed. From this point of view, a new group should be approached, the facilitators group, that is, internal improvements or innovations not directly related to the core production processes, but in support to them.

In one of the few works on innovations in facilities, based on a survey of UK companies, Goyal and Pitt (2007) have detected several changes, mainly in processes and management, which are the result of integration, cooperation and relationship of these companies with extensive contact and multi-contract networks (suppliers, partners, contractors, and subcontractors). Another survey by Cardelino and Finch (2006), whose aim was to identify innovation processes in facilities of eleven British organizations, identified that rarely do innovations follow a formal scheme and systematic practice. They occur suddenly in the early stages of projects and are typically associated with software. As to their nature, they are very close to service innovation. Iansiti (1995) warns that these innovations may arise between the routines of specifications (the projects' early technical parameters) and implementation (construction/physical activities).

As to the impact that a change can produce in organizations, a survey by Lin and Chen (2007), with small and medium companies of Taiwan, showed that there was a strong positive correlation between company size, internationalization and alliance with the sales results, aided by many organizational innovations and little intricacies. At this point the authors point out the differences of the Eastern world's path (focused on small improvements) and the Western's (seeking high leaps).

Withdrawing a bit from the economic focus, Moreira and Queiroz (2007, p. 9) point out that some authors tend to conceptualize innovation "not as an external object and that its novelty is determined by the perceived social unit that adopts it." From this perspective, a change may be an innovation for a company but not for another. Tornatzky and Fleischer (1990) warn that novelty is a situational quality, that is, it relates to time and space. Something is new for a certain period of time and in a given environment, so there is still a divergence of concepts.

RELEVANT FACTORS AND FINDINGS

The survey for this study was launched on November 2007 and ended on December 2010, with an audience of about 500 professionals in facilities. Regarding the data qualifiers, in a sampling of 49 observations, there were domestic companies (53%), large companies (73%) and companies with more than 20 years of existence (75%), suggesting mature organizational environments with market experience. As to the respondents, 63.3% of them had up to fifteen years of experience and 36.7%, more than sixteen. Forty-nine percent had graduate degrees in related areas, evidencing the low offer of specialized courses in the area of facilities in the country, preventing the profession's formalization, as it occurs in developed countries. Data also show that the activity in the area of facilities is learned in practice and not at school.

As to the changes' general characteristics, it is possible to affirm that they were focused mainly on industrial enterprises and very close to the core activities. Concerning the innovativeness level, these changes were mostly ongoing, low-cost improvements and targeted to solve problems. They were obtained in short-time partnerships, using mainly tacit and informal groups. Table 1 shows the main qualitative results of the changes' profile:

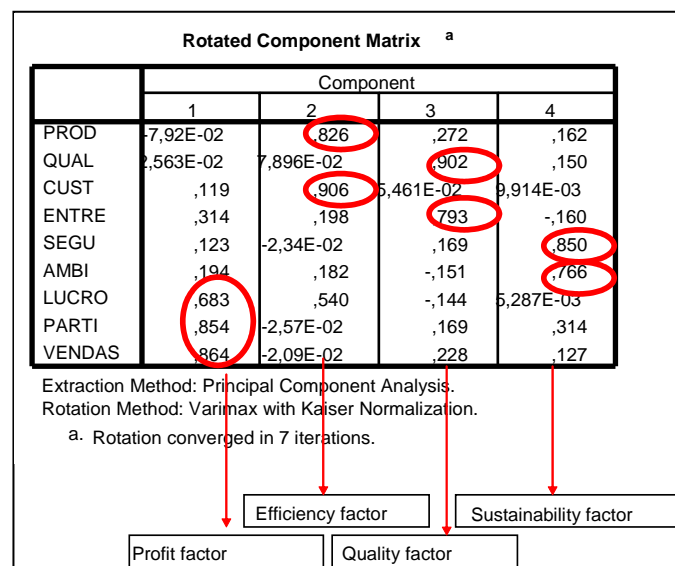
Table 1 - General profile of the changes

Questions asked during the survey	More frequent answers
Where did this innovation occur mainly?	In the processes, equipment, machines and devices supporting operations.
Where is the innovation located?	Especially in the company.
In relation to the core activities of your company, where do you place this innovation? (For example, in an automobile industry the core activity is the manufacturing of vehicles.)	Very close to the core activities.
What is the intensity of the innovation?	It is new to the company, but already exists in the national market.
What was the cost to implement the innovation (US\$)?	Up to 50,000
What is the main reason for innovating?	Troubleshooting
What was the main source of ideas for the innovation?	Mixed ideas (internal and external)
What was the average time to implement the innovation?	Between 2 and 6 months
What was the main obstacle to implement this innovation?	Time for development and deployment
What was the main knowledge used by the group in the innovation?	Informal - work experience

Source: Authors

The next step was to identify if the performance (H₁) and financial (H₂) factors formed unidentified structures in the model assumptions initially proposed in the article. The analysis yielded a 0.60 KMO (Kaiser-Meyer-Olkin), so the level is above 0.50 which is a limiter for the factor analysis application (CORRAR et al, 2007), because it compares the correlations of zero order with the partial correlations observed between the variables. The Bartlett test of sphericity was also below the limit value (0.05). The individual MAS values (anti-image matrix) in the table are mostly above 0.50. The commonalities are between 0.50 and 0.80 and the total variance explained by four factors (extracted by the Kaiser criterion) is nearly 79%. These numbers are considered satisfactory, allowing further analysis on the factors generated by factor analysis. The responses' internal reliability (Cronbach Alpha) was significant at 0.74. After two data rotations using the Varimax method, which were necessary to identify the model's main components, the study reached the information displayed in Figure 2. Hair et al. (2006) warn that to a small sample (up to 50 observations) the load factor must be greater than 0.75.

Figure 2 - Factor analysis results



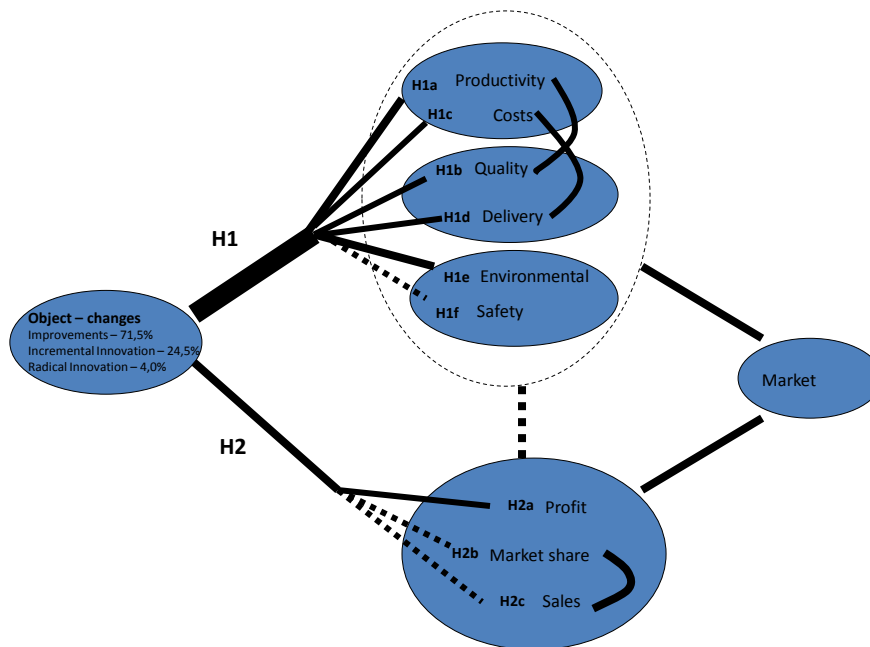
Source: Authors

The results shown in Figure 2 indicate that the factors were grouped differently from the initial assumptions of the research. Some other factors came together to form new compositions. Four new dimensions emerged showing distinct taxonomies from the traditional one: productivity, combining productivity and cost factors; quality, linking delivery and quality factors; sustainability, combining safety and environment, and profitability factors, linking sales, profit, and market share factors. These findings may

indicate that the continuous improvements and innovations can be classified by the impacts they produce, not the by history that generated them.

Figure 3, with the new stratifications, shows by means of lines the power of the impact (measured by mode) that a change produced in the organization. Thicker lines indicate significant impacts (mode 5). Narrow lines show relativity (modes 3 and 4). Dashed lines indicate low significance (mode 1 and 2). The initially proposed hypotheses were tested, confirming and refuting some claims. The median test was used to reject or refute the research hypotheses, confirming in H1 (productivity, quality and environment as positively significant) and H2 (profit, market share and sales as relatively significant).

Figure 3 - Model of hypotheses tested



Source: Authors

Among the efficiency factors, productivity revealed itself very close to quality, as well as delivery was close to costs (by factor analysis). Among the of financial performance factors, there is a strong convergence between market share and sales, including some possible trade-offs, because when sales increase there is an expected growth in market share and vice versa. There were no significant relationships between efficiency and financial factors. This corroborates studies such as those of Slack (1991) on

trade-offs between performance factors, where the leverage of one may hold up the other one. From the found clusters emerged the following categories:

- Changes in facilities for operational sustainability: this category is generated by the service takers themselves, focusing on organizational changes, with average novelty, long period of development and deployment, deriving from partnerships and implemented by foreign companies from the industrial sector. These results were frequently reported by supervisors with more than six years of professional experience that indicated the time of deployment as the main barrier to change. In this group were cases related to standards and regulations, such as the adoption of NR-10 (regulatory standards for electrical installations), NR-33 (inspection of pressure vessels), improvements in the process of approving service invoices, standardization of ecological paint colors for building maintenance and global rearrangement of facilities structure to meet corporate standards. This class seems to be aligned with the need for facilities to respond to new standards of corporate governance adopted mainly by multinational companies in recent years, minimizing labor and environmental liabilities.
- Changes in facilities for operational productivity: according to the collected data, this class is produced by domestic providers focusing on changes in processes (machines, devices, equipment), with low innovation and deriving from partnerships with customers. Changes are made in a short time (between two and six months). These results were reported mostly by supervisors with more than twenty years of professional experience in this area who reported that the organizational rigidity was the main barrier to improvement deployment. These results affect the productivity and cost efficiency factors. The examples mentioned by the survey's respondents were: the installation of remote utility meters for monitoring and controlling consumables and electronic systems for real time control of electrical substations. It seems that changes are aimed at increasing efficiency in the use of company assets and reducing operational bottlenecks.
- Changes in facilities for operational quality: according to the collected data this class is focused on changes in processes (machines, devices, and equipment), with low innovation, short development and deployment time (between two and six months), deriving from external sources and implemented by foreign service companies. These results were reported mostly by managers with over twenty

years of professional experience who stated that organizational rigidity was the main barrier to improvement deployment. As an example they mentioned the implementation of an electric power generator to improve the quality of the utility (energy sources) delivered to users.

- Changes in facilities for business profitability: these changes are produced by service providers, targeting at changes in processes (machines, devices and equipment) with medium innovation, long development and deployment time (more than twelve months), deriving from partnerships and implemented by foreign companies from the utilities sector. These results were reported mostly by managers with more than sixteen years of professional experience, who stated that organizational rigidity was the main barrier to the innovation deployment. One of the improvements mentioned in this category was the technological upgrading of machinery and anesthesia protocols, generating a maximum use of resources for the company. It was also mentioned the automation of air compressors in peak periods of consumption to reduce electricity costs.

The possibility of hybridization of the above categories is not discarded, since discreet correlations and traces of trade-offs between them were found. Some improvements seem to serve more than one category. For example, the installation of a generator might improve: the company's productivity by reducing downtime of operations in emergency situations; the quality of inputs, for the delivered energy is more stable; the business sustainability, since the decrease in energy consumption in peak periods can generate less waste for the city's electrical system; and, ultimately, the company's profitability, because the energy surplus generates revenue for the company.

Negative trade-offs between the impacts of these changes were not found, possibly due to the respondents' difficulty in accessing the companies' real metrics. Although the responses were revalidated, a change is likely to generate positive and negative impacts over time, for example, the installation of a new air compressor engine with minimal energy consumption and smoother starting. If this engine is maintained over the years with a poor maintenance policy, it will spend more energy - an opposite effect to the initial goal.

CONCLUSION

The research model confirmed that the changes mentioned by the professionals had greater impact on operational efficiency factors (specifically those of productivity,

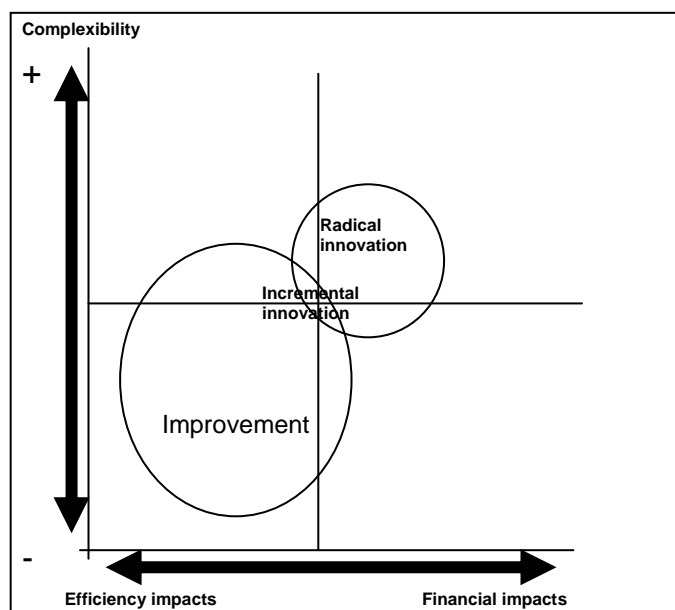
quality and environment). These findings may be linked to a more operational profile of the professionals who answered the survey, even those in leading positions. This hypothesis reinforces the work by Ferreira (2005) and Shohet and Lavy (2004) who understand that the recognition of the area as a strategic discipline does not match the actual role played by professionals in the labor market (which is more operational than strategic).

It was found that the technical and organizational changes produced by agents could in most cases be classified as continuous improvements or incremental innovations but not as innovations that produce drastic changes in goods or services. There were few cases of radical innovations. Usually they arise from internal pressures from companies seeking efficiency. Such pressures were due to organizational inertia, technological isomorphism, deterioration of assets, mismanagement and resource constraints. The changes are largely implemented through the use of improvisation and contact among service takers, service providers and of equipment, machines and systems suppliers. Another finding was that an improved technique can produce an organizational improvement, and vice versa.

To determine whether a change in facilities is considered improvement or innovation, it is recommended to locate it within the companies' operations. It usually orbits the core operations as adapted remote infrastructure. The next step is to check if their characteristics are similar to those described in Table 1 as improvement. Those beyond these characteristics are defined as incremental or radical innovations. Finally, according to Figure 4, by analyzing the complexity of the change (allocated resources, technical effort and central components) with the staff's perception of the generated impact (operational efficiencies or financial gains), one may have access to the differentiation in facilities' modified artifacts.

Figure 4 shows that the change innovation, for this research, could be classified according to complexity and perception. Regarding complexity, it means the technical efforts, human and financial resources invested in the change. In the axis of perception the edges indicate the most likely impacts generated by the change. The strategy of analyzing the impact and effort applied can guide managers in decision-making about the resources needed for a given change in facilities.

Figure 4. Improvements, incremental innovations and radical facilities



Source: Authors

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The first limitation is in the subject of this paper: innovation and improvement in facilities. Given the features' closeness in the context of facilities, these two classes are sometimes interdependent, so it was impossible to separate them. One of the methodological limitations was the inexistence of specific instruments for data collection and the questionnaire was designed based on empirical and theoretical research. The data collection instrument addressed the most important innovations or improvements occurred in the respondent's department in the last two years and did not consider other innovations during this period. The factor analysis was generated with a low number of observations. There were 49 valid replies, which restricted the studied universe. Finally, some improvements and innovations occurred in the industrial sector, therefore the sample should be expanded to other sectors.

For future research, we recommend an analysis on changes and improvements in facilities to expand the life span of the company's assets. Many of them arose during the implementation of some shift. This mutual relationship between deliberate and emerging changes during the implementation deserves an in-depth study. This paper reveals that most of the changes in facilities came from improvisation and "learning by doing, working and simulating". These concepts are another field of research.

Nakajima (1988) substantiate the concepts of TPM, indicating performance

criteria that managers should focus on. However, these criteria have equivalent weights. This article may prove the efficacy of the use of these criteria as a tool for analyzing the impacts of changes, but weighted and agglomerates. With the use of factor analysis, managers and researchers could direct changes towards certain results or study the effects in isolation.

We noticed a concern with socio-environmental changes. It would be appropriate to examine the “reverse facilities” using the same concept used for reverse logistics. Couldn’t the new plants or facilities, the so-called “Greenfields”, be clean, flexible, and primarily recyclable?

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