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THE CHALLENGE AND ART OF IMPLEMENTING 5S IN INDUSTRIES: OVERCOMING OBSTACLES TO ACHIEVE OPERATIONAL EFFICIENCY

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ABSTRACT

It is known that the end of the Second World War brought numerous challenges to the combatant countries. Japan, specifically, had its economy weakened, which resulted in a crisis. Seeking alternatives for the reestablishment of the State, the country found in the industry a means of rationalizing inputs and applying philosophies, which in addition to helping the country economically, is also a source of studies and practical applications. In this sense, the objective of this work was to address the origin and application of the 5S industrial philosophy, seeking to understand how such a tool can contribute to the increase of the operational efficiency of the industry at the time. The methodology used was the bibliographic review, using articles from different themes of applications of 5S and other philosophies. The results indicate that the application of the philosophy brings, among other benefits, efficiency in cost reduction, in addition to making the environment systematized and organized for better use of employees. Finally, it is considered essential to continue new studies on the practical application of the 5S philosophy as a way to increase the visibility of this tool, which was a precursor in the industrial reestablishment and in ensuring the continuity of several Japanese industries.

Keywords: 5S Philosophy, Industry, Operational Efficiency.

INTRODUCTION

It is known that global industrialization was triggered due to the need of countries conflicting with the war to increase their military power. This milestone, although catastrophic, was a precursor of competitiveness between countries, which generated significant investments in industry, so that nations could take the offensive against their opponents (Hirst and Thompson, 1998; Gaspar, 2015). In this sense, the evolution of industry mainly through state investments stands out, which brought great advances in manufacturing (Gewehr and Lélis, 2022). As a result, the industry has undergone several transformations, marked as industrial revolutions, where each period of revolution was decisive in tracing new levels of well-being, production and quality. Chang (2004) reports that the way industries were treated in the mid-nineteenth century, in the face of the countries in conflict at the time (USA, France, Russia, Germany and Japan), were crucial for the increase of their gross domestic products (GDP), which was the starting point for increasing manufacturing investments, configuring these countries later, as great world powers, that is, great suppliers and holders of capital, a title that is recognized to this day.

Despite this, in the post-war period, Japan, as a member of the Axis, a group that suffered defeat in the war, had its economy weakened due to the great efforts that the conflict demanded, which caused the country to have to restructure. One of the solutions was the feasibility of work philosophies that united the different labor spheres so that they could continue to produce and capitalize. Pinto and Xavier (2007) reported that "Just-in-time" (JIT) was the precursor of the practices, as it is based on production at the time when the goods were demanded, which reduced inventory costs and waste.

As a result of this philosophy, the industry underwent transformations in its "modus operandi", valuing the reliability of its products, something that was only possible from the systematization of production, valuing labor and maintenance. Nogueira et al. (2012) state that from that moment on, the industry understood maintenance as something essential to increase the quality of its products, as the JIT technique entailed total focus on production. From this, other work philosophies based on machine availability and reliability were created, known as corrective, preventive, and predictive maintenance (Oliveira, 2023).

In this perspective, the reach of lucidity about the correlation between quality and organization gave rise to the emergence of one of the main Japanese work philosophies of the time and that is practiced to the present day; 5S. This approach to the work system involves the company and its actors in a holistic way, based on the acronyms: Seiri (sense of use), Seiton (sense of organization), Seiso (sense of cleanliness), Seiketsu (sense of health and hygiene) and Shitsuke (sense of self-discipline). Silva et al. (2001) emphasize

that 5S is a program characterized by intense changes addressing the metaphorical and literal sense, that is, both physical and mental organization of the company's participants, acting in the capacity to dominate the industry in the sense of production to deliver product with total quality. This point of view corroborates the perspective of Carvalho Junior (1997) and Contador (2008), in which Japan's industrial success in the post-crisis scenario was mainly due to the implementation of new factory crops. In this way, it is believed that by reaching the level of development of the 5s philosophy, the company can optimize its activity and achieve the long-awaited continuity in the sector.

The present work aims to demonstrate how the application of the 5S philosophy can contribute to the increase of operational efficiency in organizations. Since, the unfolding of Japanese industry at the time was crucial to achieve business success, combined with the exit from the economic crisis. In view of this, a bibliographic contribution will be presented in this work, under the theoretical bias, of the systematization made at the time for the establishment of industrial philosophies. In addition, the 5S philosophy and its practical application within the industry will also be addressed, in order to correlate the Japanese success of the time with the potential success of the industries today.

THE CONTRIBUTION OF THE THEORETICAL FRAMEWORK

PREAMBLE TO JAPANESE INDUSTRIAL EVOLUTION

The economic devastation suffered by the Japanese at the end of World War II made the industrial process a source of thoughts and alternatives for state restructuring. From this perspective, Womack et al. (2003) report that the different needs of Japanese industrial evolution culminated in the development of techniques known as "lean philosophy". This term refers to the way industries think and act aiming at reducing product waste as much as possible, in addition to stimulating human effort, optimizing time-space, and correcting equipment to make the availability of machines greater, in order to respect deadlines, to deliver, in general, everything that the stakeholders of the time needed.

According to the analysis of Morgan and Liniker (2008), the aggregation of the lean philosophy allowed, in a way, the search for knowledge and information of the industry in the face of the factory organization that was underway. Allied to this, the communication between employees and sectors made it possible to synchronize production, making it possible to achieve greater efficiency. Ohno (1988), when he was part of the beginning of the lean activity, addressed industrial waste in seven main groups, so that they could be known and combated: Excess production; unnecessary transportation; unnecessary movement of people; wait; unnecessary processing; inventories, and; Defects. Since, for a

lean company, eliminating activities that do not generate value was more important than speeding up processes (Pardal; Perondi; Valeri, 2011).

APPLICATION OF INDUSTRIAL PHILOSOPHIES IN THE POST-WAR SCENARIO

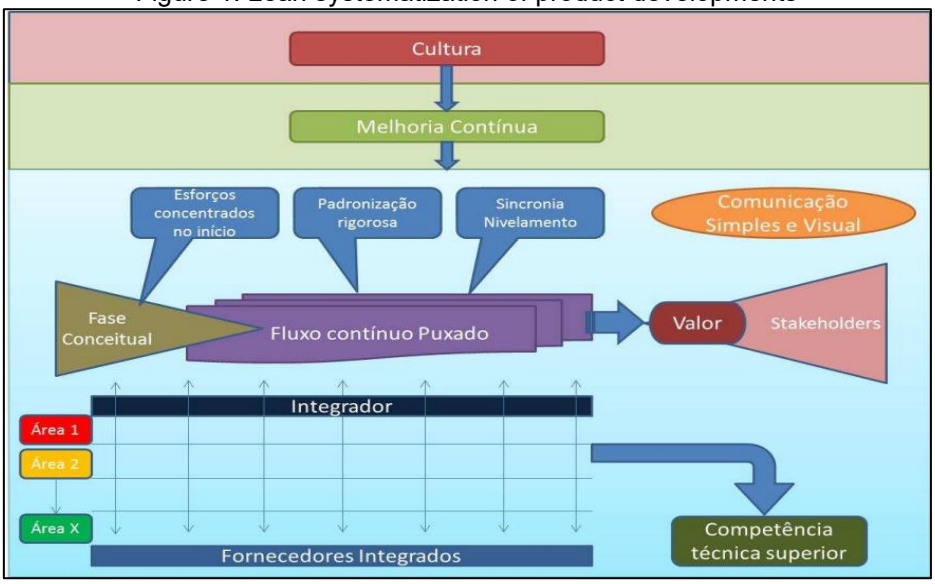
During the period of development of the philosophies of Toyota, one of the main Japanese industries developed the so-called "Just in Time", which is characterized by increasing productivity by adding low inventory, that is, with scarce resources, the Japanese vehicle manufacturer chose to produce cars when the order entered the system (Moura and Banzato, 1994). To corroborate, Vidossich (1999) comments that the technique was created in the interest of rationalizing inputs and increasing quality, focused on the philosophy of doing the best with what you have at hand.

Later, the process of implanting new cultures gave rise to methods linked to continuous improvement, which is known today as Kaizen. In turn, Kaizen is the set of techniques linked to the improvement of products and processes triggered by the need to have availability of machines during the manufacturing process, since the JIT technique has made a commitment to delivery times. Such commitment led to the creation of new "modus operandis" in the industry of the time, in order to deliver quality products. Thus, Kaizen aims to pay attention to the continuous improvement of processes and equipment, taking into account the performance of maintenance (predictive, preventive and corrective), systematization and reorganization of workstations, improvement of raw material logistics, in addition to improving the safety of machines and limiting access of people to unnecessary positions (Slack et al., 2012; Blaga et al., 2007).

In this sense, the search for excellence in production has made the Japanese industry reach a fundamental level of awareness, which is the basis, among others, of today's industrial philosophies, the so-called Total Quality Management (SQT). Carpinetti (2012) conceptualized SQT in two phases, the first being related to the maturation of the company's quality management, in which stakeholders are treated as priorities, producing what they want, need and/or have needs, that is, the phase in which the customer needs to be delighted so that he becomes loyal to the brand, where the objective is to make the company perennial in the sector. On the other hand, the second phase of SQT is related to the adequacy to internal use, a process that integrates the company's sectors with the objective of making quality the only way to achieve and maintain a good relationship with the customer. In this case, Barraza and Pujol (2012) point out that everyone involved in production is included in phase 2, and that the commitment to quality makes any and all actions/items that are not aligned with the purpose dispensable.

By relating the concepts of total quality and lean philosophy, it is possible to gauge the structural level at which the industry has reached, having as precepts the customer and the labor organization. Such ideals are exemplified in Figure 1, below.

Figure 1. Lean systematization of product developments



Source: Pardal; Perondi; Valeri (2011)

The scheme allows influencing the relationship between the delivery of quality products to the end customer, exemplified in the figure as stakeholders; and synergy with the competent departments, placing communication between agents as a crucial point. Thus, the implementation of culture as a precursor of the company's success is noted, above the technique of continuous improvement, bringing the aspects of efforts, standardization and synchrony during the industrial process. Finally, the interaction between suppliers is brought as a start from a homogeneous alloy that transforms and delights customers.

However, to reach the structural level of SQT above, it is essential to understand which tools and means are used in the process, which allows the control and organization of activities between different departments. In this sense, the following chapter will address the 5S philosophy as the main tool to achieve total quality, as well as its practical use in industries.

METHODOLOGY

The methodology of this study was to evaluate the definitions of the 5S philosophy in the industry under the aspects of different authors, such as Silva et. al (2001), Duarte; Duarte Silva; Eckhardt (2013); Campos (2005); Campos (2014) and Lima et. al (2018). Thus, it becomes possible to understand the philosophy in order to correlate it with the

current application of industries. As a specific objective, we sought to integrate articles that could bring the application of the philosophy in different industrial sectors, to evaluate the effectiveness of increasing operational efficiency.

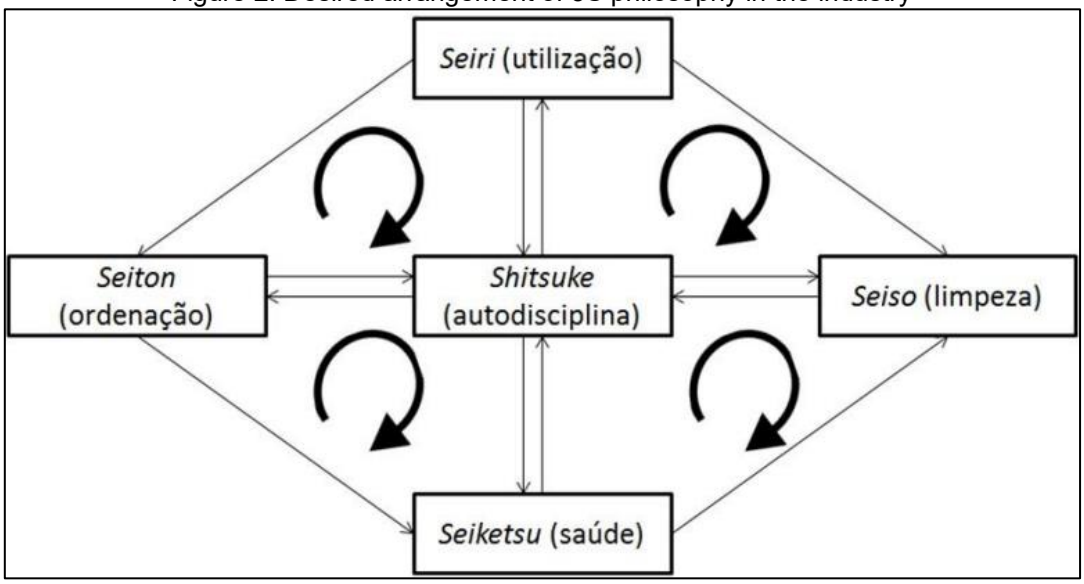
5S TOOL: DIFFERENTIAL TO ACHIEVE EFFICIENCY AND TOTAL QUALITY

Silva et al. (2001) highlight that 5S is a program characterized by sudden changes in the physical and mental sense of the organization, and is also responsible for predefining the company's culture according to the activities to be performed, as well as in the rearrangement of ideas and actions to be taken by the agents. On the other hand, Duarte; Duarte Silva; Eckhardt (2013), say that the philosophy is justified by strengthening the management base of a company to contribute to the search for efficiency, in addition to directly impacting the process of continuous improvement at a personal and business level.

These definitions follow the same line of reasoning as Campos (2014), in which 5S is based on the employees' commitment to organizing the workplace, respecting cleanliness, standardization and discipline during the execution of activities, without supervision for this. Barraza and Pujol (2012) add that business leadership is closely linked to this process and is directly responsible for implementation and management in the industry.

In general, the program is recognized by 5 Japanese words used as codes of conduct that must be followed to achieve industrial success, namely: Seiri (sense of organization), Seiton (sense of order), Seisou (sense of cleanliness), Seiketsu (sense of health) and Shitsuke (sense of self-discipline). Coutinho and Aquino (2015) point out that the schematic arrangement of the 5S philosophy is made according to the word that represents the sense of self-discipline (Shitsuke), as the system that is based on it gains importance and prominence within the industry, showing customers that the company is sufficiently capable of training employees committed to delivering the best. In agreement with this, Duarte; Duarte Silva; Eckhardt (2013) and Lima et. al (2018), state that this arrangement manages to maintain the singularity necessary for the application of SQT (Figure 2).

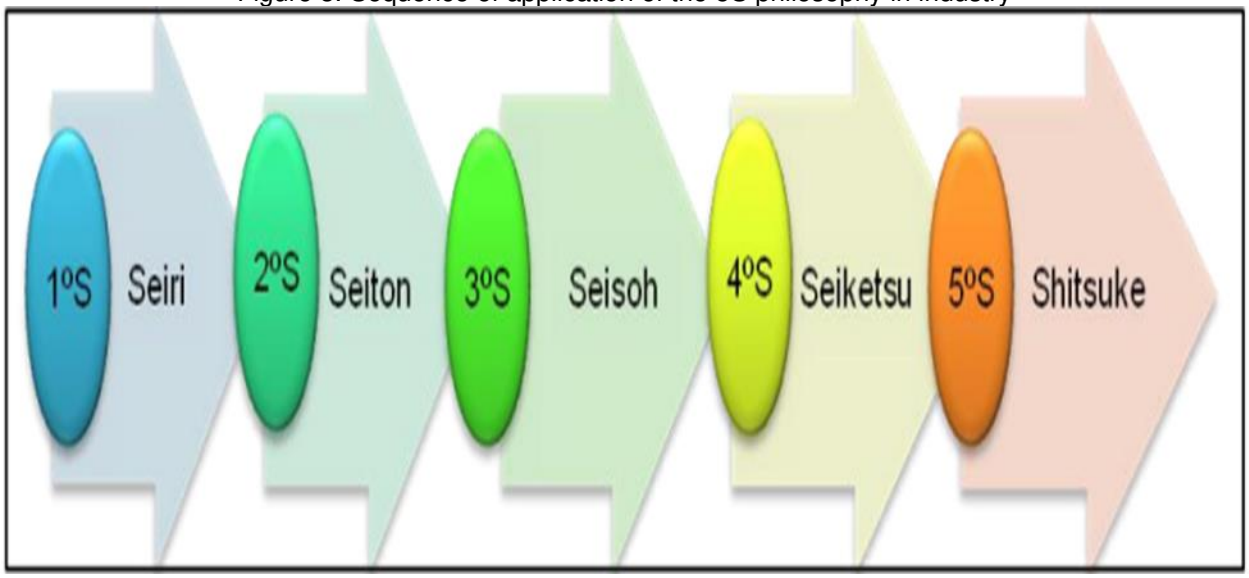
Figure 2. Desired arrangement of 5S philosophy in the industry



Source: Silva (1994) adapted by Coutinho and Aquino (2015)

When analyzing the 5S arrangement, Campos (2005) mentions that the essence of representation is based on three dimensions: Physical (layout), intellectual (execution of tasks) and social (relationship); in which the dimensions are correlated and depend on each other so that philosophy can triumph. But for this, it is necessary to understand the exact definition of each sense, as well as its sequential use (Figure 3) to carry out transparent implementation of policies in industries.

Figure 3. Sequence of application of the 5S philosophy in industry



Fonte: Kamiya et al. (2010)

In view of the orderly application of philosophy, its definitions can be highlighted below:

Seiri (sense of use)

This sense aims to bring to light ideals about the need to keep in the workplace everything that is useful to production. Thus, any and all waste and/or disablement of instruments is considered important, to focus production only on what is necessary (Campos, 2005).

Seiton (sense of orderliness)

In turn, the sense of order aims to systematize and optimize the workplace, aiming at a functional and egalitarian physical rearrangement. The idea of this sense is to increase, through organization, productivity, as well as reduce costs and avoid work accidents (Campos, 2005; Souza 2018).

Seiso (sense of cleanliness)

The sense of cleanliness, according to Lima et. al (2018), is dual, as it covers both the literal and metaphorical areas in the industry. That is, the cleaning of utensils, parts, packaging and workstations are part of the literal sense, while the cleaning of data, unnecessary/outdated information from the workstation is part of the metaphorical sense, as it is only necessary to work with relevant information. In addition, the author points out that literal cleaning must reach three levels of organization, namely: macro level in the industry, individual level and micro level, where each employee is responsible for their area and the area around them.

Seiketsu (sense of health)

According to Souza (2018), the sense of health aims to encompass the senses of use, order, and cleanliness, in which, through standardized inspection and cleaning routines, the sense of physical and mental health is achieved, since the organization is a key piece for maintaining a good relationship between employees.

Shitsuke (sense of self-discipline)

Finally, there is the sense of self-discipline, which as seen earlier, makes up the basis of the 5S philosophy. Campos (2005) states that this is the most difficult sense to implement, due to the change in behavior and attitude that it requires from employees. Thus, the company becomes co-responsible for assisting in the transition of the employee culture, meeting formal training standards, and introducing corporate policies so that it is an instrument of the turning point. In addition, Ribeiro (1994) adds that it is essential for the

industry to limit the authoritarian control that governs certain hierarchical levels, as this is a source of discouragement.

In view of all the senses of the philosophy, it is important to highlight the commitment that the company has to the employee, to deliver healthy and productive means of work. Thus, below are addressed some applications of the 5S philosophy in the industry, bringing to light the reflection of the implementation of each one, in addition to the success obtained.

RESULTS OF SOME OF THE APPLICATIONS OF THE 5S TOOL IN INDUSTRIES

According to Bonfim; Assunção and Fonseca (2018), the application of the 5S tool in the industry must contain prior planning, in order to identify the essential sectors of the company, as well as the entire body of employees who will be involved, in order to be responsible for execution and supervision, until the entire organization can reach the level of Shitsuke sense (self-discipline). Also, for the purpose of comparison with a later period, it is interesting to record all the information prior to the implementation of the tool. That said, and considering such prior execution of the tool, the discussion on the practical application of the tool in the following industries begins.

Kamiya et al. (2010), when studying the application of 5S in a laboratory for the production of vegetable fibers from green coconuts, highlighted that before the implementation of the philosophy, the time dimension was the main challenge factor, which led to a delay in defining the delivery time, due to the variation in work equipment, methodologies used and sample sizes to be produced for quality measurement. In this sense, after the application of the philosophy, the studied laboratory had a significant improvement in the Seiri (tidiness) senses, due to the definition achieved in the choice of standardized instruments, methodologies and processes, eliminating alternative procedures used before.

On the other hand, within the Seiso sense (cleaning), the application was essential, due to the need for cleaning that the process requires, in which any and all contamination present in the work environment can pose a risk to the final quality of the product, given the handling of organic products, which are susceptible to chemical and physical degradation by the environment. In addition, the control of accident prevention was something highlighted by the authors. Next, the authors highlighted the sense of Seiketsu (health) as the "icing on the cake", as a result of the achievements of the senses of tidiness and cleanliness, as the visual aspects of the physical space and the comfort of the employees were impacted.

However, the authors highlighted that the adequacy to the Seiton sense (ordering) was limited, due to the physiological characteristic of coconut fiber, in which an orderly storage process would bring risk to the integrity and quality of the fibers, and could make the process a failure. However, because coconut fiber is intolerant to prolonged storage, the authors highlighted that the "Just in time" processes were applied as a form of quick release to the customer and guarantee of product quality. This attitude is in accordance with the theory proposed by Duarte; Duarte Silva; Eckhardt (2013) and Souza (2018), in which the integration of philosophies (JIT and 5S) would bring benefits to the industry. Finally, the authors explain that it is still the team's goal to achieve the Shitsuke sense (self-discipline), due to the recent practice of the 5S tool in the laboratory, but that, above all, the sense would be fundamental to optimize the production of specimens, in addition to the other activities practiced by the teams, in which supervision would not be necessary.

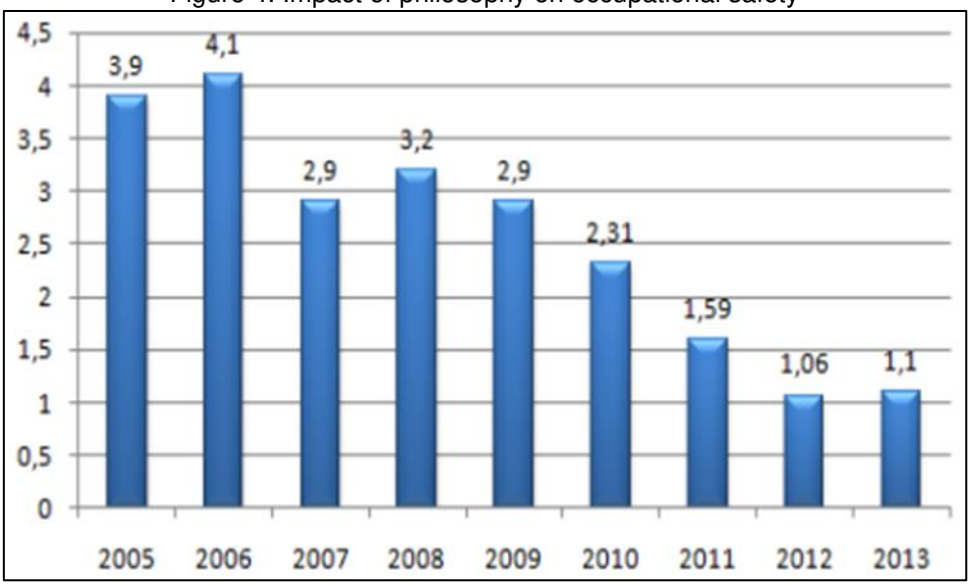
From another point of view, Coutinho and Aquino, (2015), when studying an industry that produces special long steel, explain that the 5S tool was already underway in the company for two decades. Initially, the authors emphasize that the company had the objective of making the environment free of work accidents, and that the implementation of the tool took place through the Seiri sense (use), creating a warehouse to store all the utensils that were useless at that time, which later contributed to the reduction of purchasing costs due to the reuse of utensils from the warehouse. Next, the authors describe that during the implementation phase, the company had an abrupt change in the systematization of jobs, involving executives to the factory employees, with training, workshops and other events focused on reducing accidents and optimizing resources.

After a certain period, the company reached a fundamental level of the 5S philosophy, where employees were given tools to point out possible improvements and involve them in the production of steel as co-responsible for the results obtained, in addition, feedback was implemented as a form of freedom of expression within the industry. Coutinho and Aquino (2015) state that the company started to have the objective of extending 5S practices to the personal lives of employees, as a way to achieve continuous improvement.

As a tangible result, Coutinho and Aquino (2015) emphasize the awareness of 100% of the interviewed employees about the company's general objectives, quality indicators and knowledge of continuous improvement programs in the company, as a result of general alignment on the part of those involved with the industry's mission. In addition, investments in safety and occupational safety systems reached 26.5% in a period of 5 years, implying a

decrease from 2.9% of occupational accidents/million hours worked (international index), to 1.1% in the same period, as shown in Figure 4.

Figure 4. Impact of philosophy on occupational safety



Source: Coutinho and Aquino (2015)

Finally, Coutinho and Aquino (2005) surveyed three main indicators within the company after the implementation of 5S, being the index of favorability, ergonomics and environmental responsibility. The favorability index, according to the authors, represented 75% of managers' satisfaction in the period from 2005 to 2013. On the other hand, the ergonomics index stood out in the sense of a decrease in leaves due to injuries (non-fatal work accidents) by 85% during the same period. Finally, the environmental responsibility index, another of the company's main objectives, increased the use of recycled steel by 75%, employing 30 to 50% savings in the purchase of other raw materials (Coutinho and Aquino, 2005).

Deretti (2022), when studying the 5S application in the inventory of a textile industry, with the objective of quantifying leftovers of sublimation paper (raw material), found that the philosophy also began in the Seiri sense (utilization), as the company's inventory was disorganized in the physical and computer aspect (inventory control). In this sense, when applying the philosophy, the author reaches an interesting conclusion, in which when considering calculations of some indicators, such as man-hour and machine-hour, the industry was losing 272 hours of production per year due to the lack of organization and rework to print new rolls of raw material. This waste accumulated about R$78,300.00 in additional cost to the company.

In addition to such economic cost, the leftovers and waste of raw materials also contributed to the delay of deliveries to customers and too many attempts to reduce costs

with alternative products. That is, due to the loss of competitiveness in the sector, the company sought new suppliers of dye and paper to reduce its production cost. In addition, the authors highlight the optimization of logistics movement within the inventory estimated at 5 minutes, compared to the 40 minutes estimated in the period prior to the 5S application. The decrease in labor in the inventory was also improved, as they were able to relocate employees to other areas in need, instead of concentrating them in the warehouse (Deretti, 2022).

FINAL CONSIDERATIONS

Thus, when analyzing the Japanese scenario during the exit from the economic crisis, given the industrial organization of the time, one can consider the implementation of industrial philosophies as a means of business evolution and operational efficiency. Regarding cost reduction, organization and systematization of jobs, it is possible to correlate them as a source of continuous improvement of processes, in addition to labor incentives for employees involved in the corporation.

The work covered throughout this document corroborates the idea that operational efficiency can be achieved in the midst of the challenge of implementing the 5S philosophy, specifically. And that, above all, the combination of other philosophies, such as "Just in Time" and total quality (SQT) can further optimize the production process. Since, according to the industry to be applied, the characteristics and specificities of the products change, generating the need to adapt such philosophies.

In general, it is possible to verify that the main indicator of the research addressed in this work was efficiency aimed at reducing costs, above all. Thus, in view of the non-exhaustion of all subjects involving the implementation of the 5S philosophy, as well as other Japanese industrial philosophies; it is essential to seek more applications of the tools in the industry, in order to contribute to the maximum reach of the degree of industrial awareness, making the continuity in the sector the main objective of the adherents, as occurred in Japan.

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