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Development of a conceptual model integrating management systems and the Shingo Model towards operational excellence

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To remain competitive in the marketplace, organizations are seeking the adoption of management models and tools that will allow them to find better and more effective practices to reinvent themselves, and continuously improve their business processes and product's quality in a sustainable way, hence pursuing the ultimate goal of reaching enterprise excellence. The purpose of this paper is to present a conceptual model that relates the requirements of the ISO Management System Standards with the dimensions and guiding principles of the Shingo Model for Operational Excellence. The proposed approach allows an organization with an existing management system based on one or more ISO Management System Standards to adopt and perform an assessment tool to evaluate its level of maturity regarding the adoption of the best practices and behaviours prescribed by the Shingo Model, which is a novelty contribution of this research. The validation of the proposed assessment tool took place in a Portuguese organization from the automotive sector, having comprised two moments: in the first one, an external assessor performed a set of behavioural observations that acted as a base to assign a score, while in the second moment such score was internally obtained through a survey that was filled by the organization's employees. The results reveal that these two methods converge to similar conclusions, hence confirming that the proposed model has the potential to enable an organization to assess the maturity level of its management system regarding the adoption of the guiding principles of the Shingo Model for Operational Excellence. A limitation of this research is that the model was only validated in a single company.

Keywords: Integrated management systems; Shingo Model; operational excellence; ISO 9001; continuous improvement; corporate social responsibility

Introduction

Having a certified management system is an important factor for the development of organizations and for the sustainability of their results and performance (Bernardo et al., 2015; Bravi et al., 2020; Teixeira et al., 2021). Among all the available Management System Standards (MSS), ISO 9001 for Quality Management Systems (QMS) is the widest-spread reference. Research from Chatzoglou et al. (2015) and Aba et al. (2015) provide strong evidence that the implementation of ISO 9000 is highly associated with improvements in the overall financial performance of a company. Zayas-Mateo and Martínez-

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Lorente (2021) concluded that certified industrial companies tend to achieve better outcomes than their non-certified counterparts, while Psomas et al. (2013) demonstrated that certified service companies tend to present greater product/service quality and operational performance compared with non-certified ones (Barbosa et al., 2018; Costa et al., 2019; Jiménez-Delgado et al., 2020).

In addition to the fact that the majority of the published literature does suggest that the benefits of ISO 9001 certification can last over long periods of time (Araújo et al., 2019; Sá et al., 2019). Cândido et al. (2016) found that even after decertification, organizations tend to exhibit sustainability in the performance of their business processes.

After years of strong and consecutive growth in the number of ISO 9001 certificates issued worldwide, data from the latest available ISO Survey (ISO, 2020) show a slight downward trend since 2014, especially in European countries. Ferreira and Cândido (2021), Mastrogiacono et al. (2021) and Kafel and Simon (2017) are amongst the researchers that explored the reasons behind ISO 9001 decertification. Certification sets the path for the achievement of Operational Excellence (Oakland, 2014) is related to the values and culture of an organization and is particularly relevant for those who aspire to grow and prevail in the face of competition (Correia et al., 2021; Doiro et al., 2019; Santos et al., 2021; Santos, Sá, et al., 2019; Zgodavova et al., 2020).

Many organizations have decided to develop and implement more than one management system in place. In addition to ISO 9001, there has been a proliferation of other MSS with different but complementary scopes (Bernardo et al., 2015; Samani et al., 2019), including ISO 14001 for Environmental Management Systems (EMS) and ISO 45001/OHSAS 18001 for Health and Safety Management Systems (H&SMS). Because opting for individual implementation of MSS will lead to a sub-optimization of each management system and to an excessive focus on the fulfilment of specific requirements (Carvalho et al., 2020; Rebelo et al., 2016), many organizations realized that it is a more effective and efficient approach to integrate the requirements of multiple MSS. The benefits, as well as the challenges of developing, implementing and maintaining an integrated management system (IMS), have been described by many authors, including Zeng et al. (2011), Simon et al. (2012), Santos et al. (2011) and Moumen and El Aoufir (2018).

According to Bernardo et al. (2015) and Barbosa et al. (2020), organizations that have their management systems fully integrated into a single and often certified management system can usually sustain their results and performance. Corporate sustainability is a dynamic concept that is impacted by specific environmental, economic and social aspects and priorities, which will continually change (Asif et al., 2011). An IMS usually comprises the economic (ISO 9001), environmental (ISO 14001) and social (ISO 45001 / OHSAS 18001 in terms of health & safety and/or ISO 26000 / SA 8000 for social accountability) pillars of sustainability (Borella & Borella, 2016). As underlined by Jørgensen et al. (2006), the continuous improvement of an IMS strongly depends on the development of a Lean infrastructure to meet the stakeholders' needs. However, many companies make mistakes in implementing Lean because they tend to focus on specific tools and techniques that are not well adapted to their organizational setting (Oakland, 2014; Plenert, 2019). The difference between successful and unsuccessful efforts actually relies on their ability to ingrain into its culture timeless and universal operational excellence principles rather than rely on the superficial implementation of tools and programs (Patel, 2016).

The Shingo Model is the most well-known and globally accepted framework used to guide the implementation of an operational excellence system (Carvalho et al., 2019).

This approach includes a well-established focus on the customer and Lean tools, but has extended this to include a set of guiding and supporting principles, corporate culture and wider enterprise systems, such as strategy planning and deployment, people lifecycle management, among others. Despite its international diffusion, very few studies or research are available in linking the Shingo Model with international MSS. This paper contributes to fill this gap.

Therefore, the aim of this paper is to present a model that integrates the requirements of the ISO MSS with the dimensions of the Shingo Model. In particular, a new tool that allows organizations to assess and quantify the maturity level of their management systems in adopting the best practices from an operational excellence point of view. The manuscript is organized around five sections: after an extensive review of the literature, the methodology adopted during the case study is described, being followed by the presentation and discussion of the obtained results. Finally, the conclusions of the paper are summarized.

Literature review

Integrated management systems

An IMS combines different but related components of a business into a single system for easier management. The most common IMSs comprise three management subsystems: Quality (QMS/ISO 9001), Environmental (EMS/ISO 14001) and Occupational Health & Safety (OHSMS/ISO 45001 and OHSAS 18001). IMS involving these three types of MSS have been generally used to enhance operational performance in manufacturing systems (Abisourour et al., 2020; Matias & Coelho, 2002; Rebelo et al., 2014a), to promote the value created by organizations (Deif & ElMaraghy, 2017; Gonçalves et al., 2019; Santos, Gomes, et al., 2019), and to support the role of the knowledge management process within the organizations (Gunasekaran & Ngai, 2007; Yang & Lu, 2015).

With the expansion of the global markets in recent decades, nations have become part of a process of globalization, which has increased industry competition (Alves & Alves, 2015). Due to competitive and societal pressures, many organizations have begun to develop strategies for addressing the ‘triple bottom line’ of their overall economic, environmental and social performance (Edgeman & Eskildsen, 2014; Rocha et al., 2007). This reality fostered the adoption of IMS, such as the ones dedicated to Quality (ISO 9001), Environment (ISO 14001) and Occupational Health & Safety (OHSAS 18001 and ISO 45001), which is a strategic decision of relevant importance for the competitiveness of an organization and to the sustainability of its results (Moumen & El Aoufir, 2018; Murmura et al., 2021; Rebelo et al., 2015).

The proliferation of national and international certifiable MSS that took place from the beginning of the century imposed a set of challenges for companies to effectively integrate them (Beckmerhagen et al., 2003; Bernardo et al., 2010; Santos et al., 2014). For this reason, in 2001 the International Organization for Standardization published the ISO Guide 72, a document to be used by the Technical Committees members when developing or reviewing all new international MSS (Karapetrovic, 2003). ISO Guide 72 defined a set of common elements for all MSS issued by ISO, thus providing a rational order for IMSs, based on the PDCA cycle (Başaran, 2017). In addition, some national standards organizations, including BSI from Great Britain and AFNOR from France published the PAS 99 and AC X 50-200, respectively, which are two specifications that provide guidelines and a common structure to facilitate the integration of different MSS. In 2012, ISO launched Annex SL with the intent to help organizations to achieve the benefits from integrating

the requirements of all international MSS into a common and single structure (Marques et al., 2016; Nunhes et al., 2019).

As various authors have pointed out, companies can benefit from specific advantages provided by a fully IMS, including a greater potential for innovation (Bernardo et al., 2018), an enhanced ability to control business and operational risks (Hernandez-Vivanco et al., 2018; Moumen & El Aoufir, 2018), less bureaucracy, costs and duplication of tasks (Rebelo et al., 2014b; Ribeiro et al., 2017; Santos et al., 2011; Zeng et al., 2007) and a better capacity to meet customer needs (Nunhes et al., 2019; Simon et al., 2012). Authors like Talapatra et al. (2019), Santos et al. (2014) and Zeng et al. (2011) provide an extensive literature review about the advantages as well as the constraints in integrating different MSS.

Some researchers studied IMS from various viewpoints, including the impact of certification on the performance of organizations. Hernandez-Vivanco et al. (2019) analysed the impact of adopting multiple certifications on firm performance, in particular all possible combinations encompassing the ISO 9001, ISO 14001 and OHSAS 18001/ISO 45001 standards, having concluded that ISO 9001 is the common factor in all combinations of certifications that leverage firm's performance. According to Bernardo et al. (2018) and Rebelo et al. (2016), the process of integrating multiple MSS can be divided into the following four domains: (a) integration strategy, (b) integration methodology, (c) integration level and (d) systems' auditing integration. The first domain corresponds to the scope and implementation sequence, having been addressed by authors like Karapetrovic (2003) and Rocha et al. (2007). The integration methodology refers to the methodology or tools used in the integration process, where frameworks such as those proposed by Asif et al. (2011) and Rebelo et al. (2014b) have been developed. The integration level is a domain that corresponds to the level of integration, and has been subject of research by Jørgensen et al. (2006), Santos et al. (2011) and Rebelo et al. (2016). The last domain, which was addressed by authors like Simon et al. (2011) and Rebelo et al. (2016), concerns the integration of both the internal and external audits that may result in certain benefits.

Lean

To achieve the outlined objectives and to sustain business growth, an organization needs to adopt a mindset that contemplates the maintenance of its activities and processes whilst continually improving them (Félix et al., 2019; Santos et al., 2020), where some risks may appear (Ferreira et al., 2019). One of the ways to aid this achievement is through Lean (Jiménez et al., 2019; Rodrigues et al., 2020) with the help of computer tools (Marinho et al., 2020; Santos, Mandado, et al., 2019).

The concept of Lean Management can be traced to the Toyota Production System (TPS), a manufacturing approach pioneered by the Japanese engineers Taiichi Ohno and Shigeo Shingo (Arnheiter & Maleyeff, 2005). The term 'Lean' was coined by John Krafcik (1988) and began to attract greater attention due to the influence of Womack et al. (1990), in the United States of America, through the publication of the book 'The Machine That Changed the World', which quickly became quite popular because it highlighted the discrepancy in success between other car manufacturers and Toyota, unveiling why it was so efficient. As such, the foundations of the Lean philosophy can be traced to one of the most popular production models developed by the Japanese – the Toyota Production System (TPS). This model supports the entire way of working and the results obtained by Toyota, so much so that in their publication Womack et al. (1990), define Lean through the following quote: '(...) *Compared to mass production it uses less of*

everything – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time.'

The overall objectives of Lean are to improve production methods, increase the efficiency, quality and speed of processes, eliminate waste and reduce costs (Rodrigues et al., 2019). The prevailing assertion within a substantial amount of the literature describes Lean as an approach in which the main objective of Lean is to systematically identify and eliminate waste in the organizational processes (Bhasin, 2015). One of the key points to achieve these goals is the concept of 'Value' from the customer viewpoint, since it concerns all activities that justify the attention, time and effort dedicated to them, helping to identify where waste exists and, at the same time, where the opportunities for improvement reside. The Lean toolbox is used to eliminate anything that does not add value to a process (Bhuiyan & Baghe, 2005). According to Womack and Jones (2003), 'Value' can be defined as the *'product's or service's capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer'*.

The success of the implementation and operation of Lean in an organization is dependent on the adhesion and involvement of employees as well as on the correct application of the tools at their disposal (Borris, 2006). Liker (2004) identified 14 principles for the success of any Lean program. They were clustered around four groups and the following two pillars: continuous improvement (kaizen) and respect for people. Kaizen, the first pillar, is defined as a culture of sustained improvement targeting the elimination of waste in all systems and processes of an organization (Bhuiyan & Baghe, 2005). The second pillar, respect for people, relies on respecting every single individual (Miller, 2018).

Many Lean tools can be applied depending on the panorama and the specific needs of the organization. When Lean philosophy is put into practice and tools employed in a structured way, organizations can achieve significant benefits with impact on their business results, as can be derived from the countless positive testimonies found in the literature. Through the research carried out for this paper, some successful case studies described in the available literature were selected for clarification and further analysis, regarding the business sectors where they were conducted. The following references were considered:

- Ribeiro et al. (2019): A reduction of 70% in the time spent on non-value-added tasks of an automotive production line, such as transportation during painting, waiting and unnecessary over-processing, was achieved. Tools like 5S's, visual management and SMED (Azevedo et al., 2019; McIntosh et al., 2000) were utilized. Altogether, these improvements allowed the organization to save 10.9% of the total investment planned, but also improvements on the employees' morale.
- Rodrigues et al. (2019) explored the advantages of implementing Lean to get quick-wins in terms of results. The authors describe the case of a small-medium enterprise (SME) from the metallurgical sector that obtained notorious results just 3 months after the implementation of a Lean program. The company was able to obtain a decrease of 27.9% in the costs of non-quality per hour, an increase of 5% in the machine occupancy rate, reduction of 10% in the hourly costs resulting from defective products. These advantages were also reflected in the motivation of the employees.

The search for published case studies illustrating successful implementations of Lean allowed us to ascertain that several gains can be obtained and translated into quantifiable benefits (e.g. cost avoidance, reduction of travel distances, a decrease of inventory levels, among others). Other types of benefits, including the improvement in the well-being, safety

and motivation of the employees, are sometimes also mentioned in the literature. Both types of gains are extremely relevant and important for organizations since they are likely to impact can affect their performance, although in different ways.

Nevertheless, it is also important to note that, in practice, not all attempts to implement Lean are so successful. This is due to the fact that some organizations exhibit a restrictive approach in eliminating waste by excessively focusing on the usage of tools, without considering the importance of systems and corporate culture to sustain results in the long run (Hines et al., 2020).

Management systems and lean

Lean was conceived as a total management system, not just for the manufacturing floor, so it needs to be a part of the company's QMS. Authors such as Sá et al. (2022), Salah and Rahim (2019), Marques et al. (2019), Marques et al. (2016) and Micklewright (2010) developed frameworks to take advantage of synergies between a QMS based on the ISO 9001 standard and a Lean management system.

Sá et al. (2022) developed a complete ISO 9001 interface model, where a set of Lean and Six Sigma tools are allocated to each of the 10 clauses of requirements of ISO 9001:2015. The authors also studied the degree of adoption of different tools by a set of surveyed companies. Marques et al. (2016) came up with a model that adopts the high-level structure provided by ISO Annex SL to take advantage of the existing linkages between the clauses of requirements of ISO 9001:2015 with the activities that usually take place in a Lean Six Sigma program. This model was further developed by Marques et al. (2019) that allocate a wide set of Lean and Six Sigma tools to each clause of requirements of the ISO 9001:2015 standard. Salah and Rahim (2019) presented a set of approaches to make use of Lean and Six Sigma tools to systematically improve and standardize organizational processes. According to Micklewright (2010), Management Systems (more specifically QMS based on ISO 9001) are complementary with the Lean tools, as long as developed knowledgeably and carefully, to result in gains for the organization. More than that, considering the current dynamics and challenges of the global markets, that are demanding and constantly changing, organizations must develop agile Management Systems capable of meeting the stipulated objectives. To achieve this, the operationalization of a Management System benefits from having Lean-based tools and methodologies aligned with the requirements of the standards (Sá et al., 2022).

In the Portuguese reality, studies such as those of Nogueira et al. (2018) and Sá et al. (2022) allow the understanding that although there may be some barriers within the organizations surpassing them is possible. One of the key success factors is the incorporation of Lean tools and methodologies in the overall Management System. Besides, it shows that to achieve a better and sustained performance, the application of tools, needs to have a purpose within the overall system.

The Shingo Model

Toyota Production System (TPS) was more than a simple production system, since it was developed as a company-wide management system (Miller, 2018; Sugimori et al., 1977). Whereas Taiichi Ohno's career remained with Toyota, Shigeo Shingo introduced these concepts to many other industries, not only in Japan, but also in the US and in Europe (Oakland, 2014; Rüttimann & Stöckli, 2016; Shingo, 2019).

Enterprise culture, which is the base for all involvement activities, is both a result and an enabler for sustainable and successful Lean operations (Bhamu & Sangwan, 2014). Culture is a collection of values, beliefs and behaviours held by an organization and the individuals within the organization (Plenert, 2019).

The Shingo Institute, an organization affiliated with the Utah State University, created the Shingo Model for enterprise excellence in 1993. The latest version of this model was updated at the beginning of 2020. It provides a set of guiding principles that supports the purpose and evidence of a culture (Plenert, 2019). The model emphasizes the behavioural and cultural part of organizations without forgetting the importance of integrating Lean philosophy, so that transformation and development can occur with the desired results (Shingo Institute, 2020). The related parameters correspond to:

- Guiding Principles – These refer to basic rules that ensure the understanding of the consequences of behaviour, allowing the decision making to be made in a more informed way. There are 10 guiding principles in the Shingo Model and they are organized around three dimensions, as depicted in Figure 1.
- Systems – These correspond to sets of processes, people or procedures that interact with each other, through the selection of tools that allow the implementation of the Guiding Principles;
- Tools – These refer to all the instruments that enable and assist the systems, allowing the intended results to be achieved;
- Results – The results obtained should mirror the Guiding Principles. As such, the ideal results will be all of those that classify as sustainable in the long term and that demonstrate constant improvements over time, originating from ideal behaviours.

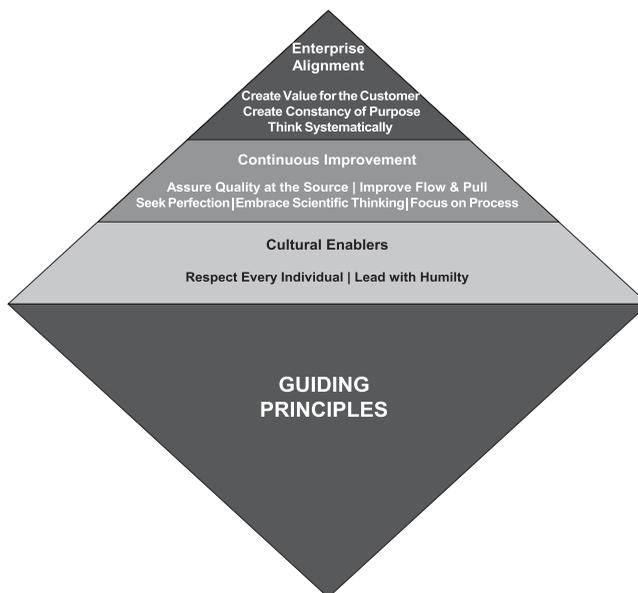


Figure 1. The guiding principles of the Shingo Model. (Source: Shingo Institute, 2020).

In Shingo's view, Excellence – the achievement of ideal results – is only valid when it is not temporary and when it is achieved through the combination of know-how and know why (Matos, 2015).

An award which assesses the level of transformation of organizations and recognizes their operational excellence, called The Shingo Prize, was created in 1988 (Edgeman, 2018). This assessment is carried out through a scoring system developed and perfected throughout the years by the Shingo Institute. Every component of each dimension is evaluated according to a scale, which considers the best description of the organization's current practices and their corresponding level of maturity. There are three levels. Level 1 means that the organization is mainly guided by tools, using some methods to solve sporadic problems. In Level 2, the organization is at an intermediate transformational phase where it already uses the tools in a structured and integrated way. Finally, the most advanced level of transformation corresponds to Level 3, in which the organization is guided by the Guiding Principles, incorporating them in their culture and in the way they work. These levels of maturity apply to each dimension or layer of the model depicted in Figure 1. It is important to emphasize that each layer can have different levels of maturity.

In general, the Shingo Model is perceived as a tool that can help organizations in the search for better results in all of its dimensions, as long as it is properly implemented (Edgeman, 2018). However, there are few research available in the literature and validated in real organizations, that describe the gains and the limitations associated with the implementation of the Shingo Model.

Research studies such as those described by Bravo-Sanchez et al. (2018) focus on the integration of Lean practices with the principles outlined by the Shingo Model. According to the authors, the advantages of the Shingo-Lean alliance lie in the fact that it fosters a much stronger collective alignment within the organization around the need of designing, developing, implementing and maintaining systems capable of driving an effective cultural transformation. The practical component of their research work took place in a healthcare company where the authors conceived and tested an Interprofessional Lean Facilitator Assessment Scale (ILFAS), a tool that helps to measure both technical and 'soft' skills levels of Lean facilitators, attributes that have a significant impact on the results of the improvement initiatives they coordinate, regarding indicators of quality, safety and reliability. Kelly and Hines (2019) provide a clear view of the direct effects resulting from the implementation of the Shingo Model in the long term. The case presented by the authors concerns a pharmaceutical company where the consolidated results were measured over a period of six years. The reported benefits include cost savings of more than 22 million Euros. Also, a reduction of the non-compliance rate by 77%, as well as the lead-time which decreased by 38%, and a decrease of 69% in the damaged inventory. The positive impact of the Shingo Model was also observed in the morale and attitude of employees, due to the focus on training and education that led to the internal promotion of 419 employees.

3. Methodology

The research methodology was divided into two stages. The first one comprised the idealization and development of the model focusing on the integration of the Shingo Model with MSS. To achieve this, a literature review was conducted to understand the state of the art on the subject, thus enabling the identification of gaps in the existing available research. Then, the specific MSS under the scope of this research were defined. The following

international MSS were considered for the model: ISO 9001:2015 (Quality Management System), ISO 14001:2015 (Environmental Management Systems) and ISO 45001:2018 (Occupational Health and Safety Management Systems). Due to the specific context of the country, a national Portuguese MSS was also included: NP 4469:2019 (Social Accountability Management Systems).

The second stage allowed us to develop the model itself, particularly in establishing a connection between the requirements contained in the mentioned MSS with the framework provided by the Shingo Model. A matrix format scoring system, derived from this integration model, was also proposed. The matrix can be used as an assessment tool, was designed to incorporate the following three parameters:

- MSS, namely the four international standards previously mentioned: ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 and NP 4469:2019;
- Lean tools, methods and concepts;
- The Shingo Model with its framework and guiding principles. One of the tools provided by this model is The Shingo Prize assessment that was used as a benchmark for the design, development and application of the matrix assessment tool herein proposed.

The proposed model is based on the assumption that all these parameters interact with each other, which means that it is not recommended to disassociate them and, as such, the effects of one parameter will have direct or indirect consequences on the others. Thereafter, the mentioned three areas ought to be regarded as part of an integrated and dynamic system, so one of the most important contributions of this research consisted of the analysis of the interaction between these different parameters. Regarding the first parameter, the four MSS referred above were analysed individually to determine which of their requirements are common and which of them are exclusive to any of the standards. From this analysis, it was concluded that regarding the specific scope of each standard, all the requirements could be related to each other. This analysis proved to be important in the sense that it allowed the confirmation that all MSS relate in a similar way with the Shingo Model, hence meaning that the weight considered for each Management System was the same.

The conceptual model was then tested in an organization from the automotive sector to be validated. The following three complementary assessment tools were incorporated into the model being tested in the host organization:

- A holistic preliminary qualitative assessment was carried out by an evaluator. This assessment approach contemplates behavioural observation of teams from different departments on their day-to-day activities.
- A quantitative assessment that consisted of a scoring system spreadsheet, filled out by an evaluator, who quantitatively ranks the observations gathered.
- A quantitative assessment approach uses a survey that is filled out by the employees.

The internship in the company where the model and its tools were tested took place at the Quality, Environment, Safety and Kaizen Department of a Portuguese corporation from the automotive sector. This company was chosen because its leaders expressed the desire to implement the Shingo Model in the future. At the beginning, it was struggling to assess its level of preparation to incorporate the Shingo Model principles and guidelines, given

the focus of the company is almost exclusively on the MSS that comprise the company's implemented IMSS.

The operational work of the research was performed by a master's student enrolling on a master thesis in this internship. She was a student of Graduation's Degree in Bio Resources. The work of the internship revolved around this study. Two evaluators with many years of experience in implementing management systems in companies as consultants were chosen. Both are also professors at the university. One of them is an external assessor and a Visiting Guest Lecturer (Executive MBA in Management) who also conducts research at the Research Centre in Industrial Engineering, Management and Sustainability. The other evaluator is a professor on the university staff, but with extensive experience in the implementation of management systems in a wide number of companies.

The first assessment is characterized for being highly subjective and dependent on the evaluator's point of view; nevertheless, it is a fundamental initial step to be able to perform the subsequent ones, since the whole model relies on behavioural judgments from the part of the evaluator.

Regarding the second assessment, the spreadsheet depicted in [Table 1](#) was developed considering the associations between the clauses of requirements described in the ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 standards and the principles contained in the dimensions or levels of the Shingo Model. This allowed us to match the clauses of requirements of the MSS with the correspondent dimensions of the Shingo Model. Although the requirements of these standards were not always designated in the same way (regulatory requirements described on [Table 1](#)), they are all related to each other, safeguarding the specific scope of each one.

The scores for each dimension are assigned by an evaluator and recorded in the spreadsheet. If the organization shows clear evidence in complying well with the evaluated dimension, the assigned score for that dimension is 17.24 points; on the other hand, if there are none or even few evidences regarding such compliance, than the assigned score is zero points. The maximum total score for the overall grid was 1000 points, allowing an easy comparison to already the existing Excellence models.

The third assessment conducted during the internship consisted of a survey comprising 15 closed questions, as depicted in [Table 2](#) and [Figure 2](#). With the intent of covering all departments of the company, a Google Forms survey was sent by e-mail to all the 165 employees of the company, hence comprising its whole set of areas. From the overall responses received, only 80 of them were considered valid, which represents a rate of 48.48%. This is considered the sample for our research.

Results and analysis

Through behavioural observations, the 'results' dimension (also referred to as dimension 4) was highlighted as a strength aspect, since the organization showed evidence of keeping track of business, management and operational performance indicators, considering the opinion of the employees. Similarly, the 'cultural enablers' dimension (also known as dimension 1) was also pinpointed as a strong point due to the clear sense of corporate values and culture that was shared throughout the organization by the employees, in every sort of activity.

On the other hand, the two other dimensions seemed to require further attention. Regarding dimension 2 – 'continuous improvement' – it showed signs of a dichotomy regarding team profiles from different departments. Some of them seemed comfortable

Table 1. Spreadsheet and corresponding scores.

	Dimensions				Maximum score
	Dimension 1	Dimension 2	Dimension 3	Dimension 4	
Regulatory requirements					
Understanding the organization and its context	x		x		34.48
Understanding the needs and expectations of the stakeholders	x	x		x	51.72
Determine the scope of the management system	x				17.24
Management system	x	x	x		51.72
Leadership and commitment	x	x	x	x	68.96
Policy	x		x		34.48
Organizational roles, responsibilities and authorities	x		x		34.48
Actions to address risks and opportunities	x	x	x		51.72
Objectives of the management system and planning to achieve them	x	x	x		51.72
Resources	x	x			34.48
Skills	x			x	34.48
Awareness	x	x	x		51.72
Communication	x	x	x		51.72
Documented information	x	x	x	x	68.96
Operational planning and control		x		x	34.48
Emergency preparedness and response	x	x	x	x	68.96
Monitoring, measurement, analysis and evaluation		x		x	34.48
Internal audit	x	x		x	51.72
Management review	x	x	x	x	68.96
Non-compliance and corrective actions		x		x	34.48
Continuous improvement	x	x	x	x	68.96
				Total	1000

and knowledgeable when using Lean tools, while and others showed signs of not understanding the – how or the why of employing such tools. The evaluation of the ‘enterprise alignment’ dimension (dimension 3) also showed a lack of a unified and coherent approach with some redundancy associated, especially when it comes to documented information.

Based on the described observations, the spreadsheet was filled out and the corresponding scores were assigned that are available in [Table 3](#).

The overall obtained score was 732.26 points (out of 1000). The scoring results for the four assessed dimensions showed greater maturity levels on the ‘cultural enablers’ and ‘results’ dimensions. The mean value associated with each dimension was calculated, allowing the construction of a radar chart on [Figure 3](#).

Table 2. Survey questions.

1	1.1	The organization invests in initiatives that promote training and awareness regarding environmental questions.
	1.2	The set of values that guide the organization's actions are communicated and comprehended on all levels of the enterprise.
	1.3	I have access to tools and systems that help and instruct me on how to maintain my workspace clean, ergonomic and safe.
2	2.1	There is committed attitude on delivery but also flexibility to eventual alterations, when it comes to the relationship with the customer.
	2.2	The organization invests in the exploration of its current activity but also in the development of new markets of interest.
	2.3	There is a clear relationship between the organization and its suppliers, with the main goal of establishing methods and practices capable of creating value.
	2.4	The administrative departments are well aligned and integrated, providing support for the value stream of the organization.
	2.5	I regularly use tools like SMED, 5Ss, Poka Yoke, A3 Thinking, Quick Change-Over, Visual Management and Value Stream Mapping.
	2.6	When possible, the solutions are presented in a visual form in order to ease the understanding.
3	3.1	The elimination of activities that do not add value, as well as the existence of a continuous workflow, are common characteristics to every level of activity within the organization.
	3.2	I utilize scientific thinking daily, which helps me to find counter measures instead of definitive solutions.
4	4.1	The client's satisfaction and the product/service quality are regularly checked and monitored.
	4.2	The time that a product/service takes between the supplier and customer is a regularly checked parameter.
	4.3	As a worker, I do not feel as if the cost reductions impact the stability, standardization and quality of the work.
	4.4	The client's satisfaction is used as a competitive advantage by the organization.

Figure 3 provides a good understanding that the tendency associated with the four dimensions is not balanced. On the contrary of dimensions 1 and 4, dimensions 2 and 3 are less developed by the organization, especially dimension 2 being the one to present a smaller inclination.

After the spreadsheet assessment, the results of the validated surveys were analysed. Cronbach's alpha is most commonly used to assess the internal consistency of a questionnaire that is made up of multiple Likert-type scales and items. Hence, taking into consideration the obtained scores, the mean value for each question, dimension and whole questionnaire was calculated, together with the standard deviation for each question to ascertain the uniformity of the results. In addition, a Cronbach's alpha test was determined (using the IBM SPSS software) to evaluate the internal consistency and reliability of the survey.

Since the questions already had staggered answers using the Likert's scale, the analysis was carried out and their results are represented on Table 4.

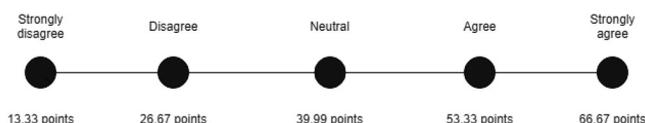


Figure 2. Closed answers for each question and their respective score.

Table 3. Spreadsheet with the performed assessment.

Regulatory requirements	Dimension 1	Dimension 2	Dimension 3	Dimension 4	Maximum score
Understanding the organization and its context	17.24		17.24		34.48
Understanding the needs and expectations of the stakeholders	17.24	17.24		17.24	51.72
Determine the scope of the management system	17.24				17.24
Management system	17.24	0	17.24		34.48
Leadership and commitment	17.24	17.24	0	17.24	51.72
Policy	17.24		0		17.24
Organizational roles, responsibilities and authorities	17.24		17.24		34.48
Actions to address risks and opportunities	17.24	0	0		17.24
Objectives of the management system and planning to achieve them	17.24	0	0		17.24
Resources	17.24	0			17.24
Skills	0			17.24	17.24
Awareness	17.24	0	0		17.24
Communication	17.24	0	17.24		34.48
Documented information	17.24	17.24	17.24	17.24	68.96
Operational planning and control		17.24		17.24	34.48
Emergency preparedness and response	17.24	0	0	0	17.24
Monitoring, measurement, analysis and evaluation		17.24		17.24	34.48
Internal audit	17.24	17.24		17.24	51.72
Management review	17.24	17.24	17.24	17.24	68.96
Non-compliance and corrective actions		17.24		17.24	34.48
Continuous improvement	17.24	0	17.24	17.24	51.72
				Total	724.08

The obtained value for Cronbach’s alpha is 0.988. Despite the fact that a strong correlation between all the items is sometimes, not an advantage, it is possible to state, according to George and Mallery (2003), that the internal consistency of the survey is good. The correlations between questions were analysed (Table 5).

Table 4. Cronbach’s alpha value was obtained through the IBM SPSS software.

Cronbach’s alpha	Number of items
0.988	15

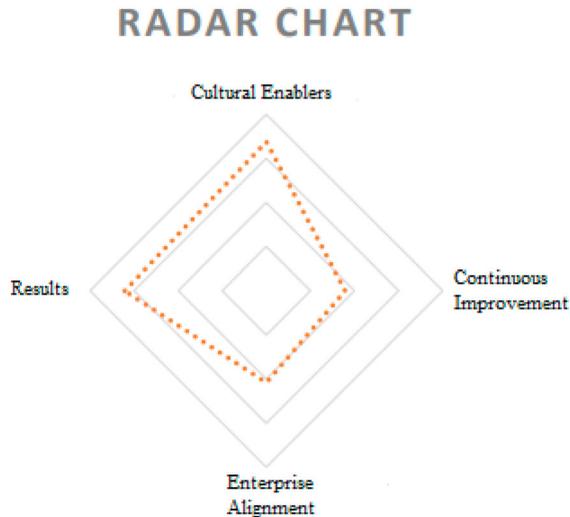


Figure 3. Radar chart with the organization's inclination, accordingly to the assessment results.

The Cronbach's alpha mean value for the correlation between questions is 0.869, which corroborates the high internal consistency of the survey, together with its reliability.

The results for the mean value and standard deviation of the questions included in section 1 – associated to the 'cultural enablers' dimension – are presented in Table 6. Since the maximum score for this section is 200 points and the obtained score is 160.32, this means that a rate of 80% of the employees has a positive perception of the organization in the scope of these questions.

By its turn, the results for Section 2 of the survey, concerning Continuous Improvement and Lean Tools are available in Table 7. In this particular case, the resulting score was 301.64 points out of 400, which translates into a rate of compatibility of 75%. Although it is not a bad score, it is however lower than the previous one, thus indicating that the perception of the employees in issues related to this scope is not so well aligned. It is also important to highlight that the question with the lowest score was question 2.5 ('I regularly use tools like SMED, 5Ss, Poka Yoke, A3 Thinking, Quick Change-Over, Visual Management and Value Stream Mapping') with 38.83 points, hence with only 36.5% of the employees showing any level of concordance with the sentence.

The results for the 'Enterprise Alignment' dimension are displayed in Table 8. The total score of 99.49 points, once again reveals a 75% rate of compatibility, with a maximum score of 133 points. It is interesting to notice that the answers received for question 3.1, which focuses on a generalized analytical guidance, are considerably lower when compared to the ones obtained received for question 3.2 that appeals to wider criteria for self-assessment.

Lastly, the score for dimension or Section 4 was 206.83 points, which translates into a 77% rate of compatibility when compared to the 267 possible points. This was the section with the highest score on a question (4.4 – The client's satisfaction is used as a competitive advantage by the organization) but it also had lower scores on the remaining questions if compared to other sections (Table 9).

After analysing the specific results regarding each section of the survey, we took a close look at the overall results. Attending to the values obtained of the standard deviation,

Table 5. Correlation matrix between questions, obtained through the Cronbach's alpha test.

	α 1.1	α 1.2	α 1.3	α 2.1	α 2.2	α 2.3	α 2.4	α 2.5	α 2.6	α 3.1	α 3.2	α 4.1	α 4.2	α 4.3	α 4.4
Q 1.1	1.000	0.968	0.889	0.932	0.890	0.941	0.895	0.756	0.886	0.845	0.850	0.863	0.825	0.805	0.831
Q 1.2	0.968	1.000	0.916	0.942	0.915	0.969	0.912	0.770	0.877	0.841	0.878	0.889	0.848	0.815	0.848
Q 1.3	0.889	0.916	1.000	0.908	0.926	0.883	0.881	0.864	0.860	0.852	0.898	0.956	0.841	0.861	0.889
Q 2.1	0.932	0.942	0.908	1.000	0.916	0.946	0.899	0.824	0.875	0.835	0.895	0.884	0.833	0.865	0.802
Q 2.2	0.890	0.915	0.926	0.916	1.000	0.939	0.853	0.848	0.853	0.829	0.927	0.906	0.819	0.853	0.822
Q 2.3	0.941	0.969	0.883	0.946	0.939	1.000	0.871	0.804	0.867	0.826	0.892	0.865	0.824	0.840	0.797
Q 2.4	0.895	0.912	0.881	0.899	0.853	0.871	1.000	0.820	0.934	0.852	0.891	0.899	0.891	0.867	0.815
Q 2.5	0.756	0.770	0.864	0.824	0.848	0.804	0.820	1.000	0.882	0.868	0.872	0.888	0.849	0.908	0.773
Q 2.6	0.886	0.877	0.860	0.875	0.853	0.867	0.934	0.882	1.000	0.892	0.876	0.871	0.912	0.907	0.810
Q 3.1	0.845	0.841	0.852	0.835	0.829	0.826	0.852	0.868	0.892	1.000	0.838	0.856	0.915	0.913	0.851
Q 3.2	0.850	0.878	0.898	0.895	0.927	0.892	0.891	0.872	0.876	0.838	1.000	0.921	0.843	0.860	0.839
Q 4.1	0.863	0.889	0.956	0.884	0.906	0.865	0.899	0.888	0.871	0.856	0.921	1.000	0.853	0.850	0.892
Q 4.2	0.825	0.848	0.841	0.833	0.819	0.824	0.891	0.849	0.912	0.915	0.843	0.853	1.000	0.924	0.838
Q 4.3	0.805	0.815	0.861	0.865	0.853	0.840	0.867	0.908	0.907	0.913	0.860	0.850	0.924	1.000	0.786
Q 4.4	0.831	0.848	0.889	0.802	0.822	0.797	0.815	0.773	0.810	0.851	0.839	0.892	0.838	0.786	1.000

Table 6. Obtained score for Section 1 of the survey – cultural enablers.

Question	Cultural enablers		
	Question 1.1	Question 1.2	Question 1.3
Mean value	52.83	53.16	54.33
Standard deviation	11.82	11.45	11.89
Total points		160.32	

Table 7. Obtained score for Section 2 of the survey – continuous improvement.

Question	Continuous improvement					
	Question 2.1	Question 2.2	Question 2.3	Question 2.4	Question 2.5	Question 2.6
Mean value	53.33	54.66	54.16	51.16	38.83	49.5
Standard deviation	9.89	9.57	9.03	11.25	16.36	12.33
Total points			301.64			

Table 8. Obtained score for Section 3 of the survey – enterprise alignment.

Question	Enterprise alignment	
	Question 3.1	Question 3.2
Mean value	46.33	53.16
Standard deviation	12.11	11.06
Total points		99.49

Table 9. Obtained score for Section 4 of the survey – results.

Question	Results			
	Question 4.1	Question 4.2	Question 4.3	Question 4.4
Mean value	54.00	48.10	47.16	57.17
Standard deviation	12.46	11.60	12.99	10.37
Total points		206.83		

the answers reveal that the highest variability occurred on questions 2.5. On the other hand, the answers for questions 2.2 and 2.3 show the greatest signs of homogeneity. All of the information gathered shows that, from the employees' point of view, the organization is not yet at a high level of maturity in terms of Excellence, but the assessment results clearly show that many of the practices from the Lean philosophy are already well rooted into the actions and mindset of the people, hence demonstrating some structure on the continuous improvement approach which is reflected on solid development on key areas.

Together with the survey results, a radar chart was built to exhibit the tendency of the organization regarding each dimension. In [Figure 4](#), it is possible to confirm that both

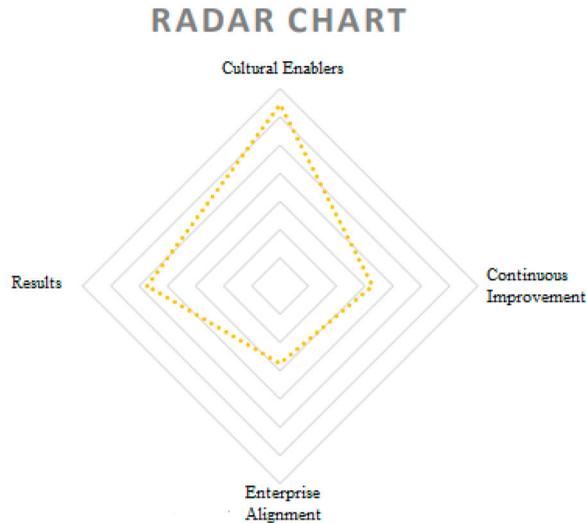


Figure 4. Radar chart with the organization’s inclination, accordingly to the survey results.

‘cultural enablers’ and ‘results’ dimensions are perceived as being stronger and positive when compared to the ‘continuous improvement’ and ‘enterprise alignment’ sections.

The overall score of the survey was 768.28 points out of 1000, corresponding to a 77% success rate on the journey to Excellence. When compared to the score that was determined by the external analysis, in the form of behavioural observations followed by the assignment of punctuation recorded on a spreadsheet, we see that the percentual difference is just 3.6%, which is not significant. It means that the external perception of the evaluator goes hand in hand with the internal perception from the employees.

Figure 5 presents a conceptual model for integrating MSS, including ISO 9001 for Quality Management Systems, ISO 14001 for Environmental Management Systems, ISO 45001 for Occupational Health and Safety Management Systems and ISO 26000 for Social Accountability Systems according to ISO 26000, with the Shingo Model for Operational Excellence. Other ISO MSS can be added to this model.

A model was developed and the study shows that it is possible to use it. It is useful in the sense that it provides tools for assessing behaviours (i.e. corporate culture) and whether they are aligned with the principles and best practices on an IMS. As a consequence, it has the



Figure 5. A conceptual model integrating management systems and the Shingo Model towards operational excellence.

potential to lead better organization at various levels of the company. It aligns continuous improvement and Lean tools contained in the Shingo model, with the main standards usually adopted in the context of IMSs, which is a contribution to enhance the ability of designed organizational systems to seek the achievement of the best results for the organization.

Discussion

The results from the application of the development of this conceptual model and its assessment tools proposed in this paper, together with its further validation, show that creating a framework that integrates aspects from MSS with the guidelines from the Shingo Model can be useful for organizations to evolve in their level of maturity regarding the adoption of behaviours and practices in accordance with best principles of Operational Excellence.

It also fills a gap in the current literature because it identifies and explores synergies between subjects that have not been yet the scope of any other research in a systematic way. By creating this model and its assessment tools, this paper contributes to providing solutions to organizations that allow them to improve their Management Systems towards recognized best practices that are encouraged by Excellence models, including the Shingo Model. Furthermore, it accommodates well qualitative and subjective issues, like behaviours, by translating them into quantifiable parameters.

Complementing an external analysis conducted by an external and independent evaluator with an internal assessment using a survey answered by the employees, allows managers to have a holistic and clearer vision about the company's baseline, hence minimizing the risk of misjudging due to partiality.

As it rests upon behavioural foundations as well as in the clauses of requirements from MSS, it can be applied to any sort of organization, regardless its business or size, thus providing a complete framework that can be used by enterprises seeking to adopt organizational models that help them to achieve competitive advantages in the global markets, whilst providing guidelines for their continuous improvement efforts.

Conclusions

The main contribution of this work was the creation of a model and a set of assessment tools that organizations can use to quantitatively evaluate their maturity in effectively incorporating the best Lean and Operational Excellence practices in their IMSs.

The results obtained through the assessment methods demonstrated that the external perception from an evaluator, based on the observation and analysis of behaviours met the internal perception of the employees, mirrored by their survey responses. Although both scores obtained (732.26 points for the external evaluation system and 768.28 points for the survey) place the organization on a favourable level of maturity, hence demonstrating that there is already evidence of good Lean practices and that the company's culture and values are thematic targets, it suggests that there is still room for improvement, to reach the maximum level of organizational excellence. Likewise, it was found that in both assessment methods, the areas associated with the systematic adoption of Lean tools and with the adoption of effective systems capable to ensure an effective deployment of the corporate strategy, were identified as those dimensions that need more attention and development in the future.

Even though the validation took place in a single company from the automotive industry, since the proposed model was designed as a universal framework, it is expected that it

will enable its applicability in organizations from other sectors in a similar effective manner.

Nevertheless, its application must be accompanied by specialized personnel who understand the objectives and the reasoning behind the model itself, being also able to evaluate and properly follow-up the results and conclusions obtained.

Future research could benefit through the achievement of a more in-depth study that considers the impact of the model and of its results and how the communication of these results can impact the perception and attitude of the employees. It is also proposed that the analysis can be carried out in several sites of the organizations, so that the results can be compared with each other. Such option will possibly encourage the sharing of knowledge and good practices within the organization itself, fostering the conjoint spirit of continuous improvement.

In addition, it is concluded that the objectives outlined were successfully met. The ideas described in this work may serve as guidelines not only for the practical implementation of the model in organizations but also for the development of other methodologies that use Lean tools, management systems and Excellence Models.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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