

LEAN INTEGRATED MANAGEMENT SYSTEM: A MODEL FOR SUSTAINABILITY IMPROVEMENT

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Abstract

This paper presents an innovative model to improve corporate sustainability via the integration of Quality, Environment, Social Responsibility and Occupational Health and Safety Management Systems with the Lean Manufacturing System; this may help organizations to improve corporate sustainability in a structured manner. This research introduces the Lean-Integrated Management System for Sustainability Improvement - LIMSSI, which is based on the rational use of resources and energy, while engaging and empowering people. It was structured considering the difficulties of organizations in performing sustainability-improvement activities, avoiding loss of organizational efficiency due to waste, duplication, and increments of bureaucratic processes, to generate synergies. The LIMSSI may improve corporate sustainability performance, rendering companies more sustainable and competitive.

Keywords:

sustainability, integrated management system, lean manufacturing, sustainable development.

1 INTRODUCTION

Nearly 30 years after the emergence of the term sustainable development [1], development is still measured with economic indicators, such as increased production or exploitation of natural resources. Georgescu-Roegen hypothesizes that economic growth based on the steady increase in the gross domestic product (GDP) is not sustainable by the global ecosystem; however, development policies are still based on the belief of inexhaustible natural resources and on the possibility of perpetual GDP growth [2]. More than 40 years after of the first warnings about the unsustainability of the production and consumption model, and the conclusion of a future of imbalance and total collapse of planet Earth [3], such problems and threats remain.

Stakeholders and the society have been increasingly pressing companies to address ecological and social sustainability [4]; more and more, organizations seek corporate sustainability (CS) for the development of competitive advantage [5]. There is unprecedented demand for sustainability, and the implementation of management systems (MS) and lean manufacturing systems (LMS) is trending; however, organizations have faced difficulties in managing them and their respective tools, mainly in the integration between such systems [6]. For some authors, the integrated management system (IMS) can conduct companies to sustained success [7]; however, companies still face remarkable difficulties in operating multiple MS simultaneously [8]. Instruments to implement strategies and manage CS are still rare [9]; the IMS may provide foundation to corporate social responsibility (CSR), nevertheless the current literature on the integration of CSR into business processes remains limited and requires further research discussed in practice [10].

Although MS improve products and processes, they are not sufficient for competitive-advantage development considering the new stakeholder and society demands. Thus, organizations have been implementing LMS to fill the gaps of MS [6]. Since 2009, Sustainability and LMS have been attracting ever-increasing interest. The literature presents a significant gap regarding research on social sustainability and LMS [11], IMS and sustainability, methods, and guidelines for IMS based on empirical evidence, and IMS and social responsibility (SR) [12].

Responding to demands from the scientific community and practitioners, we present a management model for the improvement of CS, based on the integration of the IMS (Quality, Environment, Occupational Health and Safety (OHS), and SR) with the LMS.

2 LITERATURE REVIEW AND BACKGROUND

2.1 Sustainability

CS is defined as “meeting the needs of a firm's direct and indirect stakeholders [...], without compromising its ability to meet the needs of future stakeholders as well”. This task is complex and demands for new CS-management approaches [13].

Sustainability is perceived as the 21st-century business paradigm, and the concept was translated to corporate context via the triple bottom line (TBL) framework. Nevertheless, TBL remains an abstract concept difficult to put in practice [14].

Existing literature on CSR integration into business processes is limited and its practical application requires further research [10], however, companies at growth stage in CSR have more certified MS; therefore, the IMS can provide foundation to CSR.

2.2 Management Systems

Organizations often face intense competitiveness, constant technological progress, new consumer requirements, and scarce natural resources [15]. There has been an increase in consumer demands, which presently relate to not only quality but also the environment, OHS, and sustainability [16].

Responding to stakeholder needs and expectations, and considering internal and external organizational context, organizations are implementing standardized MS [17]. Organizations still struggle with MS-implementation activities, mainly with the integration between the MS [6]. Main difficulties are the complexity of internal management, low efficiency, and increased management-structure costs [18].

When an organization has multiple MS the best practice is to merge different MS into a single and more effective IMS, since as it improves performance including the financial component [19], elimination of conflicts between individual MS with optimization of human, technological and financial

resources. Less internal and external audits, creation of added value for the business by eliminating organizational waste [17], improves efficiency through cost reduction, better internal organization and capitalizes on the synergies between the integrated MS [15].

2.3 Quality Management System

Continuous performance improvement and excellence are demanded from organizations, thus leading to the emergence of Quality Management System (QMS); QMS is vital for economic development because of its strategic benefits and strong quality–productivity correlation [20].

Organizations adopt ISO 9001 for performance enhancement, customer satisfaction, and improved supplier–customer relationships [21]. QMS promote continuous process and procedural improvements to achieve excellence, efficiency, sustainability, and competitiveness [8]. CS integration into strategic management requires consideration of QM, because it fosters the product quality, it has an impact beyond the immediate production level, and is correlated with stakeholder satisfaction [22].

2.4 Environmental Management System

The ISO 14001 is the environmental management system (EMS) standard most applied worldwide and uses a set of interrelated elements to develop and implement its environmental policy and manage its environmental aspects with balance between environmental protection and pollution prevention with socioeconomic needs [23]. EMS benefits are both environment and company-performance oriented [24]. Advanced environmental management can improve financial performance, manufacturing competitiveness, promote cost reductions, quality improvements, and generation of new products and processes [25].

ISO 14001 guides companies toward green production, requiring them to systematically manage their environmental responsibilities and impacts, thus reflecting in improvements in the environmental pillar of sustainability and consequently in CSR [23].

2.5 Social Responsibility

SR in the business context is commonly called CSR; CSR firms take corporate social actions to meet ethical stakeholder expectations via managerial activities, to advance a social good beyond law requirements on behalf of stakeholders [26]. Emphasis on CSR study and practice has helped streamline and improve corporate practices; however, incidents of unethical corporate behavior still occur. For meaningful impact, CSR must be built into every corporation level and must be seen as an organizational imperative [10].

CSR can foster competitive advantage by improving reputation and image, retention of exceptional people, employee motivation, aggregate value, environmental and social performance, and corporate governance [27]. It is important to find strategies that address CSR issues and integrate them into company operations. ISO 26000 advises on several CSR subjects and issues to assist in internal and external assessments, thus improving sustainability performance, as it provides basis for companies that have not dealt with CSR before [28].

2.6 OHS Management System

The OHSAS 18001 framework was developed in “response to customer demand for a recognizable OHSMS standard against which their MS can be assessed and certified” [29]. The OHSAS 18001 aims to support and promote good practices in OHS via systematic and structured MS [30] by mitigating accident risks and

protecting persons exposed to OHS risks associated with its activities [8].

OHSAS 18001 improves working conditions and management practices, internal safety communication and ensures compliance with legislation; reported drawbacks are certification costs, lack of employee motivation, difficulties in changing company culture, and increased bureaucracy [8].

2.7 Lean Manufacturing System

LMS seeks to implement a mindset that eliminates the seven waste types: overproduction, waiting, transportation, defects, inappropriate processing, unnecessary inventory, and unnecessary motion. This is achieved through continuous improvement of processes, focusing on customer satisfaction to increase efficiency, reduce costs, and contribute to improved quality, greater profitability, and enhanced public image [31].

Tools and techniques of LM (i.e., just-in-time (JIT), Total Productive Maintenance (TPM), pull production, cellular manufacturing, 5S/7S, Kaizen, Visual Control, Poka Yoke, and Value Stream Mapping (VSM)) can facilitate achieving sustainability [32]. VSM, particularly, is an important value-mapping method for comprehending the activity sequences and information flows used in product manufacturing and service delivery [33].

Companies that have adopted LM to improve their results also want to be seen as socially responsible. Sustainability is considered the new LM frontier, thus necessitating the investigation of LM impact on the three sustainability dimensions (environmental, economic and social) [11].

3 MATERIAL AND METHODS

Through bibliographic research, we identified gaps and research problems to propose a management model for CS improvement, based on the integration of QMS, EMS, OHSMS, and SRMS with LMS.

Based on the state of the art from the bibliographic review, together with the empirical knowledge of the researchers, with a 15-year experience in the themes addressed, we developed the initial structuring of the proposed model. To perform a critical analysis to verify feasibility, identify possible problems, and refine the model, an Action Research (AR) approach was chosen for this phase.

The AR was performed in cycles, comprising [34] [35]

- 1) a pre-stage to understand context and purpose;
- 2) six main steps to collect, feed, and analyze data, and to plan, implement, and evaluate actions;
- 3) a meta-step for monitoring that focuses on collecting data for academic research.

During AR execution, we analyzed organizational and research aspects, to confront them with the literature to generate the research conclusions.

4 THE PROPOSED MODEL

We searched for CS management models at strategic, tactical, and operational levels. We identified the lack of a sustainability management model that describes how organizations should manage sustainability to develop competitive advantage and value to society and stakeholders. Therefore, we developed an MS model that integrates QMS, EMS, OHSMS, and SRMS to the LMS to continuously improve CS performance.

4.1 Criteria for structuring the proposed model

The proposed model aims to address the economic, environmental and social sustainability dimensions, we considered the renewed MS, based on international standards:

- ISO 9001 - Quality management systems focusing on customer satisfaction;
- ISO 14001 - Environmental management systems focusing on environmental performance enhancement;
- ISO 26000 - Guidance on SR, focusing on integrating, implementing, and promoting socially responsible behavior throughout the organization; and
- OHSAS 18001 - OHS management systems, aiming to achieve the best possible working conditions, occupational health and safety.

In our literature search, no sustainability management systems were found integrating ISO 9001, ISO 14001, ISO 26000, OHSAS 18001, and LM; the proposed model has an innovative characteristic.

The model is intended to be generic, regardless if the organization has one or more MS of the model; it was structured to be applicable in organizations of any size, type, and sector. Figure 1 provide an illustration of the LIMSSI model.

To define the steps, the author considered the G4 sustainability reporting principles of the GRI [36] the VSM method proposed by ROTHER and SHOOK [37], the MS principles stated in ISO 9001 [21], ISO 14001 [25], ISO 26000 [38], and OHSAS 18001 [30], the Annex SL [39], and the empirical knowledge obtained through participation in projects and audits since 1999.

4.2 Criteria for integration of the proposed model for synergy generation

The proposed model was designed to integrate the QMS, EMS, SRMS, OHSMS, and LM. The integration aims to generate synergies to extend the benefits of each system, and to promote the rational use of resources to conduct the activities of the systems, pursuing cost reduction, reducing overlapping of tasks and rational use of resources and time. In addition, it seeks to make the organization economically profitable, ecologically correct, operationally safe, socially fair, and culturally accepted.

Thus, the promotion of lean thinking was used to improve operational and environmental performance through pollution cost reduction, environmental improvements, and efficient use of energy and resources.

The proposed model incorporated the LM principle on the importance of people (incorporating suggestions, respect for people and their recognition) to generate synergies with the social dimension. It also incorporates the transition from the 5S to 7S and kaizens, addressing sustainability, environmental hazards, risks and OHS, seeking to reduce OHS incidents by improvements in housekeeping, ergonomics and material handling.

4.3 LIMSSI implementation

The model was applied as an AR in an organization; this enabled its critical analysis. The critical analysis was performed by representatives of the strategic, tactical and operational levels of the organization and the researcher. The LIMSSI had its feasibility of application confirmed by all participants, with no occurrences of problems that impeded the application of the model.

The strategic level representative pointed out that one of the strengths of the LIMSSI model, was the fact that the model provides a constant search for legal compliance, which reinforces the basis of Social Responsibility and contributes to reduce the risks of negative impacts to the economic dimension, resulting from fines, embargoes and sanctions.

In the beginning of this study, another organization started the implementation of LIMSSI, but stopped due to

resistance to the implementation of the model processes, this organization, has recently been fined for involvement in bribery cases in its international operations and will have to pay a fine of more than US\$ 206 million.

The representative of the tactical level noted that LIMSSI is comprehensive and highlighted as strengths of the model: the integration between IMS and LMS, the focus on meeting legal requirements and focus on waste reduction. But considered that the needs of investment, guidelines and corporate definitions can be potential difficulties for the implementation of the model.

Representatives of the operational level emphasized that the model has its implementation facilitated by allowing that simple improvements, have a great impact for the organization. They also pointed as strength that the model to bring to the light important subjects like: ergonomics and reuse of materials and resources. They positively emphasized the fact that the model deals with all aspects of the organization and privileges the use of real data instead of forecasts. They reported as major contributions the immediate effect of reducing inventories and promoting the vision of the whole of the Value Stream for the employees and considered as potential difficulties the need for cultural change of the organization and the break of paradigms of the shop floor.

It was identified that the LIMSSI can contribute to sustainability, covering the economic, environmental and social pillars in order to change the organization's view that seeking sustainability improvements is an activity of generating value and can contribute to the organization's competitive advantage.

The critical analysis enabled further refinement, which resulted in the final model of the LIMSSI.

Next, the steps for the LIMSSI implementation are described.

Step 1—Identification of stakeholders

First, the organization should identify individuals or entities that may be significantly affected by its activities, products, and services. For each group of stakeholders, their expectations and interests should be identified to provide the organization with a broad view of their interrelationships, and to measure how it affects and is affected by the environmental, social, and economic environment in which it operates.

Step 2—Critical Analysis of Legal Compliance

The organization must identify and meet all legal, statutory, and other requirements to which it has subscribed. Knowing the stakeholders and the operational environment enables to implement the process of anticipating and preparing for new or modified requirements, to maintain ongoing compliance with applicable legal and other requirements. Therefore, the organization must maintain an up-to-date base of applicable requirements, principles or other economic, environmental, and social initiatives that the organization endorses or subscribes to, and a description of how to address them.

Step 3—LIMSSI Policy

Considering the stakeholders, applicable requirements and laws, and operational environment of the organization, the LIMSSI policy should be established as a statement of the principal decision maker to direct the organization towards sustainability improvement. Possible conflicts between MS functions should be approached in order to find a balance point, maximizing LIMSSI efficiency in an integrated manner and minimizing the negative impact on others. The LIMSSI policy should include a statement of the relevance of sustainability to the organization and its sustainability strategy.

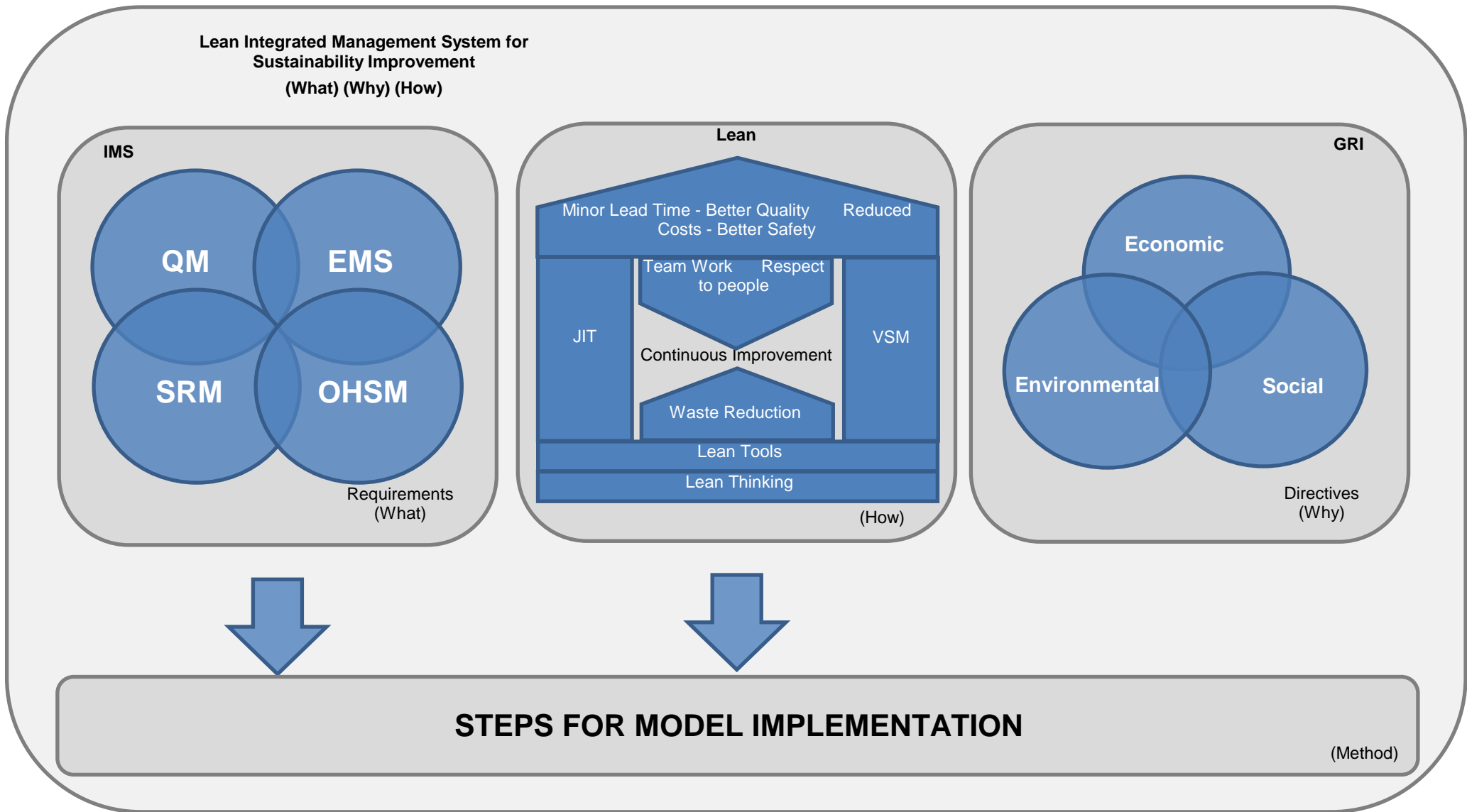


Fig. 1: Lean Integrated Management System for Sustainability Improvement Model

Step 4—TM support and involvement

A crucial point for successful LIMSSI implementation is TM involvement. Meetings with the TM should be held to define the manner of LIMSSI implementation and TM actions. During meetings, the project scope and stages should be detailed to ensure alignment between the LIMSSI and the organization needs and resources.

Step 5—Awareness

Awareness must be a constant effort throughout the activities of sustainability improvement; therefore, meetings, lectures, and other awareness-raising activities shall be promoted, including TM and employees from all organization areas and levels.

These activities should address the main concepts of LM, quality, environment, SR, OHS, their main tools, advantages and potentialities, in order to provide greater knowledge about the sustainability. The activities should seek to conceptually empower those involved and break paradigms to improve the receptivity of employees to the actions that will be developed.

Step 6—Responsibility assignment

The responsibilities for LIMSSI activities should be defined. The team should comprise a LIMSSI coordinator, at least one focal point for each of the areas of Quality, Environment, OHS, and SR, and a VS manager. They shall act as facilitators of change, using their knowledge to act in an integrated and sustainable manner.

As VSM is not restricted to only one area or sector of the organization, a person with the ability to cross organizational boundaries should be designated as the VS manager to facilitate the process of mapping, understanding, and optimizing the VS as a whole. The LIMSSI coordinator and the VS manager must freely access the TM, with freedom to operate across departmental boundaries.

The VS manager and the LIMSSI coordinator are key players in generating synergies between the IMS and the LMS.

Step 7—Product family selection

The ultimate objective is to implement LIMSSI throughout the organization. However, the model proposes that the organization initiates implementation via a product family.

A "product-process" matrix should be developed to enable the verification of product groupings with technology similarity. From such similarities, the product families can be formed. It is interesting that LIMSSI implementation is performed in a family of products that is meaningful and feasible for the organization.

Step 8—Current-state VSM

After the product-family selection, the organization must perform the current-state VSM. VSM describes the value flow as the basis for the future-state VSM design and implementation.

The current-state VSM shall be integrated into the IMS, as a complement to the description of the processes and their sequence and interaction. VSM leads to actions towards achieving planned results and continuous improvement.

For the preparation of the current-state VSM, validated data reflecting the VS operational reality should be used. Even if MS data are available, it is important that data are collected at the shop floor. The mapping should start with a walk around the VS, "door to door" of the organization, to understand the processes sequence flow and what and how the activities of the IMS are conducted. Next, information on processes and operational, quality, OHS, environmental, and SR problems must be registered.

Step 9—Defining goals and targets

Seeking for continuous improvement of sustainability, TM should establish targets based on the current-state VSM, considering its policy and legal obligations. The objectives must be measurable and consistent with the LIMSSI policy, and must encompass programs to meet the defined objectives, and include responsibility assignment, the necessary resources, manners, and deadlines.

Step 10—Definition of performance indicators

Sustainability indicators are crucial for measuring performance and achievements, and embedding sustainability into company decision-making processes and MS [40]. The lack of metrics or performance benchmarks hinder organizations from assessing sustainable performance and identifying their underperforming domains [41].

To manage the LIMSSI, the organization shall establish, implement, and maintain a set of performance indicators that meet

- requirements of law or regulations applicable to the organization, and
- requirements of stakeholders or agreements to which the organization has submitted. Stakeholders should participate directly or indirectly in defining performance indicators [4].

Based on the QMS, EMS, SRMS, OHSMS, LMS, and on the GRI principles [36], the LIMSSI model suggests at least three indicators for each dimension (economic, environmental and social), but organizations should include any additional indicators deemed necessary.

While defining, measuring and analyzing its set of indicators, the organization should consider the principles of materiality and completeness [36]. The organization shall use the performance indicators to promote synergy between the MS and the LMS, thus reducing adverse effects and increasing benefits of actions and programs towards systemic sustainability.

Step 11—Contextualization of organization sustainability performance

Performance must be contextualized based on broader sustainability concepts, and compared with the limits and demands imposed on environmental or social resources at the sectoral, local, regional, and global level. Such contextualization should inform how the organization contributes or intends to contribute to the improvement or deterioration of economic, environmental, and social conditions, considering developments and trends at local, regional or global levels.

Step 12—The Future State

The current-state VSM exposes the VS waste and problems. Such analysis should be used to design a more sustainable future-state VS. The ultimate goal is to build a VS, where processes are articulated to stakeholders; each process is as close as possible to producing only what customers need, when they need it, affecting the environment the least possible, and being safe and socially responsible.

Identification of opportunities for improvement

From the critical analysis of the current-state VSM, the organization must identify the improvement opportunities with synergy between the economic, environmental, and social dimensions for the construction of the future-state VSM for sustainability improvement. VSM is an excellent precursor of kaizen events because it helps identify which VS points need these events [37]. Process improvements and kaizen events should be subordinated to the VS project and the sustainability concept, opposed to vague

and isolated improvement efforts, enabling teams to work on improvements with a clear view of why they are making such improvements and how they connect to the sustainability of the entire VS.

Future-state VSM

The future-state VSM must be designed to eliminate waste, and when not possible, to reduce it. Another focus should be on establishing the pull system, optimizing the use of available resources, and implementing improvement opportunities that require the least use of resources, in the easiest and fastest manner possible.

Reaching the future state for sustainability improvement

The effectiveness of future-state VSM implementation significantly depends on the planning of this implementation. The LIMSSI-implementation plan should include the current- and future-state VSM, a process-analysis report, and a description of the improvement opportunities. The organization shall draw up an implementation plan for the future-state VSM. The implementation should be treated as a strategic decision of the organization.

Step 13—Integration between MS and synergy opportunities

Several organizations already have MS, however many still report difficulties in applying them. MS establish requirements—what needs to be done. However, there is a gap on how to meet these requirements. Based on the analysis of MS compatibilities and incompatibilities, we identified that the LMS is an excellent option for such integration; the organization can overcome the presented challenges. To integrate the LMS with the IMS, it is important to treat them as complementary and integrated from the beginning—not as interchangeable.

The Sustainability Committee

The organization must establish a sustainability committee (SC) with representatives from the economic, environmental, and social dimensions to promote integration and synergies. The SC should review all proposed changes, verify that improvement opportunities do not cause problems for other dimensions and whether there are alternatives that maximize improvements synergistically.

Step 14—Seek Perfection

Using the performance indicators, the VS Manager can monitor the evolution of future-state implementation and sustainability performance.

Once the future state has been reached, a new cycle of continuous improvement must be sought; seeking perfection, the future state VSM becomes a current state VSM, and a new future state VSM is necessary to pursue towards perfection. Always remembering that VS should be developed with respect for people, however, respect for people should not be confused with respect for old habits.

5 CONCLUSIONS

Organizations still face difficulties in operating multiple MS simultaneously, particularly in their integration. Considering the significant gap in sustainable MS research, here we present an innovative model for CS improvement, using the synergies from the integration of Quality, Environment, Social Responsibility and Occupational Health and Safety Management Systems with the LMS.

The LIMSSI may contribute to most effective CS management. Through a structured framework it presents 14 steps to promote the rational use of resources and energy, while engaging and empowering people. It was

structured considering the difficulties of organizations in conducting sustainability improvement activities, avoiding loss of organizational efficiency owing to waste, duplication, and increments of bureaucratic processes, to generate synergies.

LIMSSI was applied in an organization through an AR for refinement and critical analysis of the proposed model. The results of the critical analysis demonstrated the feasibility of applying the LIMSSI, as no issues were identified regarding its implementation. The model can be applied in organizations that do not have any MS or in organizations that already have MS or LMS. The findings suggest that, the LIMSSI has the potential to improve CS performance in order to render the company more competitive and sustainable.

Future research is planned to use the LIMSSI to assess sustainability performance in organizations of different backgrounds. Issues of the implementation process (i.e., resistance to change, costs, time schedule, and behavioral aspects) are opportunities for future research.

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