Occupational Safety and Hygiene VI

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Latest efforts aimed at upgrading the IMS-MM

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ABSTRACT: A great deal of research has been published recently by authors that systematically contribute to the scientific domain that deals with the management systems integration phenomenon. This paper aims at reporting the latest efforts to overcome the shortcomings detected in the first version of the Integrated Management Systems-Maturity Model (IMS-MM) by presenting the results collected from a Delphi panel. This Delphi study aimed at rating (according to an importance scale) several potential indicators/metrics that may be suitable to assess the efficiency of integrated management systems by further incorporation into the existing IMS-MM (back office component). The results suggest the existence of several “clusters” each encompassing various indicators/metrics grouped into 11 levels according to its importance aiming at the monitoring of integrated management systems.

1 INTRODUCTION

The Management Systems (MSs) integration phenomenon (or the multiple certification) has been addressed by several authors throughout the last years. A stream of literature within this scientific domain addresses the benefits, motivations and obstacles related to integration and the limitations of managing various sub-systems apart (ex: Mustapha *et al.*, 2017; Moumen & El Aoufir, 2017). Other stream of literature focus on the potential integration levels attained, models, strategies and guidelines to proceed with a proper integration (ex: Gianni *et al.*, 2017; Kania & Spilka, 2016; Rebelo *et al.*, 2017). In addition, the standards usually adopted to implement the MSs are dissected in order to seek for potential improvement opportunities and to propose strategies aiming at its alignment and harmonization. Furthermore, some authors address a critical and relevant topic—the audit function—suggesting how to select the audit team and pointing out which strategies should be implemented in order to optimize the available resources (ex: Rivera *et al.*, 2017). Other authors (in a context not so related with the standardized MSs but more focused on the integration of organizational issues) such as Visser (2017) addressed the issue of integrated value creation, Oke *et al.* highlight the importance of safety guidelines (2017) in an integrated context and Paranitharan *et al.* (2017) reported the validation of the integrated manufacturing business excellence model. Finally, a more recent stream of literature concerns with the maturity of the resulting integrated MS (IMS) and how to assess it (ex: Domingues *et al.*, 2016; Dragomir *et al.*, 2017;

Poltronieri *et al.*, 2016). This paper aims at reporting the results from a Delphi panel conducted to assess the importance of various proposed indicators/metrics. Ultimately, it is expected that these indicators/metrics will encompass and improve the existing IMS-MM by minimizing the shortcomings ascribed to it (Domingues *et al.*, 2017c). Although some of the proposed indicators/metrics do not address explicitly the efficiency assessment of the IMS it is believed that, when incorporated in the model, they will be able to provide information regarding this issue notably through the back office component of this hybrid maturity model (Domingues *et al.*, 2016). This paper is structured as follows: section two presents the revision of literature carried out, namely, a revision of the latest studies that addressed various topics within the IMSs domain and a revision of literature of the existing maturity instruments to assess IMSs. The following section (Research Method) describes the procedure adopted to select the experts that encompass the panel, the procedures adopted throughout the Delphi study and the criteria to define the consensus and the consensus zone. The “Results and Discussion” and the “Conclusions” sections present the results collected, discuss some of their potential applications and shortcomings and point out the soundest conclusions.

2 LITERATURE REVIEW

2.1 IMSs

Lately, the IMSs scientific domain has been focused explicitly by several authors and relevant contributions were published. At the same time

various authors addressed implicitly this scientific domain and assessed the impact of the new requirements brought forward in the new revisions of the ISO 9001 and ISO 14001 standards, notably, the High Level Structure (HLS) depicted in the Annex SL (Fonseca & Domingues, 2017). Based on the results reported in this latter paper the authors pointed out that QMS auditors from around the world find the HLS and the Annex SL a suitable instrument to align and harmonize the MSs implemented in companies. Mustapha *et al.* (2017) addressed the MSs that relate with the sustainability construct and proposed the Sustainable Green Management System (SGMS), *i.e.*, an integrated management framework that, the authors argue, has the potential to '... save ample resources, remove significant redundancies, promote cleaner production and enhance the profitability and efficiency...' of companies. In this line, Ezzat *et al.* (2017) proposed a framework for the integration of MSs and an evaluation method encompassing simultaneously the stakeholders' requirements, sustainability management and the level of integration of the MSs. Bernardo *et al.* (2017) reported the results from a comparative study (between Greek and Spanish companies) aiming at the identification of common patterns emergent during the integration process and found a great deal of similarities encompassing strategy, methodology and integration level. The authors found dissimilarities between the audits conducted by Greek and Spanish companies and concluded that Spanish companies integrate the audit function at higher levels than Greek companies. Gianni *et al.* (2017) addressed concurrently the IMS and the corporate sustainability topics and pointed out that the triple bottom line accountability has the potential to provide the metrics to assess IMS effectiveness. The integrated audits was a topic addressed by Rivera *et al.* (2017) who identified several shortcomings regarding the development of the audit team. In this paper the authors, in addition to the identification of the shortcomings of the current audit teams formation, propose a methodology (encompassing a set of indicators aiming at the evaluation of the efficiency of the team) to optimize the process of selection of the auditors. Rebelo *et al.* (2017) dissected the integration of MSs and the management of business risk. Supported on insights both from the existing literature and case studies the authors concluded that the integration of MSs has the potential to minimize the risks that may potentially impact key aspects of the business which highlights the potential of integration and alignment of standardized management and business management. Domingues *et al.* (2017b) reported the results from a survey conducted among companies managed through an integrated approach

and pointed out a set of common characteristics: an effective integration of policies, the existence of an integrated system manager and the alignment of tools, methods and objectives of the individual MSs. The same authors (Domingues *et al.*, 2017a) dissected some dimensions of the Portuguese certified OHSMs and concluded that the majority of these MSs (up to 95% of the certified OHSMs) coexists with other implemented MSs, *i.e.*, Portuguese OHSMs should be analysed from an integrated perspective.

2.2 Maturity models in the domain of IMSs

As of today, and to the authors' knowledge, three instruments were proposed to assess IMSs and/or maturity. Domingues *et al.* (2016) proposed the IMS-MM a (1+5)-level maturity model, supported on three axes and encompassing two components, Dragomir *et al.* (2017) proposed an instrument that take into account the information collected in process audits and Poltronieri *et al.* (2016) developed an instrument supported on the sustainability pillars. The shortcomings of the IMS-MM were evidenced when conducting case studies in several companies (Domingues *et al.*, 2017c). The qualitative nature of the information required to populate the IMS-MM (Figure 1) and the fact that the model do not consider some relevant dimensions external to the standardized MSs were identified as the major limitations of the IMS-MM. Concerning the instrument proposed by Dragomir *et al.* (2017) it should be pointed out that it is designed to assess an IMS that comprises three subsystems maximum and, in the version proposed, relies on information from the audit reports and do not take into account other dimensions or peculiarities than those reflected by the requirements of the standards that are being audited (similarly to the IMS-MM). Regarding the IMS-MM (Domingues *et al.*,

Figure 1. The front office component of the IMS-MM.

2016) it should be emphasized that it is supported on three axes: the Key Process Agents (KPAs), the externalities and the principles of quality management. It is intended, due to the abovementioned shortcomings of the current version, to introduce changes (enabling the incorporation of quantitative information) in the three axes to be assessed. The information collected from the present study will be incorporated in the axis "KPAs" in order to decrease the bias of the information supported, in the current version, in a structured questionnaire. Additionally, some changes are planned to occur in the two other axes that encompass the model and the collection of data is being carried out. However, it is not the scope of the current study to disclose the specifics of such update.

3 RESEARCH METHODS

3.1 Delphi method

The Delphi method is usually adopted to validate some research relevant topics. This method is supported by four main characteristics: anonymity, iteration, controlled feedback and the statistical treatment of the collected information. In the current study the selection of the experts (32 total) that comprise the panel took into account their experience in the IMSs domain (both academic and industrial—at least 5 years) and their contact with different geographical contexts (to assure a diversified sample). Experts from Portugal, Spain, Brazil, Sweden, Romania, Italy, UK, Greece, Denmark, Poland, Pakistan, Trinidad and Tobago and Netherlands encompassed the Delphi panel. The identification of the 29 indicators/metrics (Table 1) to be assessed by each expert was supported in the existing literature and in two case studies previously conducted.

The assessment of the importance of each indicator/metric was carried out through the adoption of a 5-point Likert scale by the means of an online survey. This assessment procedure was carried out throughout 3 iterations (or till the consensus criterion was fulfilled for each indicator/metric). After each iteration statistical treatment of the information took place to check if the consensus criterion was fulfilled or to define the consensus zone and identify the median of the results of each indicator/metric (Section 3.2). The statistical analysis of the collected data was carried out by IBM SPSS v. 24 software.

3.2 Establishment of the consensus zone and the consensus criterion

The establishment of the consensus zone and the consensus criterion were based on those reported in previous studies (Ramos, 2013). Although

the existence of several definitions of consensus zone and different reported consensus criteria the option relied on those established in a study with similar goals of the current one. The consensus

Table 1. Indicators/metrics to be assessed by the Delphi panel.

Dimension	ID _{Ind}	Indicator
Costs	ID 20	Total costs ascribed to the IMS.
	ID 21	Cost reduction achieved with the implementation of the IMS.
Audits	ID 24	% of non-conformities detected and ascribed, simultaneously, to the various MSs.
	ID 3	% of audits conducted adopting an integrated approach.
	ID 23	Average time to close corrective actions derived from external and internal audits.
Stakeholders/ Suppliers	ID 1	Nº of complaints from the stakeholders.
	ID 2	Nº of suppliers holding more than one certification.
	ID 18	% of integrated requirements demanded to suppliers.
	ID 19	Nº of suppliers assessed in the dimensions of quality, environment and OHS.
Employees	ID 10	Nº of improvement proposals originated from the employees.
	ID 14	Nº of meetings conducted to provide employees with information concerning the IMS.
	ID 16	% of employees informed about the relevance of the IMS.
	ID 17	% of employees who attended training courses about the IMS.
	ID 22	Nº of training hours addressing the topic "Integration of MSs".
	ID 12	% of training courses addressing the IMS.

(Continued)

Table 1. (Continued).

Dimension	ID _{Ind}	Indicator
Standardized Organizational Structure	ID 13	% of IMS procedures improved due to corrective actions.
	ID 8	Existence of integrated procedures.
	ID 5	N° of policy references to all stakeholders.
	ID 4	Existence of an integrated policy.
	ID 9	N° of meetings, addressing IMS issues, with the participation of Top Management.
Monitoring	ID 11	Existence of organizational functions with responsibilities and duties in the IMS.
	ID 15	N° of integrated goals established.
	ID 6	Existence of integrated indicators.
	ID 7	Existence of integrated objectives.
	ID 25	Effectiveness rate of preventive actions.
	ID 26	Effectiveness rate of corrective actions.
Integration Process	ID 27	Effectiveness rate of training sessions.
	ID 28	N° of guidelines, frameworks or standards adopted throughout the integration process.
	ID 29	N° of integrating concepts adopted during the integration process.

criterion was established considering the difference between the 1st and 3rd quartile, *i.e.*, the inter-quartile range (IQR) ≤ 1 . The indicator/metric that fulfilled the consensus criterion was removed from the assessment survey in the next Delphi iterations. Those indicators/metrics that did not attained consensus according to the abovementioned criterion were assessed in the following iterations. In this case, both the median and the consensus zone of the results collected were reported to the experts in the 2nd and 3rd iterations. The consensus zone was established considering the items in the 5 point scale that encompassed, at least, 50% of the responses from the experts.

The Delphi study was carried out throughout 3 iterations (rounds). A total of 32 experts agreed to encompass the Delphi panel and, at the end of the first iteration, 30 responses were collected. In the following iterations (2nd and 3rd) 29 and 28 responses were collected, respectively. The successive abandonment of experts during the Delphi study is a well reported shortcoming of this research method but, it is our belief, do not invalidate the results attained (3.3% abandonment rate). A total of 29 indicators/metrics were proposed to the experts in the first round to be assessed according to a 5-point importance scale (1 – Without any importance; 2 – Little importance; 3 – Important; 4 – Very important; 5 – Extremely important). Figure 2 presents the evolution of the number of indicators/metrics that attained consensus throughout the successive rounds according to the criterion previously established.

Figure 3 presents the box-plot diagram of the results from the 1st iteration.

Based on Figure 2 one should stress that all the indicators/metrics attained consensus among the experts that encompassed the panel concerning their importance to be adopted in IMSs. In order to prioritize the assessed indicators/metrics according to their importance the following guidelines and decision vectors were adopted cumulatively:

- 1st – Importance Level (Median).
- 2nd – Iteration (round) at which the consensus criterion was fulfilled and/or IQR score (the lowest the IQR the better the definition of consensus level).
- 3rd – Evolution of the Median score throughout the successive rounds (for those indicators/metrics without consensus).
- 4th – Analysis of the opinion of the experts round after round.

Figure 2. Evolution of the indicators/metrics that attained consensus.

Figure 3. Box-Plot diagram from the results of the 1st round.

Table 2. Indicators/metrics clustered according their importance.

Level	Line-up	ID _{Ind}	Comments
1	1st	ID 4	Indicators/metrics that scored 5 (Median) and fulfilled the consensus criterion in the 1st iteration (round). All of them scored IQR = 1.
	2nd	ID 6	
	3rd	ID 7	
	4th	ID 8	
2	5th	ID 25	Indicator/metric that scored 5 (Median) and fulfilled the consensus criterion in the 2nd iteration (round).
3	6th	ID 1	Indicator/metric that scored 5 (Median) and fulfilled the consensus criterion in the 3rd iteration (round).
4	7th	ID 9	Indicator/metric that scored 4 (Median) and fulfilled the consensus criterion in the 3rd iteration (round) with IQR = 0. The score of the Median kept unchanged throughout all the iterations of the Delphi study.
5	8th	ID 16	Indicator/metric that scored 4 (Median) and fulfilled the consensus criterion in the 2nd iteration (round) with IQR = 0.5. The score of the Median kept unchanged throughout all the iterations of the Delphi study.
6	9th	ID 13	Indicator/metric that scored 4 (Median) and fulfilled the consensus criterion in the 3rd iteration (round) with IQR = 0.75. The score of the Median kept unchanged throughout all the iterations of the Delphi study.

(Continued)

Table 2. (Continued).

Level	Line-up	ID _{Ind}	Comments
7	10th	ID 14	Indicators/metrics that scored 4 (Median) and fulfilled the consensus criterion in the 1st iteration (round) with IQR = 1.
	11th	ID 17	
	12th	ID 18	
	13th	ID 20	
	14th	ID 23	
	15th	ID 24	
8	16th	ID 29	Indicators/metrics that scored 4 (Median) and fulfilled the consensus criterion in the 2nd iteration (round) with IQR = 1.
	17th	ID 3	
	18th	ID 5	
	19th	ID 10	
	20th	ID 11	
	21st	ID 12	
	22nd	ID 15	
	23rd	ID 21	
	24th	ID 26	
9	25th	ID 27	Indicator/metric that scored 3 (Median) and fulfilled the consensus criterion in the 1st iteration (round).
	26th	ID 19	
10	27th	ID 2	Indicators/metrics that scored 3 (Median) and fulfilled the consensus criterion in the 2nd iteration (round). IQR = 1
	28th	ID 22	
11	29th	ID 28	Indicator/metric that scored 3 (Median) and fulfilled the consensus criterion in the 3rd iteration (round).

Considering these guidelines the following 11 clusters of indicators/metrics were identified (Table 2) and grouped according to the importance level ascribed by the experts that comprised the Delphi panel. In addition, Table 2 presents the main justification (according to the abovementioned guidelines and decision vectors) to cluster the indicators in a generic Level.

5 CONCLUSIONS

A Delphi study was conducted among 32 selected experts aiming at the assessment of the importance level that may be ascribed to 29 proposed indicators/ metrics with the potential to be adopted in the monitoring of IMSs. To sum up, it should be highlighted that indicators/metrics such as the "Existence of an integrated policy", "Existence of integrated indicators/metrics", "Existence of integrated objectives" and "Existence of integrated procedures" were rated as the most important. Moreover, the indicator/metric "Number of guidelines, frameworks or standards adopted to

integrate the MSs" was ranked at the 11th (and lowest) level of importance. Further work will encompass the incorporation of the proposed indicators/metrics in the IMS-MM as well as a more detailed analysis of the responses considered as outliers in this study.

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