Occupational Safety and Hygiene V

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Management system maturity assessment based on the IMS-MM: Case study in two companies

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ABSTRACT: This paper intends to report the assessment of integrated management systems in two companies adopting the IMS-MM. The companies targeted in this study develop their businesses in different activity sectors and are certified, at least, according to the ISO 9001, ISO 14001 and OHSAS 18001 standards. Results show that the selected companies are at different stages concerning the maturity of their integrated management systems. This seems to relate with the evolution and the ultimate purpose of their organizational structures, to the stakeholders to whom the companies align their management subsystems and to the fact that the IMS-MM is a generic tool (current version) that does not take into account the specific guidelines of each activity sector.

1. INTRODUCTION

1.1 Integrated Management Systems (IMSs)

Standardized Management Systems (SMSs) are adopted by companies in order to address more efficiently and systematically their requirements from the stakeholders (Alshemrani et al., 2019; Domingues et al., 2012). In the early 90s of the last century, companies were more prone to address the issues raised by the customers and the shareholders. Due to an increasing awareness of a context where companies operate, the roles of stakeholder encompasses today not just the customers and the stakeholders but also the employees, the suppliers and the involving society besides others (Sarapão et al., 2012). To incorporate the requirements from the stakeholders, companies often implement and certify their IMSs according to the ISO 9001 standard to address the requirements of customers, according to the ISO 14001 to standard the environmental requirements of the society and according to the OHSAS 18001 to standard the health and safety requirements of the employees. Currently several companies are managed through an Integrated Management System (IMS) that usually encompasses (but is not restricted to) the quality, environmental and occupational health and safety issues that should be taken into account. Although the existence of some guidelines and frameworks the integration of these SMSs into a single system of systems is often developed within each company constrained only by the resources available. So, it is difficult for the responsible to assess and benchmark the resulting IMS against other IMSs from other companies. To fulfill this scientific gap, a maturity model was developed and proposed by the end of 2013: the IMS-MM (Domingues et al., 2016). The current paper intends to report the adoption of this tool in two different companies each one with unique business and organizational particularities. This paper follows with an up to date revision of literature concerning the IMSs and the description of the IMS-MM. The following section describes the research methods adopted and listed in the "Results" section are compiled and listed the main achievements by the adoption of the tool. The last section summarizes the most relevant conclusions from the research conducted.

1.2 Cases studies

LIPOR activity is focused on the waste management (Landfill, sorting plant, energy recovery plant and composting plants) of several municipalities that concentrate the greater Porto area (Northwestern Portugal), notably, Póvoa de Varzim, Vila do Conde, Matosinhos, Maia, Porto,Valongo, Gondomar and Espinho. Yazaki-Salouto produces electrical goods mainly for the automotive industry. The two companies adopted different strategies and perspectives in the integration of their SMSs into a single IMS. LIPOR has proceeded with the successive implementation of the quality MS (QMS—ISO 9001), the environmental MS (EMS—ISO 14001).
and the occupational health and safety MS (OHSMS—OHSAS 18001). The ISO/TS 16949 was the principal subsystem from which the organizational structure of Yazaki-Salónia evolved and is complemented additionally with the EMS (ISO 14001) and the OHSMS (OHSAS 18001). In this latter case, the audit function acted as an integrative concept due to the need to optimize their number and frequency thus avoiding excessive disruptions to the normal production process. A third company from the healthcare sector was contacted but a deeper research on the evolution of the IMS was not possible due to the information access constraints raised by top management.

2 LITERATURE REVIEW

2.1 Integrated Management Systems (IMS)

The scientific topic of IMSs has been increasingly addressed by scholars and researchers throughout the last years. If one considers some of the contributions published solely throughout the year of 2016 (and late 2015) it is possible to collect a snapshot of the issues commonly targeted in this domain. It is possible to stress that this scientific domain is mature enough to enable some papers focusing literature review such as those published by Domingues et al. (2015) and Nuñez et al. (2016a). In latter paper the authors identify the main scientific gaps in the literature and point out the open research paths to where future research should be directed. In a following paper, these same authors listed the functions suitable to integration in an IMS (Nuñez et al., 2016b) and the conclusions converge with those of multilateral researchers that not all the IMS functions should be integrated. Meanwhile, Abad et al. (2016) listed the main difficulties arising during the implementation of IMS and Bernardo et al. (2016) identified the main peculiarities of IMSs in a non-leafing country in certifications such as Greece. The work of Kafel & Casadeus (2016) and Domingues et al. (2016) should be stressed out. These later authors proposed a maturity model to assess IMSs while the former described the changes during the time of the order and level of standards implementation. The work authored by Tempa et al. (2016), highlighting the benefits of joint management practices on safety and operational outcomes, should be referenced similarly to the work authored by Blanco-Varea et al. (2016) that promotes the linkage between the concepts of innovation and integration of MSs. It should be noted that some papers, from other scientific domains, incorporate some references from the IMSs domain. Agholoy et al. (2016), based in a case study at Embraer, and Bernal-Correa et al. (2016) point out that the concept of corporate social responsibility relates with a proper integration of MSs and Aquilini et al. (2016) stress that a successful sustainability may be attained (or complementing) a successful IMS. The work authored by Lindo et al. (2016) and Cook et al. (2016) address the audit function as a research topic and the current trend towards integrated audits. Several papers from the EMS and OHS backgrounds, such as those authored by Jolja & Kaiser (2016), Kritzmair et al. (2016) and Mustapha et al. (2016), implicitly address the issue of IMS integration.

2.2 The IMS-MM

The IMS-MM front-office component is presented in Fig. 1. This maturity model has a three-dimensional nature considering the following axes: the Key Process Areas (KPAs), externalities and the quality management principles. Integration excellence may be achieved throughout an itinerary encompassing six (5+1 base level) maturity levels. A more thorough, detailed and complete description of this model is available at Domingues et al. (2016). To assess an IMS each question related to each KPA should be evaluated by choosing one of the multiple option answers (five options Likert scale) or, for some cases in and alternative, by categorical type answers. In the first case (five options Likert scale) the score weighting (W) assigned to each KPA is determined. In the second case the answer should be "Yes" or "No". The final score is attained by multiplication of the weighting of the KPAs that comply with the above-mentioned. Moreover, the critical KPAs (KPA*) are must be characteristics, i.e., both the score and the critical KPAs should be accomplished. Finally, the ascribed externality to the level should be assessed as "Agree" or "Totally Agree" based on a five option agreement Likert scale. Table 1 displays the requirements to be fulfilled in order to an IMS evolve to an upper maturity level. Table 2 presents the KPAs to be assessed and those that are critical (KPA*).

![Figure 1. The front-office component of the IMS-MM.](image)

Table 1: Assessment framework.

<table>
<thead>
<tr>
<th>Level</th>
<th>Score</th>
<th>Requirements Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>KPA, KPA*1</td>
<td>Excellence rated as &quot;Agree&quot;, &quot;Totally Agree&quot;, or &quot;Excellently rated&quot;.</td>
</tr>
<tr>
<td>4</td>
<td>KPA*2</td>
<td>&quot;Social responsibility&quot; externally assessed, at least, as &quot;Agree&quot;</td>
</tr>
<tr>
<td>3</td>
<td>KPA*3</td>
<td>&quot;Successfully sustainability&quot; externally assessed, at least, as &quot;Agree&quot;</td>
</tr>
<tr>
<td>2</td>
<td>KPA*4</td>
<td>&quot;Life cycle analysis and management&quot; externally assessed, at least, as &quot;Agree&quot;</td>
</tr>
<tr>
<td>1</td>
<td>KPA*5</td>
<td>&quot;Macroergonomics&quot; externally assessed, at least, as &quot;Agree&quot;</td>
</tr>
</tbody>
</table>

Table 2: KPAs and critical KPAs*.

<table>
<thead>
<tr>
<th>KPA</th>
<th>Ohs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policiém integration.</td>
<td>KPA*6</td>
</tr>
<tr>
<td>Top management integrated vision.</td>
<td>KPA*7</td>
</tr>
<tr>
<td>Implementation process supported on a guide or framework.</td>
<td>KPA*8</td>
</tr>
<tr>
<td>Top management training concerning systems in office.</td>
<td>KPA*9</td>
</tr>
<tr>
<td>Organizational tools, methods and documents.</td>
<td>KPA*10</td>
</tr>
<tr>
<td>Perception that the IMS originates organizational interaction.</td>
<td>KPA*11</td>
</tr>
<tr>
<td>Not-portfolio authority by external and/or OHS managers.</td>
<td>KPA*12</td>
</tr>
<tr>
<td>Less, cooperation concept was considered during the integration process.</td>
<td>KPA*13</td>
</tr>
<tr>
<td>System hierarchy.</td>
<td>KPA*14</td>
</tr>
<tr>
<td>Management procedures integration.</td>
<td>KPA*15</td>
</tr>
<tr>
<td>Documental integration.</td>
<td>KPA*16</td>
</tr>
<tr>
<td>Integration strategies.</td>
<td>KPA*17</td>
</tr>
<tr>
<td>Processes monitoring by KPAs.</td>
<td>KPA*18</td>
</tr>
<tr>
<td>KPIs and MIPs.</td>
<td>KPA*19</td>
</tr>
<tr>
<td>Integrated innovation adoption.</td>
<td>KPA*20</td>
</tr>
<tr>
<td>Good standardization between the integrated organizational structure and the integrated process perception.</td>
<td>KPA*21</td>
</tr>
<tr>
<td>Integrated audit typology.</td>
<td>KPA*22</td>
</tr>
<tr>
<td>Identification of organizational features not susceptible of integration.</td>
<td>KPA*23</td>
</tr>
<tr>
<td>Integration strategies.</td>
<td>KPA*24</td>
</tr>
<tr>
<td>MSs performance perceived better in an integrated context.</td>
<td>KPA*25</td>
</tr>
<tr>
<td>The IMS perceived as an added value.</td>
<td>KPA*26</td>
</tr>
</tbody>
</table>

3 RESEARCH METHOD

The integration of MSs is being developed by an increasing number of companies in order to improve and optimize their organizational issues. A large stream of the available literature concerning the topic relies on quantitative methodologies such as surveys, to identify and describe some of the issues that impact on the phenomenon. However, a deeper understanding of it asks for qualitative methodologies such as case studies in order to perceive the underlying relationships between these issues. Several research techniques (interviews, documentary analysis and direct observation) were adopted to assure a proper data collection. The results were reported carefully scrutinized based on the convergence of the information collected from different sources. The assessment of maturity based on the IMS-MM took solely into account the axes "KPA" and "Excellence Management Principles" (Level 0). Hence, the results presented later on do not consider the dimension "Externalities" (Macroergonomics; Life Cycle Analysis; Successful Sustainability; Social Accountability) due to the absence of suitable information.

4 RESULTS

The assessment of maturity was carried out according the assessment framework (Table 1) with the exception of the axes "Externalities" as described in the "Research Method" section. Concerning the base level (Level 0), it was possible to verify that both companies comply with the excellence management principles. In addition, both companies address the requirements of both EMS and OHSMS standards. The main purpose of the adoption of the IMS-MM was to determine at which extent integration was carried out.

4.1 LIPOR

Related to the Level 1 LIPOR rates with "Agree" or "Totally Agree" all the KPAs including the two critical KPAs: "Policies integration" and "MSs perceived as an added value". LIPOR achieves a total score of 600 units which allow the access to Level 2 according to the assessment framework (160 units needed). Concerning Level 2, LIPOR achieves a total score of 60 units, i.e., attaining the minimum score to access to the following level. The critical KPA 13 is rated with the highest score but KPA 11 (Documental integration) is not rated at all as "Agree" (the minimum required). Although the access to level 3 is granted, a deeper documental integration seems to be necessary to prevent any future inconveniences related to this maturity level of the IMS. With respect to Level 3 all the KPAs
(based on the agreement Likeet scale) were rated at least with “Agree”. Concerning critical KPA 17 it was possible to check that “Integrated Audits” was the audit typology commonly adopted by LIPOIR. LIPOIR attains an overall score of 15 units in Level 4 which does not allow the access to Level 5 (60 units needed), KPA 3 and KPA 7 are rated “Not Agree” and “Totally Disagree”, i.e., the IMS would be more mature if an implementation guideline or framework was adopted and if an effective authority was ascribed to the MSs responsible.

4.2 Yatsuki-Saturno

Concerning Level 1, Yatsuki-Saturno achieves a total score of 25 units which does not allow the access to Level 2 according to the assessment framework (160 units needed). Moreover, critical KPA 1 is not assessed with “Agree” or “Totally Agree” although the other critical KPA (KPA 21) is indeed evaluated with the highest score. In addition, KPA 8 (Integration concept) and KPA 10 (Integration of management procedures) are not evaluated with the minimum requirements. It is possible to define a path or, at least, a set of activities in order to the IMS of Yatsuki-Saturno reach highest maturity levels. Yatsuki-Saturno should proactive an effective integration of policies and, at least, comply with one of the following issues: to define an integration concept, i.e., a common concept that may be included throughout all MS that encompass the IMS and proceed with a deeper integration of management procedures.

4.3 Overall analysis of the results

It is possible to posit that the differences observed between the two companies are related with the evolution, the ultimate purpose of their organizational structures and the stakeholders to whom the companies align their MS. Figs. 2 and 3 present both the organizational structure of LIPOIR and the organizational structure of the IMS.

Figure 1

Based on Figs. 3 and 4 it is possible to point out that LIPOIR addresses simultaneously different stakeholders. From its conception, LIPOIR took into account these stakeholders at the same level of the customers. In addition, the activity sector where LIPOIR operates (with obvious linkages to the EMS) seems to facilitate the integration of different MS leading to higher maturity levels of the resulting IMS. Fig. 4 presents the evolution of the multiple certifications achieved by LIPOIR always supported and led by a strong commitment from top management.

Figure 2

Figure 3

From its initial conception the main purpose of the MS of Yatsuki-Saturno was to achieve the quality requirements from the customers and to address more prescriptive requirements related to environmental and OHS issues than those that comprise ISO 14001 and OHSAS 18001 standards.

Figure 4

The audit function was paramount in the evolution of the IMS of Yatsuki-Saturno since it was the need to optimize the number of audits within the QMS that "unveiled the path" to further optimization between the different MS.

Figure 5

5. CONCLUSIONS

According to the IMS-MM, currently, LIPOIR has a level 4 maturity and Yatsuki-Saturno a level 1 (Fig. 6).

Figure 6

The evolution of the IMS and its ultimate purpose considering the alignment to the requirements of the significant stakeholders seems to condition the maturity level that a company may attain. Yatsuki-Saturno operates in an activity sector that is strongly impacted by the quality (customer) requirements. Yatsuki-Saturno addresses environmental and OHS issues very specific from the automotive industry such as ROHS and ELV directives. This fact seems to be embedded in the culture of the company and efforts are done in order to assure the requirements from less prescriptive documents (such as ISO 14001 and OHSAS 18001) be integrated through a systemic approach. On the other hand, the results achieved by LIPOIR seem to be aligned with the notion that an IMS attains higher maturity when, from its original conception, all the MSs implemented are regarded as equal and supported by a top management with vision and effective leadership. Although both companies operate and proceeded with the integration of MS adopting different approaches, the IMS-MM (due to its nature) seems to differentiate between those companies that operate a activity sectors with specific EMS and OHS requirements and those that adopted the less prescriptive approach pointed out by ISO standards. This fact may be interpreted as a shortcoming of the IMS-MM since this model is based solely on the integration of the ISO 9001, ISO 14001 and OHSAS 18001 standards.

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Tempe, E., Bibeau, L., Samovski-Hayat, A., Klase-

Occupational noise in urban buses—a short review

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ABSTRACT: The problem of noise in the public transportation bus and its effect to the driver must be considered systematically and examined in detail. The main aim of this short review is to approach the problem as detailed as possible, compare results and determine the effect(s) of the noise to the driver. For the purpose of this work the PRISMA Statement Methodology was applied. We found 1119 articles and 14 included in this short review. Most of the results have been obtained using ANOVA Analysis and measurements that comply with standards (ISO 9612:2009, ISO 5120:1980, ISO 1999:1990). This paper illustrates the noise level variations depending on the city bus model, its age, engine position, and other factors that disturb the comfort of working space. Regarding the analysed results from the different papers, the noise depends mostly on the engine position in the bus.

1 INTRODUCTION

It is well known fact that drivers in the public transpor-
tation are not only affected by the traffic outside the vehicle, i.e. impurities caused by serious injuries, but also internally. The bus drivers, conductors and passengers are permanently threatened by noise, heat, exhaust gases of diesel engines, vibrations of the whole body, etc. (Mohammadi, 2014; Nasiri, Ebrishmi, Monazzam, Rahimi, & Shahkohi, 2014). The noise producing does not depend only on the kind, type, and position of engine (Mohammadi, 2014; Mosadod, Day, & Datta, 2014; Mukherjee et al., 2013; Nadiri, Monazzam, Khashani, & Rasa, 2012; Portela & Zannin, 2010; Zannin, Dittad, Giovannini, & Pericuta, 2001; Zannin, 2000), but also on other factors producing impulse noise or other forms of noise at different frequencies (Frost & Benc, 2007) such as vehicle speed, stop, starting, breaking, type of tires, opening and closing of bus doors, seats, the presence of passengers, and the like (Mukherjee et al., 2003).

All these factors influence discomfort of driver's working environment, in other words the noise increases while driving or when stop. Passing through various traffic zones daily, the city bus faces different traffic density and the quality of road where the noise produces aggregation of dis-
comfort in the bus (Darijan, Skrncic, & Kran-
spicnik, 2011; Mukherjee et al., 2003).

Various surveys illustrate that engines of cer-
tain models of city buses provide different levels of daily exposure to noise ($L_{eq}$) (Bruno, Murcux, Amada, & Paulo, 2013; Darmian et al., 2011; Mohammadi, 2014; Portela & Zannin, 2010; Zannin, 2008). The scope of daily exposure to the noise (depending on the vehicle model) is 67.9 dB($L_{eq}$)58.5 dB (A) (Bruno et al., 2013; Zannin, 2008). It is also already pointed that the noise level depends on the type of city bus route, so the equivalent continual noise level can go from 84dB to 91dB (Mukherjee et al., 2003).

There are no big changes in the maximum noise level during year seasons, though the minimum equivalent noise level values during the wintersummer as Mukherjee (2003) showed. Further increase in noise in the driver's cabin is produced by the level of the vehicle speed, street/external effect and the brakes (Mukherjee et al., 2003). However, an important role in noise increase plays the engine position (Portela & Zannin, 2010; Zannin, 2008) that means the level of daily exposure with front engine location is 78.6 dB (A) ($L_{eq}$ $\leq$ 85.5 dB (A), with middle engine location is 67.9 dB (A) ($L_{eq}$ $\leq$ 76.9 dB (A), and with rear engine position this factor is 74.7 dB (A) ($L_{eq}$ $\leq$ 76.9 dB (A). According to some researchers (Bruno et al., 2013; Mohammadi, 2014) and WHO (World Health Organization) it is necessary to keep the noise level within the allowed limits in order to avoid negative impacts on our health and to con-
tribute to less discomfort of work environment.

The main objective of this paper is a short sys-
tematic review with respect to determine, first the sources of the noise of urban buses, and second the methodologies applied to measure, impact, prevention and control of the noise. Moreover, it was