MATURITY EVALUATION IN HEALTH AND SAFETY MANAGEMENT SYSTEMS: A PROPOSAL MODEL TOWARDS THE ADOPTION OF SUSTAINABLE PRACTICES

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The present study aims at presenting the main stages of a model development for maturity evaluation of H&S management systems. With this purpose, it is presented some methodological procedures used to define the maturity levels key-organizational areas and the key-practices for each area, and also the assessment of the companies’ profile characteristics that might play an important role in the maturity differentiation between similar companies. These procedures have involved Portuguese and Brazilian occupational H&S experts. Through the obtained preliminary results it is possible to verify that there is an agreement between experts in what regards of nearly a half of the key-practices proposed in the initial model. On other hand, there is a significant disagreement concerning the maturity level classification of each practice, as the Brazilian experts tend to classify practices in a higher maturity level than the Portuguese. Regarding the companies’ comparison, there is also a significant agreement that the existence of an internal service of occupational H&S in companies is the most influent factor for the heterogeneity between similar organizations.

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INTRODUCTION

The implementation of management systems, such as those related with Quality, Environment and Health and Safety (H&S), assumes that such an implementation will allow for a sustainable continuous improvement in a specific operational management domain. Furthermore, in the specific case of H&S management systems, this improvement could be carried out by involving the organizations’ high management levels, as well as other organization levels, to attain a joint goal, which is the improvement of the working conditions.

Despite that, it is possible to verify that a few organisations has progressed enough in involving all the organization levels in this process, but at the same time, some companies were not able to do it. Therefore, it seems that there is a need for establishing a model that could be able to “measure” the maturity of this process and feedback companies about their performance.

Companies have available several techniques developed for improving their performance. Some of those techniques are exclusively dedicated to the management of Occupational Health and Safety (OHS) [12]. Despite that, it is possible to find some models that propose the adoption of some actions at any organizational level, such as the SOBANE strategy (Screening, OBservation, ANalysis, Expertise) [14], the INDICATE (Identifying Needed Defences In The Civil Aviation Transport Environment) [1], [10] the ASSET (Automated Security Self-Evaluation Tool) model [18] and the OHSAS 18001 [4], which is the most disseminated model amongst the mentioned resources. However, even in the case of the most widespread models, it is possible to detect some difficulties in establishing a level of heterogeneity in measuring the performance of the management process. This heterogeneity is needed, in particular when comparing very different types of organizations, such as the companies with different sizes, certifications, activity sectors, OHS services, etc.

The lack of an internal and external reliable reference, have led to the emergence of new resources dedicated to the evaluation of OHS management systems [6]. As a consequence, it is now possible to find a wide range of possibilities for measuring organizations’ performance in this area. Amongst these available resources, maturity evaluation as been each time more, and it is already been used very often in other management areas, such as project management, and software development. Currently, it is also possible to find some models that were developed
for the specific OHS management, for example, the Safety and Security Extensions for CMMI [13], the SCMM (Safety Culture Maturity Model) [11], the MINEX [3], [15] or the +SAFE [17].

Despite the broad application cases found, in the some models, like the CMMI, the way these models are structured may originate some problems when applied to the OHS management. Those models are often very extensive and complex, requiring a significant effort for their application. Due to the fact that these models were initially developed for software projects management, their application to the OHS domain may require significant adaptations. Furthermore, in these models there is a lack of mechanisms that could be used to differentiate companies with different profiles. Accordingly, this shows the relevance of the present work, considering that it will try to define which are the more appropriate criteria for evaluating the maturity of a management systems implementation in a specific organization, as well as in identifying the main factors that could play an important role in the hypothetical results’ inconsistency.

The main aim of this work is to present a proposal model to evaluate and classify the OHS management system maturity, as well as to present some preliminary obtained results.

METHODOLOGICAL PROCEDURES

In order to accomplish the proposed aims, an exploratory research was adopted. Despite this kind of research could not be totally conclusive in some analysis aspects, it will provide some information that could be very useful for future applications, in particular for the development of the proposed model [2].

In the first stage, a literature review about maturity evaluation models was carried out. This review as involved the use of the main scientific journals database in this domain, as well as institutional websites related with maturity evaluation. All the identified models were sorted, using as criteria, in this order, (a) their relation with the OHS domain, (b) the number of citations, (c) the covered type of applications and (d) the number of referred applications.

After that, the key-areas defined in the maturity models analysed were associated with the key-areas of a typical OHS management model. This association was implemented in a matrix. Those key-areas with a great association with OHS management system were examined thoroughly and all the specific goals and practices were also analysed. All these goals and practices were adapted in order to be used as a criterion to identify the maturity of any organization, in what regards the OHS management.

The matrix was filled having in mind two aspects: i) the need to ensure that the specific goals and practices adopted were related with a typical model of OHS management; ii) the need to supply data for establishing a balance in the number of practice for each specific goal.

In the following stage, a survey was developed and applied. The mains goal of the survey was to define which were the most relevant criteria for the maturity evaluation, and in which maturity level it should be considered. In the same survey, it was also requested the definition of which are the companies’ characteristics that could interfere in the differentiation regarding OHS management performance, considering similar companies. This survey was sent to OHS experts, both from academia and from professional and technical organizations. The main questions underlying this survey were:

1. “Which companies’ characteristics will allow to distinguish different performances between companies with similar OHS management systems?”

2. “Which are the most relevant practices that should be considered in the maturity evaluation of the OHS management?”

In order to answer these questions, it was necessary to obtain a list of the companies’ characteristics that may interfere in the company OHS management system maturity. It was also needed to obtain a list of several key-practices (in the domain of OHS) and their corresponding maturity level. Each research question has generated one different survey dimension, the first one regarding the organization profile, and the second regarding the most relevant practices for the evaluation of OHS management system maturity.

Concerning the intended information to be obtained by the application of this survey, it should be emphasized that the applied survey represents a cross sectional study, which will have a specific targeted sample [2]. It was determined that all the survey’s respondents should be experts, researchers or consultants that work, or have a particular familiarity, with the subject of organizational management, OHS and maturity evaluation. As this choice imposes some limitations to the sample’s size, it was decided to include also some respondents that were not Ergonomists or Safety Engineers, but who can have a value opinion regarding organization management and maturity evaluation. The selected sample was composed by 64 invited respondents, from which 48 were Portuguese and 16 Brazilian.
The survey was applied using a website platform, which was developed to this specific purpose and has implied the need to use some computational programming.

The obtained results from the first survey were used to guide and help the construction of a second survey that will be applied to companies in order to evaluate their organizational profile and maturity level. Some of the proposed procedures to be adopted in the construction of the second survey are also presented in this paper.

RESULTS

The main maturity evaluation models that were selected and that were considered to have an important contribute to the present study were the CMMI-DEV V1.2 [5], the MINEX [3], [15], the SCMM [11] and the +SAFE [17]. After their analysis, it was concluded that there are no significant variability amongst the evaluation mechanism used by these models. All the main models proposed five different maturity levels, similarly to what Crosby’s [7] has proposed in his first applications. An exception occurs with the case of MINEX, this model also considers the maturity concept but it makes no distinctions between maturity levels, and the maturity is defined in a continuous scale ranging from 0 to 1000 points.

Amongst the selected models, the CMMI-DEV v1.2 was the one who have influenced more the present work. However, some of the proposed areas in the models SCMM and +SAFE were also used for analysis of the relationship between maturity evaluation models and OHS management systems. In the same way, the key-areas were also used to propose a new evaluation criterion. Those areas were later divided in specific goals and key-practices, having in mind the similarity between the used items from the original models and the balance between the number of practices in each key-area.

In this first survey, the obtained response rate was 61%. In Portugal, this rate was 56%, while in Brazil was significantly higher, 75%. Considering the mentioned response rates, the final number of respondents corresponds to 69% from Portuguese respondents and 31% from Brazil.

In Fig. 1, it is possible to observe the answers’ behaviour regarding the organizational profile dimension. The great majority of the respondents (59%) have agreed on the suggested criteria that might play a high contribution for obtaining heterogeneous results, regarding OHS performance, between similar companies. The existence of internal of an OHS service, as suggested by 87% of the answers is the main factor regarding this contribution. The factor that has obtained the lowest score was the companies’ annual sales, with only 64% of the answers. The number of workers is the factor that has generated a higher disagreement amongst the respondents, with the higher standard deviation, 0.75 points.

Regarding the second dimension of the survey, the key-practices for the OHS management, it was verified that, in average, the respondents have agreed that the suggested key-practices should be included in the highest maturity levels, namely between levels L3 and L4 (Fig. 2). The mean obtained score was 3.51 points, in a scale ranging between 1 and 5. If respondents consider that a key-practice is not appropriate for maturity evaluation, then they can opt for answer in the “not applicable” category.
Comparing the obtained answers between Portugal and Brazil, it is possible to verify that there is significant differences in almost a half of the total key-practices (24 items), as well as in 3 items in the organization profile dimension. In all of these identified differences, the Brazilian answers have indicated a higher maturity level for the considered key-practices.

Amongst the differences in key-practices it was possible to identify four different groups, namely those regarding the levels L2, L3, L4 and L5. Level L1, according to the results, have not been indicated as containing any of the suggested key-practices. All the key-practices were considered by the respondents as belonging to, at least, one of the mentioned maturity levels. The distribution amongst the different levels was as following:

- L1 = 0 key practices;
- L2 = 3 key practices;
- L3 = 13 key practices;
- L4 = 28 key practices;
- L5 = 4 key practices.

After the analysis of the results, the suggested key-practices were complemented by a few additional key-practices that were not included in the survey. The main criterion for the selection of these complementary practices was the need to balance the number of practices allocated to each maturity level. The selection was also oriented by the number of citations that each of the considered key-practices have in the reviewed bibliographic references within the domain of OHS. The new added practices were allocated to the levels L1, L2 and L5 and, therefore, we have obtained a new survey that includes almost 80 key-practices. The distribution of the key-practices by each level remains like this:

- L1 = 13 key practices;
- L2 = 13 key practices;
- L3 = 13 key practices;
- L4 = 28 key practices;
- L5 = 13 key practices.

### Maturity Level Computation

In what concerns the analysis of the organizational profile characteristics, it was decided that each characteristic will receive a different weight, which should be based on the experts’ opinion. In accordance, those characteristics with higher score will have a higher weight. The main idea was to differentiate organizations, and at the same time relate their characteristics to the needed effort for increase their maturity level. For example, if we consider two different companies, for instance, both from the chemical sector and with their quality and OHS management systems certified. The first one has 10 workers, no internal OHS service and annual sales lower than the other. The second company has 500 workers and an internal OHS service. Using their profile characteristics, it is expected that the needed effort to advance in the maturity of the OHS management system should be substantially different. In fact, it is expected that the first company will achieve a lower score on the organization profile dimension and, consequently, will have less difficult (it means less accomplish less key-practices) to advance to higher maturity level.

The Organizational Profile Score ($S_{OP}$) is obtained by the sum of the weights, regarding each organizational characteristic. Generically, the higher the company scored in the $S_{OP}$, the lower will be the requirements for a maturity level increase, and vice-versa. The required effort for the company will be distinct, according to his organizational profile. This effort will be represented by an Inertia Index ($I_{inertia}$), which will be used jointly with the key-practices accomplishment percentage, for the different maturity levels. The $I_{inertia}$ is obtained as indicated in the Equation 1.

$$I_{inertia} = \left( \frac{S_{OP}}{280} \right) - \left( \frac{1}{7} \right)$$

By its turn, each key-practice does not have any associated weights. Each practice may, or not, be accomplished. This is verified if the company have adopted a specific practice in a period less, or equal, to the suggested period, then the answer will be “yes”, otherwise it will be “no”. A positive answer will score 1 point, and a negative answer will score 0 point. Using this scoring scheme, it was possible to obtain the key-practices accomplishment percentage ($%_{ac}$). This percentage was obtained by the sum of all scores, divided by the numbers of existent practices in each level. Equation 2 represents the mathematical procedures used to determine the accomplishment percentage in each maturity level, where $L_i$ is the level $i$, $M$ is the number of practices in the level $i$, and $S$ is the score for each practice ($m$).

$$%_{ac} = \left( \frac{\sum_{m=1}^{M} S_m}{M_{Li}} \right)$$
With the obtained value of $\%_{ac}$ and the $I_{\text{inertia}}$ it was possible to obtain the adjusted accomplishment percentage ($\%_{ac\_adj}$) for the maturity levels L2, L3, L4 and L5. For L1 the percentage $\%_{ac\_adj}$ will be equal to $\%_{ac}$. This adjusted percentage avoids that a company achieved an accomplishment value, in a specific maturity level, higher than the same percentage in a lower maturity level. Equation 3 shows how the adjusted percentage is computed.

\[
\text{Eq. 3. } \%_{ac\_adj|L_i} = \%_{ac|L_i} \times (\%_{ac|L_{(i-1)}})^{I_{\text{inertia}}}
\]

where $L_i$ is the maturity level, and $L_{(i-1)}$ is the maturity level immediately before level $i$.

The maturity level classification criteria for a specific company will be defined using a criterion involving the $\%_{ac\_adj}$, i.e., if a company accomplishes 80%, or more, in a specific maturity levels key-practices, then that level will be the maturity level of the company’s OHS management system.

Companies’ maturity level assessment

Using the previous described results, a second survey was developed and applied. This survey was designed considering the need to obtain a high response rate. As the number of questions will be inevitably larger than the first one used in the first stage, it was necessary to use some usability guidelines and principles to improve the easiness and attractiveness of the survey fulfillment. One of the underlying ideas was to give respondents the sensation that it is worthy to answer the survey and to spend some time doing that.

Similar to the first survey, this second stage will also use a website platform. Through this platform, it will be easy to reach companies, both in Brazil and Portugal. The use of internet is quite common amongst Portuguese and Brazilian companies. Moreover, this type of interface will allow an interaction that will not be possible if a printed questionnaire was applied.

The survey will be divided in five different webpages, namely:

- Introduction;
- Organizational profile questions;
- Organizational profile results presentation;
- Key-practices questions;
- Final results on the company’s maturity level, regarding OHS management system.

In the introduction webpage it will be presented two access possibilities, one option if the user is not registered and another option if the user has already a login name and password. In the first access option, the respondent should compulsory go through all the questions regarding the organizational profile, which probably will take about 6 to 8 minutes to fulfill. After completing this phase, the respondent will be able to access the next page, where he can see all the information about his company organizational profile and the profile of the entire sample of companies that have answered the survey. In the next step, the respondent will have to answer to all the questions regarding the adopted key-practices. This survey’s phase will take approximately 15 minutes. At the end of the survey, the maturity level of the company will be computed and presented to the respondent, considering the organizational profile and the key-practices referred.

During the results presentation, the respondent will also have the possibility to return later on to consult the survey’s results and the position of his company regarding the other respondents of the sample. When the respondents return to the survey, a login name and password will be requested. As soon as the respondent is identified by the system, he will be able to access directly to the overall results.

The first call for participation will be sent to companies through e-mail, in which will be included a description of the survey, some instructions for fulfilling the questionnaire, as well as a direct link to the survey’s webpage.

CONCLUSIONS

The aim of this study was to present the current development of a proposal model for maturity evaluation concerning the OHS management systems, as well as in presenting some of the preliminary obtained results.

From the literature review, it was possible to observe that some of the procedures used by other maturity evaluation models are somehow ambiguous, and are dedicated to other management systems and, therefore, with a need for adaptation to the specific area of OHS. Moreover, those models are excessively long and complex, as is the case of the CMMI-DEV v1.2, which requires a specific type of audits.

Concerning the results of the survey applied to OHS experts, it was possible to verify that there is a long list of key-practices that could be considered for maturity evaluation of a specific organization. Most of these practices represent a sustainable approach in what regards the organization engagement with the OHS area.
Furthermore, the obtained results seem to demonstrate that there is a tendency to classify most of the key-practices as belonging to higher maturity levels. Additionally, it was also possible to verify that the key-practices were not identically distributed by all the maturity levels.

Both Portuguese and Brazilian OHS experts have considered that the existence of internal OHS service is the most important factor for OHS performance concerning the differentiation between similar companies. Although there is an agreement in the majority of the analysed points, in approximately one third of the suggested factors the experts from the two countries presented significant different opinions.

It was also possible to conclude that there is a significant agreement in what regards the key-practices classification. When there was some disagreement it was possible to note that Brazilian experts tend to classify key-practices with a higher level.

Finally, it is important to refer that this study is part of an ongoing project, therefore it is hoped that further results can be obtained and the preliminary conclusions presented here can be updated and/or validated.

REFERENCES