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To cite this article: Alsaddeeq Basheer Yousuf Blaou *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **607** 012004

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Frame work for the Development of Occupational Safety and Health Assessment Model for Libyan Iron and Steel Industry

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Abstract. The aim of this study is to find an efficient method for assessment of occupational health and safety management (OHSM) practices which focused on the complexity of the iron and steel industry. Indeed, there are several method used in process management assessment but unfortunately, it does not hold the interaction that can exist between the health and safety risks management process and the complexity of iron and steel industry. To remedy this disadvantage, this study proposed reducing the number of indicators down to several or major KPIs. In order to achieve the selection of small set of KPIs from the larger set of PPIs, a SMART criteria and AHP in the domain of multi-criteria decision making (MCDM) analysis is proposed to be employed for developing a model for the assessment of OHSM practices in Libya iron and steel industry. The enterprises' safety performance index would benefit from the new assessment model.

1. Introduction

In history, not too long ago, the industry was brutally affected by ferocious occurrences in form of health crises and natural tragedies. Most of such incidents dealt a huge impact on production and economic activities of the industries. The repercussion of these mishaps are out of sequence and inconspicuous. For this reason, the occupational health and safety management in the industries has appeared to be an essential topic globally. Occupational risk has been defined as “a possible events whose unfavorable consequences are difficult to accept or are even unacceptable” [1]. In recent years, study on OHSM evaluation has become an essential area for research for the reason that occupational risks were continuously happening in the industries [2]. Iron and steel industries are among the occupations that are labelled with high-risk in the present era. Due to the blend of many reasons, which may include the high-risk working environment (which is typical of iron and steel industry) and low education level of unskilled menial workers, [3, 4].

The steelmaking process is very long and multifaceted. Such a complex enterprises normally go along with occupational health and safety risk, as well as the management of risk issues that emanates at the stage of iron making through the final stage of steel rolling. The risk management influences the entire system through marketing, information and inventory, procurements and transportation, which is because of the immense uncertainties created by the variance in the midst of decision-makers with



different background and interest, policy strategies and the influence of marketing that might surface unavoidably in such an intricate organization.

It was rightfully established that the best and a well effective approach to manage risk is to improve safety performance. This according to Fung, et al. [5] should be geared towards preventing accidents as well as reducing uncertainties prior to its occurrence. Therefore, safety risk analysis can be viewed as the basis upon which concept and activities of safety management is built. Thus, “safety performance” assessment has turn out to be a serious task, which fashioned as fragment of safety management systems [6-8]. Based on the aforementioned, it is clear that in order to improve safety performance in the dynamic industrial set-up, safety personnel and specialists are the important figure to conduct thorough assessment in the field [9, 10]. Thus, it is imperative that safety personals’ have a very good understanding and experiences on what safety assessment tools and models may affect the integrity and reliability of the performance assessment.

Previous studies concerns on some arrears like occupational risk factors or OHSM associated with construction and allied industries [4, 5]. Thus, studies related to “occupational health and safety” risk and risk management on iron and steel workplace are rare. Therefore, this study sort to build up on the need for effective OHSM in iron and steel industries through effective assessment of the OHSMs by developing an efficient and reliable assessment model suitable for iron and steel making industry. Therefore, criteria for effective model development have been put forward.

2. Literature review

In this section, the study attempt to create an impression about the nuts and bolts of safety and health management in accordance with the literature reviewed. The discussion will therefore include: basic definition of safety and health, safety and health management and the assessment method.

2.1. Occupation health and safety

Health and safety are part of “well-being”, which in accordance with the dictionary definition, “well-being” is “welfare” [11]. It is therefore correct to say that, health and safety make-up a strong feature of the workers’ welfare that have received quite a good attention for a period of time, especially as it relates to occupational management. “Health” in the words of Mathis and Jackson [12] is “a general state of physical, mental and emotional well-being”. Thus, an individual that is “free of illness”, psychological or emotional complications that mar his/her average human deeds is considered a healthy person. Therefore, the usual health management activities in industries and firms attempt to preserve the “overall well-being” of individual employees. Similarly, safety is the protection of the physical “well-being” of the populaces [12]. This means that, the sole purpose of active safety programs in firms and industries is for inhibiting incidents or accidents in the work places. Thus, the objective of safety is mainly for protection of workers, tools and the facilities.

The concept of health and safety is mostly discussed as safety and health hazard in many of the reviewed literature. Sikpa [13] defines safety hazards in accordance to the early work of Cascio, Wayne (1986) “as those aspects of the work environment that have the potential of immediate and sometimes violent harm to an employee” While the author describe Health hazards as “those aspects of work environment that slowly and cumulatively (and often irreversibly) lead to deterioration of an employee’s health”. Cole [14] enumerated the common causes of health and safety hazard to include “physical and biological hazards, toxic and carcinogenic dust and chemicals and stressful working conditions”.

The concept of health and safety hazard had a continuous development since the coming of International Labor Organization (ILO) 1959 and beyond. Many health and safety policies have emerged, usually containing a clear aims and stated objectives of an organization concerning safety and health. It is often designed as an organized structure that is in a form of a system and procedure for the personnel that were given the responsibilities of handling issues concerning safety and health. Thus, referred as the health and safety management.

2.2. *Occupation health and safety management (OHSM)*

The major purpose of safety management is to preserve and promote personnel's health and safety. Hence, "health and safety management" is referred as an organized and prearranged activity that is governed by efficient management with a major objective for controlling health and safety risks [15]. In some case, the terms "safety program" and "safety system" are used instead despite that the latter two terms stress less the role of management [16]. Similarly, Booth and Lee [17] indicate that the main aim of safety management is to interfere with the causative process resulting in incidents and accidents. This involves active knowledge of the system detecting both visible and latent risks. It is a total system ensuring proper planning and executing of safety activities and arranging follow up system. Since the major activities of safety management circled around risk analysis, safety training arrangements, accident investigations, near miss investigations, safety promotion and human reliability" [17]. Safety performance improvements shall be recognized through a sustainable reduction in occupational and safety process deviations that lead to a loss, injury or damage. Thus, assessment of the management of health and safety practices needs a regular evaluation of progress achieved and to acquire feedback and suggestions for what's working and what's not.

2.3. *Assessment of occupation health and safety management*

Performance assessment usually give emphasis to measurement of performance on a certain subject matter, which is usually given a particular improvement strategies [18]. Whenever improving performance is mentioned, the tough on how best the implementation of performance management will be achieved become very important. This is true because it assists towards providing a systems for making a long and short term decisions with high benefits [19]. A familiar contribution by Bititci, et al. [20] added that "performance measure" is often acknowledged to be an essential instrument commonly employed in performance management, because it leads to the acquisition of important data that is relevant for taking decisions that can positively influence the performance of an organization. It can be declared that performance measurement has been taken as a topic of considerable interest for a long period, and it was mainly employed to measure performance as it relates to finance – in the form of income and returns or auditing. Accordingly, the economic measures of performance is popular and has continued to be the individual scale used for measuring the success of an organization. Nonetheless, Porter [21] stated "that performance scales based on fiscal indices cannot handle topical changes in industries, especially because of the appearance of novel technologies together with strong competition". This and many more indicates the need for providing appropriate methodology for measuring the success or otherwise of OHSM.

2.4. *Approaches to health and safety performance evaluation*

Studies were carried out to unravel the reason hindering the effective functioning of OHSM in many companies. The results of such studies, lead to some proposed factors that are considered to be the bottleneck to having a functioning systematic OHSM system. Researchers like Arocena and Núñez [10], Biggs, et al. [22] mentioned the lack of commitment as a factor, while the early work of Salminen [23], saw that lack of knowledge as the inhibiting factor. Although, the report by Nordlöf, et al. [24] has revealed that at present, adequate awareness on OHSM has been achieved. Nonetheless, the lack of formalized routines for effective auditing and improvement of the safety and health management system has been reported by quite a large number of literatures reviewed [7, 10, 25]. Karlun [26], Nordlöf, et al. [27] commented that such a situation where formalized practice for assessment and improvement is neglected, it will translate to failure of the OHSM system.

Lamenting on the lack of formalized routines for effective auditing and improvement of the safety and health management practices in companies, Teo and Ling [6] reported that "In Singapore, there was no regulation to govern the way in which the safety management systems (SMS) policies are drafted by construction firms" as at the time of their investigations. And that, "There is also no standard protocol on how safety auditing is to be conducted." Similarly, Nordlöf, et al. [24] reported that "No generally established instrument to measure OHSM practices was found" during their studies on Swedish national

data. In the other hand, Beriha, et al. [28] found that, safety and health has “always been a major concern in the Indian industrial setting.” However, the author further stated that only a small number of studies apply a reliable method for prediction of accident and assessment of the safety and health practices. Other studies that supported this claim include [29-32].

Further studies indicates that, the main approaches for assessment of safety and health management system are; “the retrospective or lagging indicators approach” and “the prospective or leading safety performance evaluation approach”. The “Retrospective or lagging indicators approach” has been criticized by Carder and Ragan [33], Cooper and Phillips [34] with failures of not revealing the cause-effect relationships that would drive system improvement, and having less predictive value and the high possibility for under-reporting of incidence. In the order hand, the “Prospective or leading safety performance evaluation approach” has demonstrated the potency of keeping in touch with the modern organizational and safety management styles because it make available the information needing from “incident-based measurement” and it disclose how well an organization is carrying out those activities that are responsible for inhibiting injuries and ill-health. Thorough review of contemporary studies on safety and health performance evaluation indicates that most studies in this area of interest are based on the “Prospective or leading safety performance evaluation approach”. Hence, this proposed study will be in accordance with this approach also.

3. Frame work for assessment of health and safety practice

The Libyan “iron and steel industry” was established in 1979 and situated around the coastal area of Misurata which is 210 Km away from Tripoli. The company has the capability of producing 1,324,000 tons of liquid steel annually. The operation of the “iron and steel industry” depends largely on direct reduction of iron and steel scrap [35]. It is very certain that in the long and complex process of steelmaking, initiatives are accompanied by risk from the iron making to the final steelmaking. It was reported by Abusa [36] that, “the industry also suffers from high accident rates, which results in absenteeism, loss of productivity, permanent disability, and even fatalities”.

Usually, the best productive approach for improving safety performance have to be by inhibiting accident occurrence and decreasing uncertainty prior to its happening [37, 38]. Accordingly, safety and health risk study is a basis on which “safety management” is structured. Hence, qualified the safety assessment as a serious act of safety management systems [39, 40]. In view of that, a review of methods and techniques that have been applied for assessment of safety and health management system was conducted and only the performance assessment methods that are typical of and very useful in the area of health and safety management practices were selected and discussed. Consequently, in line with the criterion of a holistic approach and in accordance to the recommendations by [41-44]. The study ensure the development of PPI subsets for individual components of SH management system in accordance to the description in Figure 1. The preliminary result which is in agreement with Sgourou, et al. [44], shows a considerable large number of proactive performance indicators (PPIs) with quite huge internal structures were developed.

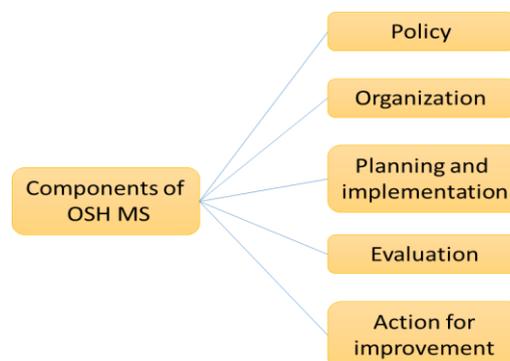


Figure 1. Components of SH management system for the development of PPI subsets.

The challenge as described by Podgórski [45] is the complexity of the measurement system due to bulkiness of data that is needed to be gathered and processed, where more time and personnel to perform measurements is required. The need for KPIs selection became inevitable as recommended by Keeble, et al. [46], Chan and Chan [47], Change [48], Øien, et al. [49] specify how necessary it is for decreasing the number of indicators down to major KPIs. The SMART criteria shown in Figure 2 was employed in determining the set of features that are expected of a good KPI.

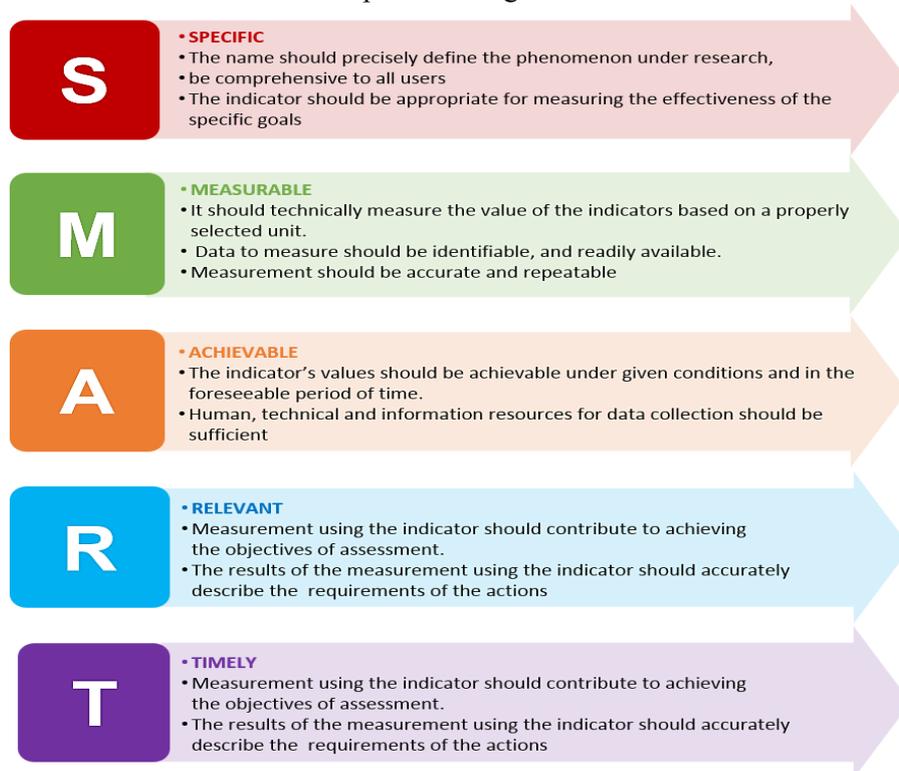


Figure 2. The SMART criteria for KPI selection.

In order to achieve a reduced number of KPI that can be suitably used in the evaluation of OSHM system, it is necessary to select the most important indicators from the large group of the already defined PPIs. An analysis of the available studies on the application of “Multi Criteria Decision Making” (MCDM) as a reliable methodology for selection of KPIs from the large group of PPIs indicates that many MCDM methodology can be employed for the selection. However, an analysis of the literature as presented in Figure 3, indicated that the “Analytic Hierarchy Process” AHP is among the commonly and the most used method in practice.

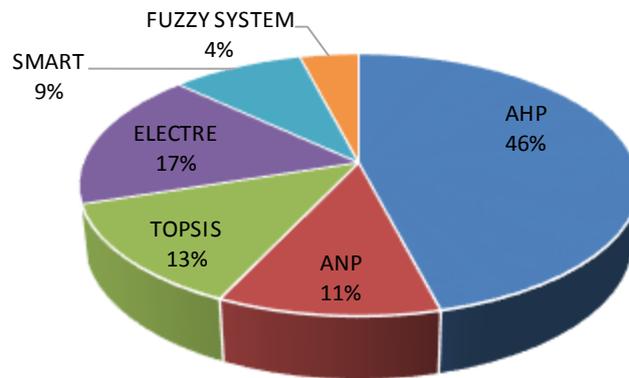


Figure 3. Applications of MCDM methods for KPI selection

The wider application of AHP in MCDM process was due to its moderate level of simplicity, coupled with the availability of relevant supporting software, and the prospect that it can be applied toward resolving decision issues concerning the economy, technology, leadership and areas of science. Therefore, this study choose to combine the decision making methodology of SMART and the hierarchical processing of AHP for developing the proposed model for the assessment of OHS practices in Libya iron and steel industry.

4. Conclusion

This research work appeared to be the first to study the active application of safety and health management in Libyan iron and steel industry, with particular consideration to the appraisal of the health and safety practices. The study's visible contribution is the presentation of various assessment techniques and the magnitude to which the techniques and philosophies are put to practice. As well as the contributions the techniques offered for managing health and safety risks effectively in the Libyan iron and steel industry. Important findings from the study is summarized below:

- Real status of safety and health management practices throughout the whole industry is uncertain. The absence of comprehensive blueprint towards realizing the full implementation of safety and health management practices is evident, with no standardized model or instrument for evaluation of safety and health management practices.
- The target to improve the Libyan iron and steel industry toward achieving adequate safety and health management practices is feasible only if the leadership, health specialists and the workers adjust to their responsibility and work together.
- The strategy for achieving effective safety and health management practices including sharing the vision of fulfilling the implementation process with all the related employees and ensuring the required resources for effective implementation of these practices.

Conclusively, significant amount of resources will need to be allocated for education and training on the significance of safety and health practices. Most especially, assessment of the safety and health management practices remained the only avenue to check on the effectiveness or otherwise of the system. Hence, having a robust assessment model that is unique for the Libyan iron and steel industry is very crucial and necessary.

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