



## Occupational health and safety risks: Towards the integration into project management

Adel Badri <sup>a,\*</sup>, André Gbodossou <sup>b</sup>, Sylvie Nadeau <sup>a</sup>

<sup>a</sup> Mechanical Engineering Department, University of Quebec, École de technologie supérieure, 1100 Notre Dame West, Montreal (Quebec), Canada H3C 1K3

<sup>b</sup> Unit of Education and Research in Management Sciences, University of Quebec, Abitibi-Témiscamingue, Rouyn-Noranda (Quebec), Canada J9X 5E4

### ARTICLE INFO

#### Article history:

Received 21 November 2010

Received in revised form 10 June 2011

Accepted 8 August 2011

Available online 13 September 2011

#### Keywords:

OHS risk management

Laws

Management systems

Project management

Industrial safety practices

### ABSTRACT

Project management in industrial settings in many cases is deficient with respect to integrating OHS risks. This deficiency manifests itself as problems affecting the safety of industrial practices and is explained generally by poor knowledge of OHS within organizations and project teams.

We present, through this paper, a critical review and provide an overview of research and industrial practices aimed at systematic integration of OHS risks into the execution of projects, based on published scientific literature. We thus introduce some of the tools, methods and approaches being developed or adapted to integrate OHS and a general description of the current status of this integration in various fields.

Our focus includes, in fact, laws, management systems, OHS risk management throughout project life cycle and efforts to integrate OHS risk management to industrial safety practices including approaches using historical data and industrial interventions.

We conclude that publications identified are mainly derived from the construction industry and we stress that the objectives, methodologies and results are largely heterogeneous. The integration of OHS risk is not systematic in all industrial fields despite the changing and improving laws and management systems.

In order to complete the overview of OHS integration, we will suggest future reviews and research that specifically investigates other innovative OHS applications and many analyses of recent industrial accidents. Complete synopsis will give opportunities for researchers to use or improve methods and approaches to promote OHS risk management in the manufacturing sector that suffer from lack of knowledge in this area.

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### 1. Introduction

The practice of engineering is called upon increasingly for systematic management that integrates OHS risks with operational risks. This stems directly from article 2.01 of the code of ethics adopted by the Quebec order of professional engineers (OIQ, 2011): “In all aspects of his work, the engineer must respect his obligations towards man and take into account the consequences of the performance of his work on the environment and on the life, health and property of every person”.

In Canada, a new era of governance characterized by attitudes and behaviors expected from “a good parent toward a child” (Péruce and Bernier, 2009) has emerged owing to Criminal Code amendments adopted in March 2004 (Federal Act C-21) and possible consequences resulting from criminal proceedings where

measures to protect the health and safety of workers do not exist.

Taking into account the need to eliminate occupational risks contributes to the success of projects (e.g. Gambatese, 2000a,b; Smallwood, 2004; Baril-Gingras et al., 2006; Fung et al., 2010). The elimination of OHS risks is always more beneficial when introduced at the definition stage of a process and during the fine tuning of projects (Charvolin and Duchet, 2006), but also when users remain mindful of it all the way to the completion of a project.

Since the 1980s and in particular the inception of the notion of “integrated prevention” (Claudon et al., 2008), engineers and various stakeholders in OHS have sought to integrate health and safety into the list of tools used in the design of projects. Although numerous software programs and workplace measures have been developed, project designers encounter difficulty using the enormous quantity of data generated as a result and deciding when and where to apply the new information without causing delays and cost increases.

\* Corresponding author. Tel.: +1 514 3968800x7322.

E-mail addresses: [adel.badri.1@ens.etsmtl.ca](mailto:adel.badri.1@ens.etsmtl.ca), [badri.adel@gmail.com](mailto:badri.adel@gmail.com) (A. Badri).

### 1.1. Problem and objective of the present review

Actually, industry uses rigorous project management, modern and safe facilities and robust rules of occupational health and safety but accidents continue to cause human and social problems (e.g. Shikdar and Sawaqed, 2003; Smallwood, 2004; Li et al., 2009). Several industrial sectors encounter, continuously, serious accidents during all projects phases (e.g. Li et al., 2009) despite their efforts to integrate OHS in project risk management. This situation leads us to examine the current status of the systematic integration of OHS management risks into project management and industrial safety practices.

This paper is organized as follows. Section 2 presents the methodology, including a few definitions related to risk management. Section 3 details the results of the literature identified. The studies are categorized as explained in the methodology. We then summarize the state of OHS integration in industry and we suggest some possible directions for future research in Section 4. Finally, the conclusion of the manuscript is provided in Section 5.

## 2. Methodology

### 2.1. Strategy and research process

To achieve the objective of our research, we have organized our review of the literature as follows: (1) purpose of research; (2) search of the literature; (3) selection of relevant studies; (4) extraction and classification of data obtained from studies; (5) discussion of studies.

Firstly, we survey the recent literature and summarize briefly the extent to which OHS risks are taken into account in the project management and industrial safety practices, with special focus on the construction industry. This work is thus intended to help us in identifying research avenues to address the lack of knowledge noted particularly in the systematic management of OHS risks in the manufacturing sector.

Secondly, we have selected literature and structured our examination of the question surrounding the integration of OHS risks into project management and industrial practices. We queried Compendex, Inspec, IEEE Xplore, Eureka.cc and NIOSHTIC-2 using keywords such as risk, elements of risk, risk factors, risk management, project management, project lifecycle, risk assessment, risk analysis, method, occupational health and safety (OHS), risk management standards, OHS assessment, OHS performance, OHS measurement, OHS intervention, quantitative assessment, qualitative assessment, safety procedures, safety programs, systematic approach, design, ergonomics, safety culture, organization, construction, industry, laws, hazard, causal, model, tools, framework. We also identified books published recently, along with a large number of research reports, by consulting the Internet sites of INRS<sup>1</sup> and IRSST.<sup>2</sup> The search strategy combined two sets of keywords using “AND” or “OR” strategies.

Thirdly, relevant studies were assessed for methodological quality and clarity of their objectives. We analyzed titles, keywords and abstracts of peer-reviewed publications, standards of management and pertinent book chapters. It should be noted that we have analyzed more than 70 peer-reviewed publications for over 5 months. Peer-reviewed publications are from around the world (in English and French) and published between 1997 and today.

Fourthly, how to integrate the management of OHS risks in industry differs greatly from one sector to another. In part, these differences are mainly due to risk acceptability, development of

laws and standards, maturity of project management standards and use of management systems.

We attempted to conduct an interdisciplinary review of literature. We stress that the objectives, methodologies and results of relevant studies identified are largely heterogeneous. In the purpose of trying to classify these publications, we used the mutual influences between the categories we've identified. These mutual influences are inspired from influence diagrams used in engineering. An influence diagram traces links between elements of a system adapted to the context of study (Alexandru, 2009).

If we take the construction sector as an example, the development of laws has helped in changing and improved project management standards (Gambatese, 2000b). This development of project management standards has also enabled the creation and the implementation of several tools and methods that improved project management. The efforts of researchers followed law developments and have stimulated developments of best practices (e.g. Zachariassen and Knudsen, 2002; Saurin et al., 2004; Hare et al., 2006).

For this reason we tried to organize the results based on these identified links of influence. These outcome categories (gray rectangles) and links of influences (arrows) are detailed in the Fig. 1.

Finally, we discuss results of literature while following categories and links of influences detailed above. In Section 4, we summarize the state of the OHS integration in industry, limitations of the review and recommendations.

### 2.2. Risk and risk management: definitions

The Project Management Body of Knowledge (PMBOK<sup>®</sup> Guide, 2008a)<sup>3</sup> states that project management is the application of knowledge, skills, tools and techniques to project activities in response to needs of the project. The management of a project spans five groups of processes: commitment, planning, execution, control and closure. In chapter 3 of the Construction Extension to the PMBOK<sup>®</sup> Guide (2008b), PMI<sup>®</sup> gave an overview of the project safety management processes. This process includes “all activities of the project sponsor/owner and the performing organization which determine safety policies, objectives, and, responsibilities so the project is planned and executed in a manner that prevents accidents, which cause, or have the potential to cause, personal injury, fatalities, or property damage”. In this extension, PMI<sup>®</sup> defined the term safety management by both safety management and health management. It is important to note that project safety management interacts with all aspects of project management. These interactions are based essentially on communication between all stakeholders (PMBOK<sup>®</sup> Guide, 2008b).

Risk is defined as the influence of uncertainty on the attainment of goals (ISO 31000, 2009). It is defined also as inherent in the activities of man and all enterprises. Risk is a combination of the probability and the consequences of the occurrence of a specified dangerous event (OHSAS 18001, 2007). “OHS Risk” is the significance of a hazard, in terms of the probability, and severity of an injury or illness occurring as a result of the hazard. In this paper, we mean by “Risk” the other forms of risk that must be managed by an organization: contract management, construction cost, planning and statistics, human resources and logistics, etc. (Mi and Nie, 2008).

“Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and monitoring and control on a project” (PMBOK<sup>®</sup> Guide, 2008a). In the risk management process, risks identification step is the foundation (Liu and Guo, 2009) and it presents challenges

<sup>1</sup> Institut National de Recherche et de Sécurité (France).

<sup>2</sup> Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST), Quebec, Canada.

<sup>3</sup> Project Management Body of Knowledge: a reference work on project management, edited by the Project Management Institute (PMI<sup>®</sup>).

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