ASSESSMENT OF OCCUPATIONAL HEALTH AND SAFETY PERFORMANCE EVALUATION TOOLS: STATE OF THE ART AND CHALLENGES FOR SMALL AND MEDIUM-SIZED ENTERPRISES

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Abstract

Occupational health and safety (OHS) is poorer in small and medium-sized enterprises (SMEs) than in large corporations. Fatal accidents are up to eight times more frequent in SMEs and non-fatal injuries are as much as 50% more likely to occur. In order to improve the OHS status of SMEs, the constraints under which these businesses operate must be taken into account.

In this critical review of the literature, we present an overview of research and industrial practices relating to OHS performance evaluation, and therefore of the information-gathering tools developed or adapted for this purpose, with emphasis on the SME context. The goal of this work is to identify avenues of research that are likely to yield practical means of meeting the challenge of integrating OHS into SME culture.

Our principal conclusion is that the particularities of the SME context have not attracted the attention of any significant number of researchers in the subject area of OHS. The development of tools that offer a broader choice of performance indicators to OHS specialists intervening in SME settings would contribute significantly to improving accident prevention in the workplace.

Keywords: Occupational health and safety (OHS), performance, measurement, indicators, tools, small and medium-sized enterprises (SMEs).

1. Introduction

In industrialized countries, concerted efforts to prevent work-related injuries have met with tangible success. Specifically in Québec, the number of cases has dropped by 50,000 between 1997 and 2013 (CSST, 1997; CSST, 2013). Although this is reassuring, we note that the performance of small and medium-sized enterprises (SMEs) has improved somewhat less (MacEachen et al., 2010; Masi et al., 2014).

In Canada, a small business is defined as a company with a staff of fewer than 100 employees (Statistics Canada, 2013). In Québec, such businesses represent 98% of all businesses and employ 67% of the workforce (Statistics Canada, 2013). Workplace fatal accidents are up to eight times more frequent in SMEs (Mendeloff et al., 2006) and non-fatal accidents are as much as 50% more likely to occur (Fabiano et al., 2004). This poorer OHS performance in SMEs is noted throughout the industrialized world (Champoux and Brun, 2003; Vickers et al., 2005).

The scientific literature contains no standard definition of OHS performance, each author proposing his or her own (Liu et al. 2014). Some researchers describe the concept as the performance of a management system in terms of OHS (Wu et al., 2008). Others have defined it as the ability of businesses to prevent occupational injuries (De Koster et al., 2011). Some researchers define a good OHS performance as a lesion-free record (workplace accidents and occupational illnesses or injuries) over a long period of time (Pedro and Miguel, 2003). Since the occurrence of injury is largely random (Reiman and Pietikäinen, 2012), this definition has its limitations (Delatour et al., 2014). A business might be lesion-free for a long period of time due to the coincidence of favourable circumstances. In such cases, it is not clear that OHS performance is actually superior, nor does the sporadic occurrence of a few lesions necessarily indicate that OHS performance has deteriorated.

For the purposes of this study, a definition of OHS performance based on two specific criteria has been adopted:

- A business performs well if its OHS management is effective (De Koster et al., 2011 ; Liu et al., 2014 ; Sgourou et al., 2010 ; Wu et al., 2008).

– OHS management is effective if it leads to reduction or elimination of occupational injuries and illnesses on the short to medium term (Pedro and Miguel, 2003).

For several years now researchers have been attempting to identify the factors that explain why OHS performance differs so much between SMEs and large corporations. We note that four factors appear to be the principal obstacles to closing this gap. To begin with, SMEs have fewer financial and human resources at their disposal (Masi et al., 2014). Under conditions of economic uncertainty, managers of SMEs are reluctant to spend time and resources on problems that do not arise on a regular basis, and this would certainly include OHS issues (MacEachen et al., 2010; Agumba and Haupt, 2012). A second consideration is that few managers of SMEs are particularly sensitized to OHS or have significant knowledge or know-how in this realm (Masi et al., 2014). A third consideration is that OHS is not generally a well-established value or priority in SME culture. Managers often have biases and inflexible perceptions and beliefs regarding OHS (MacEachen et al., 2010). And finally, SMEs tend to be more isolated than other businesses. Assistance such as firms specialized in OHS could provide to SMEs is often regarded as too technical and too costly (Masi et al., 2014).

Given the definition of OHS performance that we are using, improvement will be manifested necessarily as implementation of preventive activities that lead to reductions in occupational lesions on the short to medium term. Several elements favour this implementation and the resulting improvements. Those discussed in the literature are summarized in the six points below:

– There is a consensus surrounding the importance of the commitment of upper management (Abudayyeh et al., 2006; De Koster et al. 2011; Hallowell et al., 2013; Mirabi et al., 2014).
– Risk management is an indispensable element of OHS performance (De Koster et al., 2011; Hallowell et al., 2013; Mirabi et al., 2014; BSI, 2007; CSA, 2006). In effect, a business cannot improve its OHS performance without controlling occupational risks. The risk management process generally comprises five phases: (1) risk identification, (2) risk analysis, (3) risk control, (4) follow-up and (5) monitoring of the corrective measures taken (Badri et al., 2012).

- Training of staff in good practices to adopt in the workplace (Hallowell et al., 2013; Hinze et al., 2011; BSI, 2007; CSA, 2006).
- Leadership by production managers (supervisors, etc.) is identified as an important element for improving OHS (Hinze et al., 2013; Mirabi et al., 2014; Stadnyk, 2011). According to other authors, two aspects of leadership are the most important: 1) favouring the participation of workers and 2) being communicative and attentive to the preoccupations of workers (Simard and Marchand, 1997).
- Safe behaviour including compliance with safety rules and participation in the identification and elimination of hazards (Liu et al., 2014; Mirabi et al., 2014; Sgourou et al., 2010; LSST, 2016).
- Considering prevention from a continuous improvement perspective. Although continuous improvement of OHS is a less-discussed subject, OHS management systems (OHSMS) are based essentially on this concept (BSI, 2007; CSA, 2006).

Some authors point out that improving the OHS performance of an SME is not achieved in the same manner as in a large corporation (Masi et al., 2014). First, in order for OHS management in an SME to be effective, the approach must be simple, low-cost and meet the needs of the workers and managers (Hasle and Limborg, 2006; Sinclair et al., 2013). The elements most emphasized are commitment of upper management and risk management (Walker and Tait, 2004) while the most crucial is the approach to convincing the decision-makers to make a stronger commitment to OHS management (Hallowell et al., 2013; Hasle and Limborg, 2006). Improving OHS thus requires a concerted effort focused on several elements within a business. Weakness or absence of any of these will have a proportionate impact on OHS.

Evaluation of performance may be defined as the process of quantifying the effectiveness of actions (Neely, 1995). This allows better targeting of strategic or operational goals, assessment of progress made and comparison with competitors (*benchmarking*). Performance evaluation is an essential component of OHS management (Liu et al., 2014). It allows monitoring of implementation processes, activity development and results (Sgourou et al., 2010). In other words, performance evaluation facilitates improvement of performance through clear identification of weaknesses and suitable corrective measures.

Considering the differences between small and large businesses, as much in terms of the elements that allow improved performance as in terms of obstacles encountered only in the SME setting, we recognize that the evaluation of OHS performance must be adapted to the size of the business.

OHS performance evaluation is carried out essentially using performance indicators. A performance indicator is the measurement of an element considered important within a given model (Wreathall, 2009). Two types of indicator are recognized, namely reactive and proactive (Roy et al., 2008). In conventional practice, OHS performance is evaluated using reactive indicators (Sinelnikov et al., 2015). These allow assessment of the impact of actions undertaken to manage OHS (Juglaret, 2012). The most commonly used reactive indicators are accident frequency and the seriousness index.

There are several advantages to using reactive indicators. They are simple, cost very little to obtain, and are easy to interpret (Roy et al., 2008). They constitute valid measurements of OHS performance (Lingard et al., 2011), meaning that they provide a view of the actual performance of a business. Competitive and comparative analyses are also possible, since the underlying formulae are standardized (Sgourou et al., 2010) and trends can be monitored (Lingard et al., 2011). An SME that sees continued improvement in its reactive indicators knows that it is on the right path with regard to accident prevention. When based on large volumes of data, they are highly useful, especially for assessing the effectiveness of preventive actions (Cadieux et al., 2006). Nevertheless, OHS performance evaluation based solely on reactive indicators is incomplete in several ways (Reiman and Pietikäinen, 2012). To begin with, their reliability is questionable. They are not sensitive enough to detect short-term improvement or deterioration (Roy et al., 2008). In addition, under-reporting of injuries reduces their precision, and they generally do not include near misses or incidents (Roy et al., 2008). Furthermore, they provide information about OHS performance prior to the period of measurement. They do not provide a current view or any means of anticipating future performance, and hence any basis for timely implementation of corrective measures (Cadieux et al., 2006). Another factor to consider is the *shotgun* effect of these indicators (Hinze et al., 2013). They do not indicate what specific operations to target in order to improve accident prevention. When a reactive indicator suggests poor

performance, a manager might undertake several actions without knowing which if any will address the actual problem. Finally, decisions based on these indicators can lead to an "accident cycle" (Cadieux et al., 2006 ; Lingard et al., 2011), meaning that responses to poor performance, while effective, diminish as improvements are achieved, and the number of accidents increases again. Over the long term, such fluctuations in preventive measures are counterproductive to OHS improvement (Cadieux et al., 2006).

Proactive indicators are measurements of the progress achieved by giving priority to specific preventive activities (Reiman and Pietikäinen, 2012). An example would be the frequency of workplace inspections. This type of indicator focuses on preventive actions in place and those that should be implemented. Their use has a strong influence on worker behaviour (Hallowell et al., 2013; Roy et al., 2008), for example through better follow-up of preventive action plans. A manager can thus set priorities (Roy et al., 2008).

Proactive indicators also have their drawbacks. First of all, the information they contain is highly specific (Reiman and Pietikäinen, 2012). The frequency of OHS inspections, expressed as some number per month, provides no information relating to the quality of the inspections or to non-compliances noted. The validity of an evaluation based on proactive indicators thus depends on the relevance of the initial choices. The view of the situation may be incomplete. These indicators are not easily measured and are subject to biases, and evaluations based on them tend to be lengthy and subjective (Reiman and Pietikäinen, 2012). Training in their use is required and the evaluation criteria have to be explained to the users (Robson et al., 2012). And finally, the relationship between this type of indicator and the number of occupational injuries remains unknown (Delatour et al., 2014). For example, it is not known how frequent inspections need to be in order to result in a given level of OHS performance.

2. Methodology

The goal of this paper is to provide an overview of the tools used currently for OHS performance evaluation and to determine their suitability for use in the SME context. To achieve this goal, we have organized our review of the literature as follows: (1) literature search method; (2) selection of relevant publications; (3) extraction and classification of data; (4) discussion of the studies.

We began with a survey of the literature and a brief summary of the extent to which OHS performance is evaluated in organisational management and OHS practices, with special focus on SMEs.

We then selected articles by querying the databases *Compendex*, *Inspec* and *Google Scholar* using keywords such as performance, occupational health and safety (OHS), safety, indicator, evaluation, analysis, OHS measure, OHS intervention, quantitative evaluation, qualitative evaluation, safety program, safety audit, safety culture, organisation, industry, law, model and tools. We also obtained research reports published by OHS organisations (e.g. Institut national de recherche et de sécurité, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, etc.). Searches were carried out in French and English with keyword groups combined using the "AND" or "OR" operators. The publications thus obtained were used to structure our examination of OHS performance evaluation and especially the tools used therefor.

Relevant studies were assessed for methodological quality and the clarity of their objectives. We analyzed titles, keywords and abstracts. Only research articles subjected to peer-review, research reports, theses or memoirs, standards and laws were included. Conference articles and articles from the professional literature were excluded. We thus analyzed more than 60 peer-reviewed publications. Of these, 43 were retained. These were published in journals around the world, mostly between 2005 and 2015 and as far back as 1995.

Finally, our discussion focused on these 43 publications. Their relationship to the general subject area is shown below in an impact diagram (Figure 1). Some of them have contributed to development in more than one field. With regard to OHS performance

evaluation tools, the analysis was conducted using four criteria drawn from the literature and detailed in the following sections of this paper: content validity, combined use of both types of indicator, simplicity and reliability.

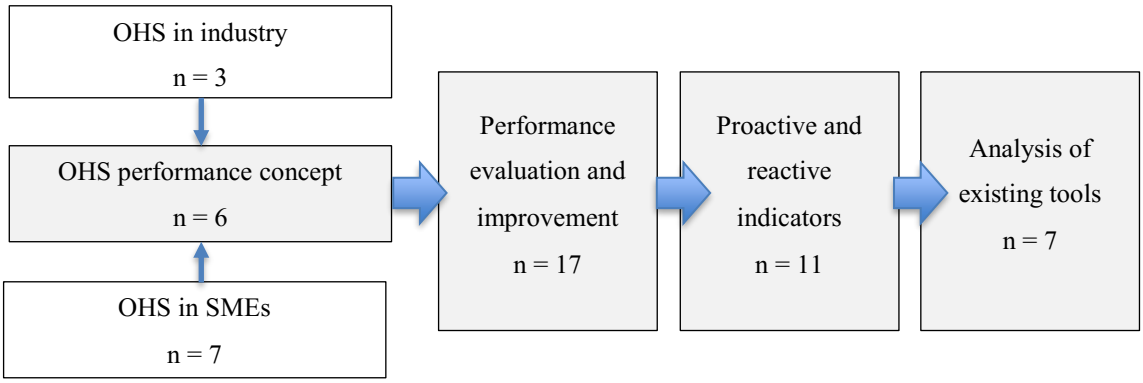

Figure 1: Distribution of 43 publications in terms of impact in various subject areas relating to OHS performance evaluation

3. Results

In accordance with our methodology, six performance evaluation tools were selected from the scientific literature published since 2005 and described in detail. We analysed the extent to which their features correspond to the needs of SMEs. In order to facilitate our analysis of the existing tools and to see how they might be used in an SME setting, we reduced the recurrent themes in the literature to four criteria:

- Content validity: this indicates the extent to which the various components of a tool represent the concept under evaluation. We thus sought to determine whether or not the tool is usable for evaluating all of the six elements that could contribute to improving OHS. These elements are: (1) commitment of upper management, (2) risk management, (3) training, (4) leadership by production managers, (5) safe behaviour and (6) management of accident prevention using a continuous improvement approach (Simard and Marchand, 1997; Walker and Tait, 2004; Abudayyeh et al., 2006; CSA, 2006; Hasle and Limborg, 2006; BSI, 2007; Sgourou et al., 2010; De Koster et al., 2011 ; Badri et al., 2012 ; Hallowell et al., 2013; Hinze et al., 2013; Masi et al., 2014; Mirabi et al., 2014; Liu et al., 2014; LSST, 2016).

Among these elements, commitment of upper management and risk management are both indispensible for evaluating SMEs.

- Combined use of both types of indicator: To obtain an overall evaluation of the OHS performance of an SME, we expect the tool to include both reactive and proactive indicators (Cadieux et al., 2006 ; Roy et al., 2008 ; Lingard et al., 2011 ; Reiman and Pietikainen, 2012 ; Robson et al., 2012 ; Hinze et al., 2013 ; Delatour et al., 2014 ; Sinelnikov et al., 2015).
- Simplicity: The managers of SMEs have little knowledge of OHS and few resources at their disposal. The approach therefore must be simple and low-cost (Hasle and Limborg, 2006; Sinclair et al., 2013). An OHS performance evaluation tool adapted to the SME setting must be easy to fill out and interpret quickly with little training.
- Reliability: This is defined as the similarity of the results obtained using the tool, from one evaluator to the next. This is an important criterion and one that is often not met (Robson et al., 2010).

Based on our survey of the literature, only six new OHS performance evaluation tools have been described since 2005. It should be noted that other tools have been described elsewhere or are the intellectual property of private businesses and are therefore not included in our analysis. Table 1 lists the six tools, each of which will be discussed in the sections that follow.

Table 1: Comparison of six OHS performance evaluation tools selected in the scientific literature

	Tool	Basis of design	Evaluation content	Sector targeted and Country	Intended user	Criteria noted
1	CHaSPI SME (Wright et al., 2005)	Selection of indicators drawn from literature Reviewed by experts	12 reactive indicators 110 proactive indicators	All sectors United Kingdom	Insurers	Validity Combined indicators Simplicity
2	OHS self-diagnostic tool (Roy et al., 2008)	Selection of indicators drawn from literature Reviewed by experts Iterative process	Proactive indicators (number unknown)	Printing Canada	Manager	Reliability
3	Project Safety Index (Lingard et al., 2011)	Selection of indicators in collaboration with managers and clients	4 reactive indicators 7 proactive indicators 14 survey questions	Construction Australia	Manager	Validity Combined indicators
4	Organizational Performance Metric (Amick et al., 2011)	Selection of indicators drawn from literature Reviewed by experts	8 proactive indicators	All sectors Canada	Manager OHS professional	Simplicity
5	Total Safety Performance (Liu et al., 2014)	Selection of indicators drawn from literature Reviewed by experts	25 proactive indicators	Semi-conductor Taiwan	Not defined	Validity Simplicity
6	Fuzzy comprehensive performance evaluation of HSE (Li et al., 2015)	Selection of indicators drawn from company in-house procedure	29 proactive indicators	Petrochemical China	Manager OHS professional	Validity Reliability

3.1 Tool 1 - Corporate health and safety performance index (CHaSPI, SME version)

This tool was designed in 2005 for the Health and Safety Executive (HSE), the OHS inspection authority in the United Kingdom (Wright et al., 2005). Experts in accident prevention participated in the selection of indicators among those identified in a review of the literature. The tool designers then finalized the set of 110 proactive and 12 reactive indicators. The proactive indicators were divided into 10 categories based on potential risks associated with the following activities: manual handling of loads, repetitive movements, use of chemicals, working at heights, contact with unprotected components of machinery, work with high-pressure equipment or installations, use of vehicles, moving on hazardous surfaces and exposure to noise and/or vibrations. For brevity, only a few examples of the indicators are shown in Table 2 below:

Table 2: Indicators used in the CHaSPI OHS performance evaluation tool (adapted text)

N°	Indicator
1	Workers participate in the identification of risks involved in materials or stock handling tasks and in the choice of methods of avoiding injury.
2	No worker lifts any load greater than 15 kg (or 10 kg for female employees) without mechanical assistance.
3	Loads greater than 10 kg (or 7 kg for female employees) are always handled without twisting or extending the back.
4	Loads greater than 10 kg (or 7 kg for female employees) are never handled below the knees or above the shoulders.
5	Mechanical aids are available to carry out handling tasks that require assistance.
6	Workers are monitored in order to avoid aggravating deteriorating physical conditions by manual handling of materials or stock.
7	Workers are trained in the proper handling of materials and stock.
8	An audit is carried out at least once every 3 months in order to keep informed about pain and discomfort associated with handling tasks.
9	Workers are informed that they must inform their supervisors of all pain caused by the handling of materials and stock.
10	The immediate supervisor checks load-handling techniques regularly.

In this tool, the proactive indicators are scored on a two-level Likert scale. A score of 1 indicates that the indicator is not used or is absent. A score of 2 indicates that the indicator is used or is present. Software compiles and presents the results graphically to facilitate interpretation.

Among the advantageous features of this tool is content validity. All elements of OHS are evaluated directly or indirectly. Proactive indicators are divided into risk categories, thus facilitating the identification of suitable preventive actions, which are linked directly to the indicators. For example, "workers are trained in the proper handling of materials and stock" suggests a preventive action to be taken. Reactive and proactive indicators are used to provide an overall assessment of performance. Finally, the tool can be filled out over the phone and the software is helpful for interpreting the results. However, the inter-judge reliability of the tool has not been verified, and it appears that results may vary considerably from one evaluator to the next. The tool does not have references to standardize the manner in which it is filled out. The exact meaning of the expression "workers are trained" is open to interpretation, namely of what constitutes training. What if only 50% of the workers have been trained?

3.2 Tool 2 - OHS self-diagnostic tool

Designed in the context of a study conducted by the IRSST (the Robert-Sauvé occupational health and safety research institute, Québec), this OHS performance evaluation tool is intended for use in manufacturing businesses (Roy et al., 2008). It is essentially a questionnaire composed entirely of proactive indicators scored on a 10-point Likert scale. Unlike the other tools, it is to be filled out by workers. Here are some of the indicators in the words of the author:

- "The required protective devices are installed on the equipment and machinery."
- "Preventive maintenance of the equipment is carried out."
- "The company provides the personal protective devices required for the work."

Involving the entire staff in the evaluation is an interesting approach. Only two of the six tools are designed in this manner. However, such evaluations have their limitations. The effectiveness of measures may reflect the state of labour-management relations and corrective notices from upper management might be disregarded. The authors of the study anticipated this problem. Using analysis of variance, they grouped respondents into three categories: severe, lax, and barometers. This provides the option of not counting the responses of workers who have an unduly negative or positive view of the OHS situation, thus improving the reliability of the tool. Its principal drawback is that completing the

questionnaire and processing the results require quite a more time than is generally acceptable in SMEs. Since no complete version of the tool was available, we did not analyse the evaluation content.

3.3 Tool 3 - Project Safety Index (PSI)

The design of this tool is attributed to Lingard et al. (2011). The initial goal of their study was to explore the use of reactive and proactive indicators in combination as well as the opinion of workers regarding the use of an OHS performance evaluation tool. The managers and clients of a large construction company were involved in the selection of the indicators and the design of the tool. The indicators retained are summarized in Table 3.

Table 3: Indicators used in the PSI tool for OHS performance evaluation (adapted text)

Type	Indicator
Reactive	Number of employees injured
	Number of injuries requiring medical treatment
	Number of injuries requiring only first aid
	Number of injuries resulting in lost hours of work
Proactive	Number of declared near-misses
	Number of informal inspections
	Number of problems noted during informal inspections
	Number of formal inspections
	Number of problems noted during formal inspections
	Number of analyses of risk
	Number of problems noted during analyses of risks
Survey (complementary)	"My supervisor recognizes and supports safe behaviour"
	"My supervisor takes OHS seriously"
	"My supervisor is open to ideas for improving OHS"
	"My colleagues get involved in the preventive activities"
	"My colleagues try to make the workplace safer"
	"My colleagues pay attention to risks"
	"The work crew values OHS"
	"I have been properly trained in OHS"
	"I have received sufficient instruction on work procedures"
	"I feel free to inform the managers about OHS problems"
	"OHS problems can be discussed openly"
	"Workers' suggestions are appreciated"
	"As long as the work is completed on time, the managers do not care how it gets done" (negative point)
	"As long as no accidents happen, the managers do not care how the work gets done" (negative point)

The evaluation content is complete, thanks in large part to the survey completed by the workers. Unlike tool 2, which does not gather worker opinions, the combination of these with the proactive and reactive indicators facilitates interpretation of the results and identification of corrective measures. The tool is also easy to fill out and the indicators are explicit enough not to require the evaluator to interpret the answers. This is an appreciable advantage.

On the other hand, surveying the entire production staff of a business requires a lot of time. It is unrealistic to expect to monitor OHS performance continually in this manner in SMEs. Surveying workers also has limitations, for example when the results could be influenced by the current state of labour-management relations. Unlike for tool 2, the authors have not provided means of compensating for this potential problem. The reliability of the tool over time is therefore uncertain.

3.4 Tool 4 - Organizational Performance Metric (OPM)

Designed for the *Institute for Work and Health* (a Canadian organisation dedicated to improving work conditions), this tool is the creation of Amick et al. (2011), whose principal concern was apparently minimizing the time required to use it. The eight proactive indicators are shown in Table 4. The design is based on a review of the literature and on input from experts in the field.

Table 4: Indicators used in the OPM tool for OHS performance evaluation (adapted text)

N°	Indicator
1	Regular formal audits are part of the company's normal practices
2	The entire staff values improvement of OHS
3	The company values OHS as much as production or quality
4	Supervisors and workers have the knowledge to perform their tasks safely
5	Workers are always involved in decisions that have implications for their safety
6	Staff having OHS responsibilities have the authority to implement changes identified as necessary
7	There is positive recognition for working safely
8	All workers are provided with the protective equipment needed to work safely

These indicators are scored on a five-point Likert scale. An OHS representative or a company manager fills out the questionnaire. The principal advantage of this tool lies in its simplicity. It can be used over a long distance to obtain a general outline of changes in OHS in a business.

On the other hand, some elements of OHS performance are neglected in the evaluation content. None of the items refers to training, risk management or continuous improvement. The small number of indicators and the absence of reactive indicators raise concerns about reliability and consistency from one business to the next or from one user to the next. For example, the definition of "formal audit" likely varies, as would interpretation of the word "regular" and hence the chosen point on the Likert scale. Although helpful for obtaining broad differentiations between businesses, the usefulness of this tool to an OHS professional or a manager is limited. For example, a poor score for "The entire staff values improvement of OHS" does not suggest what corrective action might bring about the desired change in attitude. De-valuing of OHS by staff may be due to a multitude of factors, and appropriate preventive actions in response will vary depending on the specific situation and the resources at the disposal of the business.

3.5 Tool 5 - Total safety performance (TSP)

Liu et al. (2014) designed this tool to assess the OHS overall performance of a business. Adopting an evaluation model based on a general approach, the authors used 25 proactive indicators (Table 5) drawn from the literature and divided along three dimensions: organisational, technical and behavioural. Input from OHS experts was received for the development of the questionnaire. The indicators are scored on a five-point Likert scale.

Table 5: Indicators used in the TSP tool for OHS performance evaluation (adapted text)

N°	Dimension	Indicator
1	Technical	Inspection
2		Emergency plan
3		Personal protective equipment
4		Management of chemicals
5		Control of risks
6		Risk analysis
7	Organisational	Law, legislation
8		Accident investigation
9		Commitment of upper management
10		Organisation and responsibility
11		Training
12		Management of subcontractors
13		Supply management
14		Management of change
15		Work permits (hazardous work)
16		Communication
17		Monitoring of the work environment
18		Health check-ups
19		Audit
20		Review of planning
21		Review of execution
22		Follow-up review
23	Behavioural	Staff participation
24		Safety-oriented behaviour
25		Safety-oriented attitude

The principal advantage of this tool resides in its structure and the choice of proactive indicators. By ensuring representation of organisational, technical and behavioural elements, the authors have devised what we consider to be an essentially complete evaluation. The five-point Likert scale scores quickly provide an overview without advanced expertise in the field. However, as is the case with tool 4, this evaluation does not indicate which preventive actions would best address a given apparent weakness, and the consistency of the results is uncertain. For example, it is unclear what the “Inspection” indicator encompasses, or what a score of 3 would mean versus a 5 assigned by another evaluator. Again, there are no supporting reactive indicators.

3.6 Tool 6 - Fuzzy comprehensive performance evaluation of HSE

This tool is based on *fuzzy logic* (Li et al., 2015), which allows simultaneous evaluations by several users to be taken into account. The evaluation is software-assisted and represents aggregate results. The content consists of the 29 proactive indicators (Table 6) drawn from the internal procedures of a large petrochemical company and scored on a five-point Likert scale.

Table 6: Indicators used in the HSE fuzzy logic tool for OHS performance evaluation (adapted text)

N°	Indicator	N°	Indicator
1	Leadership and commitment	16	Relations with the public
2	Values and mission	17	Work permits
3	Risk management	18	Workplace health
4	Law and legislation	19	Clean production
5	Objectives and targets	20	Operational control
6	Programmes	21	Management of change
7	Organisational approach	22	Emergency plan
8	Resources	23	Performance measurement
9	Training and sensitisation	24	Evaluation of compliance
10	Communication	25	Correction of non-compliance
11	Documentation	26	Accident management
12	Monitoring of documentation	27	Monitoring of accounting
13	Safeness of the premises	28	OHS internal audit
14	Subcontractor management	29	Upper managerial review
15	Clients and products		

Aggregation of the scores of several evaluators is a very interesting approach to ensuring improved reliability. It should be noted that the goal of the authors was to explore the application of fuzzy logic to OHS performance evaluation and that selecting an optimal set of indicators was not their primary preoccupation. In the case of the petrochemical company, the selection of proactive indicators from their in-house procedures appears to provide a complete evaluation. However, some of these indicators would be difficult to apply to SMEs in general. For example, subcontractor management or relations with the public are not as important to SMEs as they are to large corporations. Furthermore, the aggregation of multiple evaluations is of no real interest to a typical SME in which a single manager, OHS representative or professional would be using the tool. Finally, as is the case

for tools 2, 3 and 4, the HSE tool does not include any reactive indicator, and as is the case for tools 4 and 5, the proactive indicators do not suggest what specific preventive actions would result in improved scores.

4. Discussion

OHS performance evaluation is complicated and focused on several elements, including management commitment and risk management (BSI, 2007). Improving OHS performance requires a strategy of continuous improvement (CSA, 2006). A business that is attempting to improve its performance must not only put these elements in place but also ensure especially that the measures are effective, efficient and provide adequate means of monitoring OHS. It is therefore indispensible for such a business to evaluate its OHS performance periodically. In reality, this evaluation often falls by the wayside in SMEs (MacEachen et al., 2010).

OHS performance evaluation tools are often based on reactive indicators (e.g. workplace accident frequency or seriousness). Although simple to measure, this type of indicator provides little useful information for identifying OHS deficiencies (Hinze et al., 2013). Researchers are starting to turn their attention to proactive indicators (e.g. percentage of employees with OHS training, the frequency of workplace inspections) as a way of obtaining more helpful evaluations. These indicate the efficiency of preventive processes within a business, and even to identify problems before they result in accidents (Sinelkinov, 2015). Proactive indicators thus represent an important source of OHS information. However, their use remains largely unexplored in the scientific literature (Wright et al., 2005; Roy et al., 2008; Lingard et al., 2011; Amick et al., 2011).

The strengths and weaknesses of these two types of indicator show that neither type alone provides a precise and reliable measurement of performance (Lingard et al., 2011). In order to obtain a complete evaluation, both types ought to be used simultaneously. By triangulating these, it should be possible not only to obtain an overall and realistic view of the situation, but also to identify needs (Lingard et al., 2011). Information obtained from one type of indicator could confirm or add value to the information drawn from the other. In summary, performance indicators, whether reactive or proactive, each have their strengths and weaknesses. These are summarized in Table 7.

Table 7: Complementarity of reactive and proactive performance indicators

Indicator	Advantage	Drawback	References
Reactive	- Easy to interpret - Recognized validity - Simple - Quick - Low cost - Identify trends	- Poor sensitivity - Poor reliability - *Shotgun effect* - Inform about the past - Feed accident cycles	Cadieux et al. (2006) Roy et al. (2008) Lingard et al. (2011) Reiman and Pietikainen (2012) Robson et al. (2012) Hinze et al. (2013) Delatour et al. (2014) Sinelnikov et al. (2015)
Proactive	- Inform about current status - Identify actions to take	- Validity inconsistent - Difficult to measure - Subject to bias - Indicator-effect association unknown	

Several observations emerge from this comparison of six OHS performance evaluation tools. First of all, the same design method was used in most cases: referring to the scientific literature for the selection of performance indicators and then having experts review the selections. In most cases, this led to evaluation content that was complete and corresponded to the aims of the researchers. Next, it appeared that few authors were interested in developing tools adapted specifically to the SME setting, the exception being the *Health and Safety Executive* (tool 1, Wright et al., 2005). Moreover, it was this tool that appeared best suited to the needs of small businesses. Although reliability was a stated concern of some authors, no group checked inter-judge reliability. This reliability refers to the similarity of the results obtained by different experts using the same tool, and is essential for OHS evaluation aids that are to be truly helpful (Robson et al., 2010).

We also noted that only two of the tools were intended for filling out by an OHS professional. One of these, designed for the *Institute for Work and Health* (Amick et al., 2011), consisted of eight proactive indicators that provide a quick performance evaluation but only scant assessment of the effectiveness of preventive activities. At best, the professional obtains a general outline of the situation. The other tool (Li et al. 2015) allows

simultaneous consideration of several professional opinions, something unlikely to occur in an SME, where one OHS professional is almost a luxury. Its evaluation content would be difficult to apply to SMEs in general, since it was derived from the in-house procedure in place in a petrochemical company.

The development of OHS performance evaluation tools containing a choice of indicators more suitable for SMEs and offering better inter-judge reliability would be a welcome advancement in the field of OHS.

Table 8 shows the extent to which the six selected tools meet the four criteria (validity of content, combined use of the two types of indicators, simplicity and reliability) as well as the degree of applicability of each tool to the SME setting.

Table 8: Degree of applicability of selected tools in the SME setting

Tool		Criteria				Degree of applicability in SMEs
		Content validity	**Indicators**	**Simplicity**	**Reliability**	
		Six elements contributing to improving OHS	Use both types of indicators	Simple and low-cost approach	Results not dependent on evaluator	
1	CHaSPI SME (Wright et al., 2005)	Yes	Yes	Yes	No	Applicable with adjustments
2	OHS self-diagnostic tool (Roy et al., 2008)	Data unavailable	No	No	Yes	Not applicable (requires too much time)
3	Project Safety Index (Lingard et al., 2011)	Yes	Yes	Yes	No	Not applicable (requires too much time)
4	Organizational Performance Metric (Amick et al., 2011)	No	No	Yes	No	Applicable with adjustments
5	Total Safety Performance (Liu et al., 2014)	Yes	No	Yes	No	Applicable with adjustments
6	Fuzzy comprehensive performance evaluation of HSE (Li et al., 2015)	Yes	No	No	Yes	Applicable with adjustments

Limitations of this review

We examined only publications retrievable by querying databases. With one exception (Mendeloff, 2006), all of the documents were either peer-reviewed journal articles or government publications. The OHS performance evaluation tools examined were limited to those described in scientific publications. Other types of literature (e.g. government reports, unpublished internal reports, patents, etc.) were not taken into consideration. Some approaches to the task of OHS performance evaluation may therefore have been overlooked. These are potentially numerous.

5. Conclusion

Performance evaluation is an important step in the process of improving any operation or condition, and this is certainly true for OHS. Over the years, several evaluation tools have been developed in order to monitor progress in OHS and the effectiveness of preventive actions in businesses and other organisations where the tasks of workers involve physical risks.

This review of the tools currently described in the scientific literature reveals that the particular needs of SMEs are not being met adequately. No tool is adapted specifically and completely to this type of business. The development of OHS performance evaluation tools containing a choice of indicators more suitable for SMEs and offering better inter-judge reliability would be a welcome advancement in the field of OHS.

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