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A management accounting perspective on safety

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ABSTRACT

Management accounting supports decision making in organisations by providing managers with relevant information and analysis on the performance, costs, and benefits of a certain operation. For safety-related issues, cost-based calculations dominate practice, and typical measures include cost per injury or the total cost of accidents. Monetary information is needed to guide safety-related decision-making. Besides focusing on financial information, management accounting should also focus on non-financial information, such as safety improvement, strategic safety objectives and employee relations.

In safety-related investments, the monetary costs of an investment are usually well known, but the monetary value of the benefits is hard to calculate. Thus, there is a need for cost–benefit evaluation methods, including the non-financial benefits and value created though preventing accidents. In addition to calculating the safety investment costs, the efficiency of the improvements, such as productivity improvements, quality and the value of safety goodwill, should be evaluated as well.

The objective of this paper is to chart current management accounting practices related to safety issues on the basis of findings from relevant literature. Moreover, we discuss the applicability of certain management accounting methods for safety-related decision-making and how these can be used to improve current practices further. The relevant methods include the Balanced Scorecard approach, the payback period, the simple rate of return, and the benefit-to-cost ratio. They all offer means of calculating the cost and benefits of safety if the basic problems of uncertainty, valuation, perimeter of analysis, and quantification of costs and benefits are perceived. Valuing human life in cost–benefit analyses is also discussed.

1. Introduction

1.1. Background

Successful management requires relevant information guiding decision-making in organisations. This also applies to decision-making related to safety. From a safety management viewpoint, information is mainly needed to: (1) decide where to focus actions, such as safety interventions and their nature; (2) monitor the level of safety and (3) motivate those in a position to take the necessary action (see e.g. Hale, 2009). Furthermore, more precise cost calculations result in more realistic bids, customer profitability and project cost calculations (Rikhardsson and Impgaard, 2004). In responsible safety-critical organisations, safety-related objectives, such as minimising accidents, are often also strategic objectives. Decisions made in organisations affect the achievement of these objectives; hence, understanding the decision-making context is essential. However, the safety management perspective is generally absent in management studies and literature. There is a call for a more multidisciplinary approach and engagement with safety issues in management research (Zanko and Dawson, 2012).

The role of management accounting (MA) is to provide information for internal decision-makers, typically managers. Unlike financial accounting (FA), which provides information for external users such as investors, creditors and tax officers, MA is not regulated by mandatory rules such as accounting standards and generally accepted accounting principles. For credibility reasons, the information generated by MA must be in line with FA. Typically, MA obtains data from FA. Moreover, MA information is quite often used in FA, such as in inventory valuation. Thus, although there are no strict rules for MA, the four main ethical accounting rules—prudence, consistency, objectivity and relevance—should be kept in mind.

MA information is also needed for safety-related investments and interventions. Nevertheless, the tradition of utilising methods of MA is not well-established in safety-related decision-making. Safety indicators traditionally used to provide this information

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include, for example, output indicators, such as the accident rate and lost days, and intermediate indicators, such as safety climate scores and safety training.

For safety-related issues, cost-based calculations dominate practice, and typical measures include cost per injury or the total cost of accidents. A typical problem in safety-related investments is that the monetary costs of an investment are usually well known, but the monetary value of the benefit is difficult to calculate. This is true, for instance, when trying to define the value of a company's safety reputation with respect to its employees or customers. Thus, the need for cost–benefit evaluations of safety investment is recognised. From the MA perspective, the value lost through accident costs and created through preventing them is interesting. However, comparing certain investment costs with uncertain benefits (e.g. the avoidance of accident cost) is problematic (see e.g. Aven and Flage, 2009). In addition to calculating safety investment costs, the efficiency of the improvements should be evaluated. Quite often, only cost savings are measured, but productivity improvements and even the values of safety goodwill should be measured as well. Besides focusing on financial information, MA currently also focuses on non-financial information, such as project evaluation, strategic planning and stakeholder relations (Rikhardsson, 2006). Corresponding information is also required to guide safety-related decision-making. The efficiency of the improvements can be enhanced by collaborating with occupational health and safety (OHS) professionals in planning and decision-making activities (Grant et al., 2003).

1.2. Objectives

The primary objective of this article is to chart current MA methods on the basis of findings from relevant literature. The focus is on methods suitable for evaluating the safety investments and interventions and defining the value of safety. As we discuss MA methods, we recognise that a company's view on a topic, even the cost and benefits, can be a burden to different stakeholders, such as like individuals and society. Moreover, we discuss the applicability of these MA methods for safety-related decision-making and how they can be used to improve current practices further. In addition, weaknesses in the literature are identified as topics for further research.

2. Materials and methods

This paper is based on a literature review compiled through a Finnish multidisciplinary research project, Safety Valu€, which aims to promote economic measurement and indicators of safety. The literature review and related workshops were conducted by a multidisciplinary group of safety and accounting researchers from the Tampere University of Technology, the VTT Finnish Technical Research Centre and the Finnish Institute of Occupational Health. The objective of the literature review and workshops was to investigate the current state of the research concerning the value of safety, safety performance measurement and management accounting methods suitable for safety investments and interventions. In the multidisciplinary workshops, the study was directed and outlined according to the objectives of the Safety Valu€ project. This study forms the basis for the forthcoming safety performance measurement concepts and models of the Safety Valu€ project. The literature searches were carried out in English with multidisciplinary databases and portals such as Compendex and Elsevier Science Direct. Former systematic reviews on OHS and safety intervention topics and reviews on economic analysis were taken into consideration. The relevant peer-reviewed scientific articles, review articles, conference papers and books were chosen by the researchers. The relevance of the information was discussed within the research group to achieve a solid consensus.

The entire literature review is utilised to extend appropriate from the viewpoint of the objectives of this paper. The observations made on the basis of the literature review are supplemented with authors' experiences in previous work. This paper will serve as a basis for the future development of a vision and a roadmap for measuring the financial effects of safety and related tools according to the Safety Valu€ project's research plan.

Many different definitions of safety exist. How safety is understood and defined directs what factors are taken into account and when decisions related to safety are made. The concept of safety in this paper is defined as it has been defined in the Safety Valu€ project. The focus is on industrial branch and organisational safety. The concept of safety has been defined by 11 researchers in Safety Valu€ project workshops: ***organisational safety*** *is the capability of the organisation to manage the operations to sustain economic, social and environmental well-being.* Based on the findings of the literature review, many relevant articles deal with OHS. In this paper, OHS is seen as an essential element of organisational safety.

3. Theory

3.1. Performance measurement and the Balanced Scorecard approach

There are many reasons for performance measurement. Uusi-Rauva (1996) points out the following reasons: guiding, planning, controlling, alarming, diagnosing, learning, informing and rewarding. Ingalls (1999), on the other hand, finds that measures first indicate where priorities are placed. Moreover, measuring enables reasoned decisions and assessments and provides the basis for comparison with previous performance or planned performance. Fig. 1 illustrates how individual key performance indicators (KPIs) may be derived top-down starting with the strategy (de Waal, 2007). This top-down direction is essential (see e.g. Kaplan and Norton, 2004; Uusi-Rauva, 1996). Individual measures should be based on important factors, preferably on critical success factors (CSFs). Boynton and Zmud (1984) define CSFs as follows: "*Those few things that must go well to ensure success for a manager or an organization, and, therefore, they represent those managerial or enterprise areas that must be given special and continual attention to bring about high performance.*"

Organisations often successfully use business performance approaches such as the Balanced Scorecard (BSC) (Kaplan and Norton, 1996a) to develop and align their organisational strategies. The BSC is one of the most widely used performance measurement frameworks (Tung et al., 2011). The concept was developed because

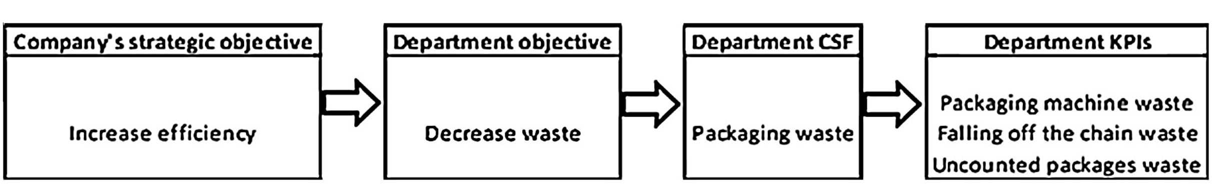

Fig. 1. Deriving KPIs from strategic objectives (adapted from de Waal, 2007).

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traditional financial measures could not capture all of an organisation's value-creating activities, such as competence, technologies and innovation. Typically used financial measures, such as return on equity, indicate the results of past actions but provide little guidance on future performance. Consequently, operational measures relating to customer satisfaction, internal processes, innovation and learning are needed alongside financial measures. These measures provide valuable information on the future financial potential of the company and focus on lead indicators in monitoring the organisational objectives. Without these operational measures, there will be a gap between the planning of the strategy and its implementation, as little information is provided on how well the long-term strategic objectives will be achieved. The four perspectives of a typical BSC are the financial, internal business, innovation and learning and customer perspectives. They are presented in Fig. 2. As a strategic decision-making framework, BSC integrates data from these four perspectives. Other perspectives, such as the employee perspective, may be used in addition to these traditional ones (Malmi, 2001).

The original BSC does not emphasise safety elements (Kaplan and Norton, 1996a). However, the supplementary elements may be used in addition to four basic perspectives. Safety may also be considered as a part of, for example, the internal business perspective. Besides safety issues, Brignall (2001) argues that two other notable issues, namely environmental and social matters, are missing from the BSC approach. These approaches are related to corporate social responsibility (CSR), and, as a part of it, social responsibility reporting. According to Gray (1998), the publication of negative results of accidents, for example, inspires efforts to reduce accident risk.

Major organisations face challenges in binding safety strategy to business objectives. Like testing, according to Stevens (2007), safety should not be buried deep under production. It deserves attention at the business level. However, according to Mintzberg (1983), there is evidence that it pays to be good, but not too good (in social responsibility). For example, negative publicity is avoided by meeting the average standard level (Osmundsen et al., 2008).

The BSC approach offers one model for integrating a safety strategy and measures into business objectives. The safety strategy should be derived from the business strategy and unambiguously support the main objectives of an organisation. Kaplan and Norton (2001) argue that companies should include health and safety objectives in BSC if the regulatory or other health and safety considerations are vital for their strategy. Beyond compliance, they may be willing to improve their reputation to recruit and retain valuable personnel.

3.2. Management accounting practices for measuring costs and benefits

There is a saying, 'different costs for different purposes', which means that we have to know in which situation and to which purpose cost calculations are used. There is no one universal correct cost; calculations are based on assumptions of value, usage and so on. The important factor is to know how and why the assumptions are made. Thus, we must decide certain things before designing a MA system. First, we must decide what costs and incomes (benefits) should be included. The general principle that should be followed is causality, meaning that only those costs and incomes caused by a decision or action should be included. Moreover, we must keep the relevancy rule in mind. There is no practical reason to include one-cent costs if, in general, we are discussing thousands of Euros. Second, we must decide how costs and benefits are valued. When defining a value for machinery, several values can be used, such as replacement value, bookkeeping value and insurance value. However, value is often subjective, and when it comes to more complicated situations, the question becomes more philosophical than technical, such as the value of life (Hansson, 2007). If we decide to use monetary value for life, it is only for calculation purposes—not a value of any specific person's life. Third, we must decide how costs and benefits are measured. Can we use typical measures of money, time, length, weight, and so on, or are we required to use some other means, subjective or more indirect measures? Moreover, how can pain, sickness or suffering be measured? Fourth, we must decide how costs and benefits are assigned to cost objects. The causality principle should be followed, and it is often possible. However, it becomes more complicated when addressing uncertain benefits. Often, causality is unclear, and as companies are not operating in a controlled environment, many factors affect the outcome. Finally, when costs and benefits accrue over time, we must decide how they should be divided over

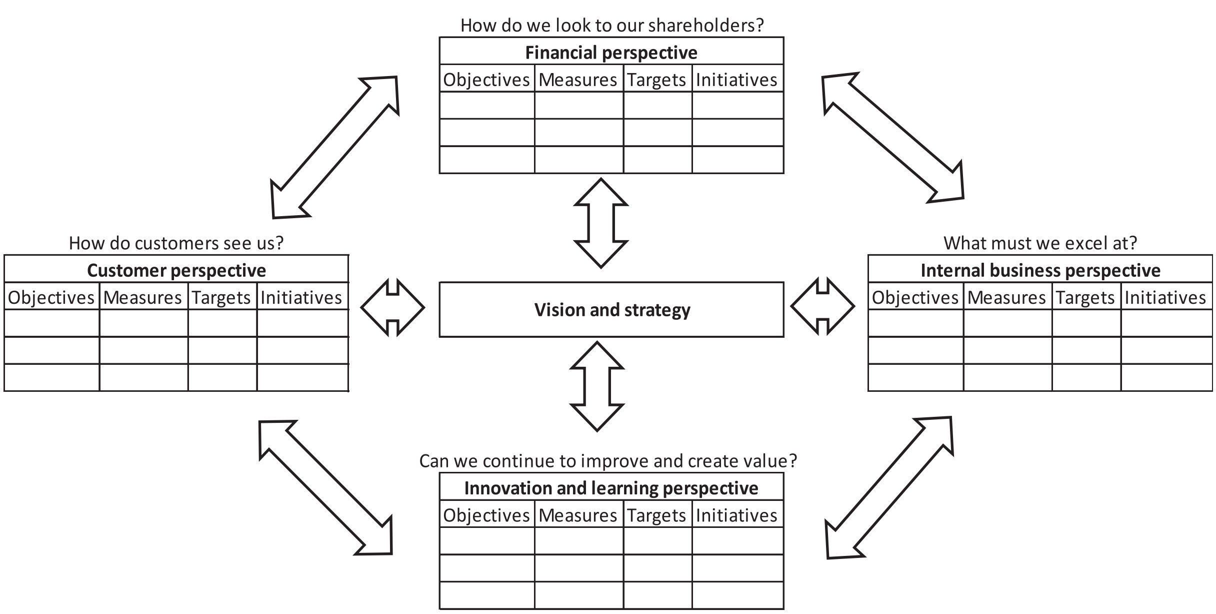

Fig. 2. The four perspectives of the Balanced Scorecard (adapted from Kaplan and Norton, 1992, 1996b).

the years. In other words, how can we divide the costs of an investment over the lifetime of the investment?

If the goal—for instance in society—is equality in relation to safety (the same basic opportunities to stay alive), the pure cost–benefit assessment in monetary terms may lead to great inequalities. This is caused by the obvious fact that the expenses for 'saving a life' vary a lot depending on the context (for example, it is much more expensive to ensure safety in mines than in offices). Since the goal is equality in safety, if the cost–benefit assessment is applied, society should use context-specific balancing instruments, such as monetary support for safety work or the threat of penalties.

3.2.1. Occupational health and safety costs

It is often stated that overall OHS costs must be made explicit to motivate managers to take OHS issues into account in their decision-making (e.g., Tappura et al., 2013). However, they are rarely assessed, for example, due to difficult and time-consuming data-collection processes (Jallon et al., 2011a). The costs of occupational accidents, as well as health and safety costs, have been the subject of many studies. Heinrich's work dating back to the 1920s is considered the first. In their literature review, Jallon et al. (2011b) list 29 different studies in which direct and indirect costs of workplace accidents are measured. Nine of these studies have a top-down approach that uses national data and statistics to calculate an average cost by accident. Seven studies have a bottom-up approach, and an average cost is defined based on surveys and interviews. The remaining 13 studies are based on company-level data collection, and seven of these have some sort of cost–benefit analysis (CBA). Although the study is not comprehensive, it sheds some light on the challenges in measuring OHS costs.

Rikhardsson (2006) compares selected methods for measuring OHS costs: the Accident Consequence Tree (ACT), Reie and Imbeau ABC, Systematic Accident Cost Analysis (SACA), and Health & Safety Executive (HSE). All four methods have a primary focus on the costs of occupational accidents and have similarities with activity-based costing. They are used to collect systematic data on activities and consequences when an accident happens. Moreover, all these methods are tested and their usability proven. However, all the methods are still quite local, and none is widely used.

Jallon et al. (2011a) studies the process that begins with an accident and finishes with the injured person's full return to work at 10 companies in four different industrial sectors. It is found that the process is quite similar in all companies. There are mandatory and optional activities, but the general process is quite the same. Thus, a process map can be used to track costs and can provide the framework to determine the costs of occupational accidents.

There are several classifications of OHS costs. One of the simplest is dividing them into two categories: preventive costs and the costs of consequences (e.g. López-Alonso et al., 2013). Lahiri et al. (2005) have four classes in their net-cost model: the direct costs of investment on interventions, medical care costs, loss in productivity and productivity enhancement. The costs of consequences can be divided into insured and non-insured costs. Furthermore, the classification between direct (e.g. absence and medical) costs and indirect (e.g. overtime, administrative and production) costs is commonly used. There are some rules of thumb about the ratio between direct and indirect costs in which indirect costs are typically notably higher (Tappura et al., 2013). However, the ratio depends on many contingency factors, such as the industry sector, company size, accident type and length of absence, and neither general rules nor a multiplier between direct and indirect costs can be used (Cagno et al., 2013; Tappura et al., 2013).

Sun et al. (2006) classify indirect cost components into five classes: legal and administrative, productivity, replacement, investigation and other. Gavious et al. (2009) calculate the total costs of industrial accidents as the sum of direct costs, indirect costs, added marginal costs due to the accident and immeasurable costs such as reputation and workers' motivation. Rikhardsson and Impgaard (2004) describe the following six categories of accident costs:

1. Absence of the injured employee (e.g. payment of sick pay and payment of supplementary sick pay).
2. Communication (e.g. formal communication to the staff and management of the organisation as well as informal communication between employees).
3. Administration (e.g. payroll administration, administration regarding health and safety regulations and reporting requirements, follow-up activities and meetings).
4. Prevention initiatives (e.g. purchase of machine components and training initiatives).
5. Operation disturbance (e.g. training of replacements, revenue loss, co-worker overtime and reduction in production).
6. Others (e.g. fines and gifts given to the injured employee).

In general, it can be noted that direct and insured costs are easy to identify and obtain from FA. The indirect costs are more complicated to define, and companies tend to underestimate these invisible costs (Jallon et al., 2011b; Cagno et al., 2013). Furthermore, typically, benefits can only be estimated, and uncertainty is quite high. How much can a safety intervention help avoid medical care costs, and what is the effect on productivity? The accuracy of an estimation of the latter is important because the productivity change is typically the most important single factor when defining the cost–benefit ratio, and typically, a safety intervention cannot be justified without an enhancement in productivity (Sievänen et al., 2013).

3.2.2. Capital budgeting techniques

When an investment is made, costs and benefits accrue over time, which can be many years. To estimate the profitability of the investment, capital budgeting techniques are used. These techniques can be classified into two classes: those that take into account the time value of money and those that do not. In the time value of money techniques, past and future cash flows are discounted, typically to a present value. Practically, there are two techniques that discount cash flows: net present value (NPV) and internal rate of return (IRR). In NPV, all net incomes/expenses are discounted to a certain year, typically year 0, the time of initial investment. To do these calculations, first, all cash flows and their timing should be identified and then discounted to the present value using a determined discount rate. However, defining an appropriate discount rate is not straightforward. The rate can be chosen among many possibilities; it can be the average cost of capital or the marginal cost of capital, it can vary based on the risk of the investment, or it can be an agreed-upon interest rate. The IRR is often considered the most sophisticated capital budgeting technique for evaluating investment alternatives. The IRR gives the discount rate such that the NPV of an investment is equal to zero and the investment with the highest IRR is the most profitable. The IRR technique assumes that all cash flow can be reinvested and that the return rate remains the same. This is often unrealistic and supports the use of the NPV as a capital budgeting technique.

There are two commonly used techniques that do not take into account the time value of money: the payback period and the simple rate of return. The payback period is the time required to recoup the amount of the initial investment. Time is calculated by dividing the net initial investment by the net annual cash flow. The payback period is perhaps the most frequently used capital budgeting technique, as it is simple and easy to understand. Moreover, if the payback time is short, the results are quite accurate. The simple rate of return is a simplified IRR because it does not take the time value of money into consideration. There are several ways to calculate the rate of return, and it can be calculated either on a yearly basis or as a total value. Moreover, it is sometimes called the return on investment (ROI) or the accounting rate of return.

The use of both techniques, the payback period and the simple rate of return, is justified if the uncertainty of the initial values is great, which is often the case for long-term safety investments. There is another reason to use simplified techniques. Often, the uncertainty of estimations is high, and the avoidance of medical care costs and changes in productivity cannon be proven. Typically, the profitability of OHS investment is strongly connected to indirect cost and benefits, and the direct costs, which can be easily traced, cover only part, often a minor part, of the total costs and benefits.

3.3. Valuation of safety

Safety is widely agreed to be a positive value for individuals. In business, safety can be seen as a prerequisite for operation, which means that regulations and agreements are followed to ensure the operation of the company without external disturbances. Many companies have also discovered a positive value of safety and have taken actions to improve their safety above the legally required level. As safety in a company gradually improves, it eventually reaches a level where easy solutions to improve safety have already been applied and further improvement requires more difficult and costly applications. Then the need for assessment of the safety improvement efforts in the decision phase becomes evident.

Many companies have improved their safety above the minimum legal requirements, which shows that they value safety, even though the valuation is not specifically calculated. In these cases, the indirect benefits seem to be more important. Reputation and the creation of trust in a company is a clear customer-driven motivation for safety work in certain cases, such as in food or aviation safety, where the need for safety is obvious for every customer. The environmental movement has raised environmental safety to almost the same position, even though its importance was originally not so obvious. The growing 'vision zero' or 'zero accident' movement is heading to the same place in the field of workplace safety. Recently, negative workplace safety issues have aroused public attention and thus potentially affected reputation. A bad reputation decreases sales, but this effect is uncertain and difficult to evaluate. Other potential indirect benefits of safety are the impact on productivity, product quality and customer satisfaction (Linhard, 2005; Sievänen et al., 2013) or business efficiency and reputation (Gavious et al., 2009).

Ronza et al. (2009) note that, in safety-related cost assessment, one of the most difficult and controversial issues is probably that of attributing a value to human life due to social and moral implications. Nevertheless, they see it as the only way to establish costs when people are hurt. If the moral and social issues are not calculated, the value of human life (or injury) for a company consists of the direct and indirect costs it causes for the company, as mentioned above. Other ways to evaluate the value of human life have been used mostly in relation to societal decision-making (see e.g. Hauer, 2011). In particular, the determined 'value of statistical life' has been used, for example, when decisions concerning traffic safety investments are made. The idea is that, if the costs of safety investment do not exceed the value of the lives they (statistically) save, the investment should be made. Two approaches to determine the value of statistical life have been used: the human capital approach and the willingness to pay approach. The human capital approach counts the loss of individuals' future earnings (i.e. the market value of their work) as the value of their life. The average of such a value of statistical life can be estimated, for instance, on the basis of national statistical data. The willingness to pay approach estimates the value of statistical life by examining how much people are willing to pay for saving lives. This is done either by surveys or by analysing the actual safety-related acquisitions of people.

In addition, disability adjusted life years (DALYs) have been used in cost-effectiveness analysis at the micro-level and in sectoral priorisation in estimating the burden of disease (Fox-Rushby and Hanson, 2001). DALYs are the sum of the present value of future years of lifetime lost through early mortality and adjusted for the average severity of disability caused by disease or injury.

4. Results and discussion

In this paper, the literature review and definitions are based on the objectives of the Safety Valu€ project. The perspective of the literature review was defined and directed by multidisciplinary workshops. The literature review was not systematic but based on a profound analysis of relevant OHS and MA studies to chart the MA methods suitable for safety-related decision-making. The literature analysed in this study serve as a good representation of how the MA methods are used in OHS literature. However, the OHS perspective is absent from MA literature. An analysis of the articles resulting from the literature review and related workshops showed that the following perspectives were relevant to this study: the performance measurement (BSC approach), measuring health and safety costs and benefits and the valuation of human life.

5. Integrating safety into performance measurement and the Balanced Scorecard approach

Green (1994) advocated a BSC approach to safety, but a few other studies are related to this approach (Gallagher et al., 2001). Köper et al. (2009) link OHS to overall business performance and competitiveness, applying the BSC approach. They present and report the connection between health-related issues and key performance factors (quality, productivity, cost reduction and absenteeism). They find that the financial impact of health-related interventions could be demonstrated by the occupational health and safety scorecard approach. However, they state that the quality and availability of health-related data is a major limitation in linking OSH and business performance.

According to Karahalios (2014), the safety-related financial perspective in BSC involves accident costs and profits by reducing the risk of accidents. The customer perspective includes customer expectations such as quality and productivity. The internal business perspective is concerned with, for example, training, planning, review or other procedures that should be followed to avoid accidents. The learning perspective is used to measure the adequacy of resources to provide safety, including technology, human resources and knowledge. In another study, Karahalios et al. (2011) find that the BSC approach can be used to assess the implementation of maritime regulations. They also find that regulations will be more successfully implemented if there is a balance of costs and benefits between stakeholders. The same kind of approach has recently been used to monitor the regulatory compliance of companies (Garcia-Valderrama et al., 2008; Huang, 2007; Osmundsen et al., 2008; Stevens, 2007). Pedersen and Neergaard (2008) discuss integrating CSR and its social and environmental perspectives into a strategic management and performance measurement system, such as the BSC.

Gunduz and Simsek (2007) apply a slightly modified BSC approach to address the safety challenges of the construction industry. First, they renamed the original four perspectives as follows: financial and cultural, learning, process and employee. The initial objects for each perspective were selected based on a literature review. Then a questionnaire was sent to 250 construction industry professionals, which yielded 40 completed forms. These results, combined with the literature review, defined the final objectives. In total, 21 objectives were chosen, and at least one measure was assigned to each. The authors also suggested possible initiatives for achieving the objectives, but concluded that target-setting must be done in individual companies during the implementation stage since these targets differ from one company to another. In addition, Ingalls (1999) find that one of the main ideas of the BSC, including measures that provide information about the future, is of great importance when it comes to safety. Many commonly used safety measures, such as the number of accidents or days lost, reflect the outcomes of past actions but reveal little about overall safety performance. Four functional areas represent the main determinants of organisational safety performance and are measurable: culture/systems, behaviour, safety programs and learning/growth. The author suggests that a BSC approach using these four perspectives and deriving the objectives from the safety strategy could be used to measure organisational safety. Both these studies find that a BSC is a useful tool in safety performance measurement. Furthermore, both studies emphasise the role of organisational culture as an important determinant of safety and have named one perspective accordingly.

According to Mearns and Håvold (2003), the UK regulator and management within the offshore oil and gas industry endorse the value of applying a BSC approach to health, safety and the environment. Their research indicates the value of this approach. Although the senior managers interviewed had a positive attitude toward BSC and those who had implemented the tool achieved results, they indicated that there was much room for improvement in deciding on and including new indicators in the scorecards. One particularly challenging aspect was selecting indicators that had a real impact on performance. The companies using BSC included mainly outcome measures, but process measures are starting to find their way into the scorecards of some organisations surveyed in this study.

Besides general business performance indicators, the evaluation of safety performance is essential in measuring the organisation's commitment to safety, assessing the achievements related to policies and objectives and recognising both good and inadequate standards of performance (OECD, 2008). Safety performance may be evaluated by output indicators (e.g. LTI, absence per accident and lost days) and intermediate measures, such as reports of dangerous situations, safety climate scores, the incorporation of safety in toolbox meetings and behavioural observation rounds with dialogue (Hale et al., 2010).

The application of different managerial tools, such as the BSC approach, is commonly, at least to some extent, based on the assumption that decision-making is a rational process. However, this is not always the case, the reasons being, for instance, that managers might not fully understand the nature of the problem; they may focus too much on past experiences rather than finding completely new solutions, organisation-related factors and the possibility for fostering one's own interest instead of the interest of the whole organisation (Heracleous, 1994).

5.1. Practices measuring health and safety costs and benefits

Decision-making in organisations may be aided by certain calculation techniques, such as CBA. These techniques are presented and discussed as follows. Through CBA, numerical weighing of advantages and disadvantages of certain options is done for decisions. There are philosophical problems affecting the practical performance of CBA, such as how to assign a monetary price to a human life or determine the price of environmental assets. According to Hansson (2007), it is quite common that neither of these practices is applied in CBA. However, CBA is philosophically interesting due to its interconnection with consequentialism (or consequential evaluation) and counterfactual analysis.

Although the time value of money techniques are more sophisticated, they are not commonly used in the case of OHS investments. Typically, the profitability of an investment or intervention is measured by the ROI or benefit-to-cost ratio (e.g. Lahiri et al., 2005; Lyon, 1997). Similarly, the payback period (PBP) is commonly used (e.g. Chhokar et al., 2005; Kemmlert, 1996). However, when studying reported benefit-to-cost ratios and payback times, it is obvious that there is no use for the time value of money. For example, Kemmlert (1996) reports a payback time of one to four months, Oxenburgh and Marlow (2005) two months and Chhokar et al. (2005) 2.5 years. Similarly, benefit-to-cost ratios are reported to be quite high, 5.25, by Amador-Rodezno (2005) and even as high as 84.9 by Lahiri et al. (2005). In all of these cases, the payback period has been so short that the time value of money is negligible compared to the advantages of the investment or intervention. In Table 1 examples of the methods and benefits of the selected studies are presented. All but on case is based on actual data. However, the actual benefits or saving are always estimated because the other possibility, no intervention, does not exists. Only Lahiri et al. (2005) report to use time value for money when adjusting the investment costs. Moreover, they required 7% for the return on investment as a break even profitability.

Economic evaluations are often systematic comparisons of two or more health technologies, services or programs in terms of both costs and consequences (Uegaki et al., 2010). Moreover, evaluations can be comparisons of before and after OHS intervention. There are many case studies of different interventions. The most effort had been invested in costing studies, while problems have been identified with valuing benefits in health and safety (Niven, 2002). According to Tompa et al., 2006, most of the studies consider the consequences only in monetary terms, rather than both

Table 1
Methods and benefits of interventions.

Source	Type of intervention	Methods used	Actual/estimated	Notes
Kemmlert (1996)	Case I: ergonomic	PBP: 4 months	Actual	
	Case II: ergonomic	PBP: 3 months		
	Case III: ergonomic	PBP: 3 months		
	Case IV: ergonomic	PBP: 1 months		
Lyon (1997)	Ergonomic	ROI: 10,8, PBP: 0,1 years	Estimated	
Amador-Rodezno (2005)	Ergonomic	Benefit-to-cost: 5,3	Actual	
Lahiri et al. (2005)	Case A: ergonomic	Benefit-to-cost: 15,4	Actual – questionnaire	Time value for money used
	Case B: ergonomic	Benefit-to-cost: 84,9		
	Case C: ergonomic	Benefit-to-cost: 5,5		
Chhokar et al. (2005)	Ergonomic	PBP: 0,8 or 2,5 years	Actual	
Oxenburgh and Marlow (2005)	Ergonomic, work procedures, and organisational	PBP: 2 months	Actual	All changes were not safety related

the costs and consequences associated with the intervention. In Uegaki's et al. (2010) review, 34 studies fulfilled their selection criteria, and all of them conducted a financial appraisal, but only two studies additionally carried out cost-effectiveness analysis (CEA). None of the included studies performed a cost–utility analysis (CUA). Sixty-five per cent of the financial appraisals reported the difference between monetary benefits and program costs as net savings or benefits, 32% provided a benefit-to-cost ratio, 21% reported the ROI, 9% calculated a payback period and 6% noted an IRR.

Typically, the financial results of OHS interventions are positive. Of 34 studies by Uegaki et al. (2010), 28 reported cost savings or monetary benefits in favour of the intervention, three reported negative savings, two reported both negative and positive monetary benefits and one reported both a cost-neutral and positive situation. The 26 studies reviewed by Verbeek et al. (2009) found that 19 of them had a payback period of less than a year. There were three common studies in the reviews. Similarly, positive effects of ergonomics are reported by Beevis and Slade (2003).

Oxenburgh and Marlow (2005) describe a tool that can be used to estimate the effectiveness of an intervention (workplace change) prior to its introduction. They tested their tool in a hotel that had seen its workers' compensation insurance premium rise to an extent that was affecting the overall company profit. The intervention included improved equipment and maintenance, improved training, work procedures and organisational changes. The tool allowed the estimation of payback time. Due to a change in the employment mix (reduction in contract staff and replacement by casual staff), reduced employee turnover, improved work quality and a greater-than-expected reduction in the insurance costs, the actual payback period was only two months (actual conditions after one year). The estimated payback period was 17 months.

It has been claimed that the methodological quality of economic evaluations of OHS interventions has been poor (e.g. Niven, 2002; Tompa et al., 2006; Uegaki et al., 2010). Uegaki et al. (2010) use the Consensus on Health Economic Criteria (CHEC-list), a 19-item assessment tool, to evaluate 34 studies. The CHEC list represents a minimum set of methodological criteria that address the internal and external validity aspects of studies. None of those studied fulfilled all the criteria, and only three studies scored over 75%. Verbeek et al. (2009) report similar problems when trying to make studies comparable. Tompa et al. (2010) provide guidelines for good practices in economic evaluation and call for a broader perspective (social cost) as well as non-monetary outcomes for industrial and public relations reasons.

The methodological weaknesses cause problems in generalisation, and managers can make incorrect decisions as a result. However, the problem is not unique to OHS intervention studies. Most OHS intervention studies are case studies, for which generalisation is a typical problem. Moreover, there are always philosophical problems in CBA, such as what the monetary price of loss of a human life is or the indeterminateness of control over future decisions (Hansson, 2007). Even though the quality of OHS intervention studies can be discussed, it is good to notice that most of the studies give similar results and thus validate each other. In practice, it is not necessary to know the exact value of intervention. It is more important to know whether the effect is positive or negative. There remains the question of how the costs and benefits are valued and measured.

The values of an organisation and the accepted risk level highly depend on the current values of society (e.g. Merrick et al., 2005). Companies often consider safety programs beyond regulatory or standard compliance to present themselves in a positive light for their stakeholders. Thus, they regard the strategic value of safety programs (Corcoran and Shackman, 2007). In recent studies, ROI and balance of costs and benefits have been analysed and discussed together with the compliance of regulatory, industry or corporative requirements (e.g. Garcia-Valderrama et al., 2008; Huang, 2009; Karahalios et al., 2011; Osmundsen et al., 2008; Stevens, 2007). Cooper (2010) assesses the cost-effectiveness of behavioural safety processes in terms of ROI.

5.2. Adequate risk level and costs of saving human life

Use of the value of statistical life (VSL) is a special application of CBA. It is related to the traditional risk reduction principle presented, for example, in various standards. The principle states that all risks should be reduced to an 'adequate level' or 'as low as reasonably practicable' (see e.g. ISO 12100:2010 and OHSAS 18001:2007). VSL represents the limit of the 'adequacy' or 'reasonability' or the safety effort justifying the costs (Aven and Flage, 2009; Hauer, 2011). Using VSL to represent all (significant) safety benefits simplifies the calculations. Several different estimates of VSL are used. For example, Health and Safety Executive sets the VSL as £1 million ($1.6 million), different US federal agencies have recommended values between $1.5 and 5.8 million, in Sweden, the official value is SEK 21 million ($3.2 million) and in offshore industry, £6 million ($9.8 million) has been used (Andersson and Lindberg, 2009; Aven and Flage, 2009; Hauer, 2011; Health and Safety Executive, 2001).

One strength of the VSL approach is that it is simple for its users. It is also socially justifiable since it represents a lower bound to the benefits to society or the value people set for saving a life. A weakness of the VSL approach is that it only counts deaths. As such, it is applicable for underdeveloped areas where saving lives remains a major issue (like in traffic). However, in most industries—at least in the western world—the main focus is on preventing injuries or even preventing near misses. For that purpose, VSL is too coarse a tool. The same approach could be applicable in relation to injuries, but the estimation of the 'value of statistical injury' would be more complicated since the severity of injuries varies greatly. Studies to estimate the costs of injury have been conducted. In a Finnish study representing different branches of industry and 36 cases, the average cost of one occupational accident was about €6000 ($8200), varying from €300–72,000 ($400–99,000) (Aaltonen et al., 2007). In the USA, the average cost of one occupational accident is estimated to be $15,000 for all industries, and the cost is higher in construction, at $27,000 (Waehrer et al., 2007). Both approaches used to estimate VSL values could also be used to estimate the value of statistical injury. Since the estimation and monetary valuation of costs and benefits of different safety efforts is difficult and laborious, further development of the VSL approach with regard to the value of statistical injury would prove beneficial.

DALYs have also been used in cost-effectiveness calculations and as a method for estimating the burden of disease. However, there are problems in using DALYs since many analyses are not comparable or transferable due to methodological reasons, unclear assumptions made and context limitations. When DALYs are used in cost-effectiveness calculations, certain reporting criteria should be noticed to help the decision-makers to understand the robustness of the results. For example, relevant population models should be used, and all the assumptions used in calculations should be clearly stated (Fox-Rushby and Hanson, 2001).

Setting a common monetary value for (saving) human life represents a kind of economic equality—the value of life is the same for everybody in calculations (in real life, the situation is obviously not the case). Using this as a decision criterion with CBA may lead to inequality in relation to safety when applied in different contexts because of the intrinsic differences between the expenses of safety. Often, the goal can be the equality in safety, that is, the same basic opportunity to remain unharmed for everyone in a society or in an organisation. The 'zero accident goal' is an extreme example of this equality in safety, but the certain upper limit for 'tolerable' risk levels is also used. Above the limit, the risk is regarded as intolerable, so nobody should ever face such risk. The cost–benefit analyses with the VSL can be used even if the goal is the equality in safety, but in that case, some instruments (e.g. additional support) are needed to ensure the equality, or different VSL values in different contexts should be used. Paté-Cornell (2002) suggests that CBA matters only for the tolerable risk levels. This means improving the safety above the minimum required level. CBA still makes sense even if the required safety level (or the goal) is zero accidents since there is always a question about how to use the available resources for safety work most effectively.

6. Conclusions

It should be noted that managerial decision-making is also driven by factors other than rational management accounting. Especially concerning such an emotionally sensitive topic as safety, basic values and emotions may be more effective than any calculations—in many cases, a clear conscience is a strong driving force when the question is about human lives. However, the purpose of this article is to examine the opportunities to apply a management accounting approach to safety work since management accounting is an essential factor in managerial decision-making.

Aligning the safety perspective and business strategy provides value for organisations when they make interventions and investments. They can see one shared goal instead of many varied or even conflicting goals. Using the BSC approach, they can obtain feedback on the effectiveness of actions to make better decisions. There are conceptions and methods for assessing the profitability of safety investments, but they should be further developed from the MA perspective. Non-financial benefits, such as safety and productivity improvements, should be taken into consideration alongside financial benefits. Productivity improvements yield better profitability, and often, safety interventions can be financially judged only because of improved productivity (Sievänen et al., 2013). Safety intervention may have other positive effects, such as better employee commitment but the causality is hard to testify. Moreover, the quality and availability of health-related data is still a major limitation to link OSH and business performance (Köper et al., 2009). Another challenge is selecting indicators that really affect the performance of an organisation (Mearns and Håvold, 2003).

Current MA techniques can all offer means of calculating the costs and benefits of safety. In simple cases, where the direct costs of a preventable accident are significant and the means to prevent it are well defined and known to be effective, the calculation and decision are straightforward tasks. However, in most cases, when estimating the costs and benefits of OHS investments and interventions, we must recognise the potential weaknesses of the methods. The basic problems of uncertainty, valuation, perimeter of analysis and quantification of costs and benefits are always present. There are no right answers to these questions. These are the assumptions that shall be made when defining an MA system.

Typically, OHS interventions are never controlled experiments, so it is hard to include all the consequences of the intervention because they can occur in a distant future and causality might not be straightforward. Moreover, some things can happen even without intervention. OHS interventions can be undertaken to prevent accidents, but accidents happen randomly and the probability is typically low. One serious accident has a significant effect on calculations. Due to high uncertainty, simple capital budgeting methods work well, and there is no need to use a time value of money technique. The payback period and benefit-to-cost ratio give precise enough estimations. For the same reasons, some methods like stock valuation are hard to justify. The link between better safety and stock value is vague, and stock value is a result of many other things that cannot be eliminated in real life.

Valuation is an even bigger problem in a philosophical sense. Should we give a commensurable value for everything? Typically, this means monetary value. For practical purposes, we can do so, but at the same time, we must recognise the possible weakness in doing so. When we give a monetary value for life or pain, we can expect this to be questioned. Instead of valuation of the saved lives, the goal and benefit could be equality at certain level of safety. In this case, the economic analyses serve in searching for the most effective use of resources. One possible solution is not to give monetary value for everything and to include non-monetary values in calculations. This idea has been brought out in the BSC and presents a good option in many cases. The BSC approach aligns safety and business strategies and objectives, especially when safety is vital for the business. One specific advantage of the cost–benefit approach is that, by using it, it is possible to credit to safety benefits that are not directly based on the value of safety itself but are side effects of safety work.

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