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OHSAS 18001 contribution to real and formal safety elements in safety management system in manufacturing

Õ. Paas*, K. Reinhold and P. Tint

Tallinn University of Technology, Faculty of Economics, Institute of Business Administration, Chair of Work Environment and Safety, Ehitajate 5, EE19086 Tallinn, Estonia; *Correspondence: onnela.paas@gmail.com

Abstract. The current paper examines safety management systems in the Estonian manufacturing industry. The aim of this research is to assess via safety audit, to what extent OHSAS18001 contributes to real and formal safety elements of SMS in manufacturing companies. In 2014, eight OHSAS 18001-certified organisations and eight non-certified Estonian enterprises from different branches of manufacturing were interviewed and assessed using MISHA method. The results show via statistical analysis that OHSAS 18001 has a significant impact on formal safety, real safety and combined safety elements. It can be also concluded that the OHSAS 18001 certification facilitates companies' commitment to health and safety activities and leads to dealing with additional topics promoting workplace health and safety. Therefore, OHSAS 18001 can be seen as a strategic unit for improving safety performance. However, after examining three types of companies, we can conclude that a safety management system can be effectively implemented also without possessing the OHSAS 18001 certification, but in the Estonian economy market it usually requires affiliation with a larger corporation or concern. Based on the analysis, a conceptual model is created which helps the company reallocate the resources in a way that all possible safety elements will be covered.

Key words: MISHA method, OHSAS 18001, safety audit, safety management.

INTRODUCTION

The safety management system (SMS) can be considered as a systematic and comprehensive process for proactive managing of safety risks that integrates operations and technical services with financial and human resource management. In order to ensure a successful outcome, the SMS must: (1) be comprehensive and integrated into all of the organization's decisions and actions with respect to adopted control measures; (2) be documented, implemented and readily accessible and used as the primary means of ensuring safe operation; (3) comply with all the requirements stated in the occupational health and safety (OHS) regulation and (4) be continually reviewed and revised so that the SMS remains up-to-date and effective (Kamp & Blansch, 2000; Bottani et al., 2009; Fernandez-Muniz et al., 2009; Möldri et al., 2012; Rebelo et al., 2014; Mežinska et al., 2015; Yorio et al., 2015).

Frazier et al. (2013) suggest the following sub-factors in SMS: safety policy, procedures and rules, training, communication, incident reporting and analysis, safety

audits and inspections, rewards and recognitions, employee engagement, safety meetings / committees, suggestions / concerns and discipline.

After the SMS procedures have been developed, they need to be implemented by people with appropriate skills and knowledge. Training packages should be developed to explain the SMS and they should be delivered effectively to all workers. One possibility for establishing and ensuring effective SMS is to apply for an SMS certification (such as OHSAS 18001 (EVS, 2007)), which creates the basis for systematic work in the area of safety management, hazard identification and prevention, and promotes strong improvement process being put to use (Paas et al., 2015b). The benefits of OHSAS 18001 have been studied by several authors in recent years (Nielsen, 2000; Torp et al., 2000; Hale, 2009; Rocha, 2010; Granerud and Rocha, 2011; Fernandez-Muniz et al., 2012a; Fernandez-Muniz et al., 2012b; Koivupalo et al., 2015;). The aforementioned studies indicate that adopting OHSAS 18001 may improve the organisation's image, reputation and performance. Moreover, it integrates OHS into the company's management system, reduces the risk of accidents, improves the company's compliance with legal obligations, favours a learning process and helps to create a higher level of transparency. However, OHSAS 18001 certification has also been criticised, especially for having a tendency to increase the bureaucratisation of health and safety issues and therefore discourage genuine worker involvement. This may shift the focus from health and safety issues towards paperwork control, which may diminish the activities dealing with OHS problems (Kamp & Blansch, 2000; Nielsen, 2000; Granerud & Rocha, 2011).

The aforethought SMS contributes to a positive safety culture (Fernandez-Muniz et al., 2007a; Fernandez-Muniz et al., 2007b; Hale et al., 2010; Nordlöf et al., 2015; Yourio et al., 2015). A healthy and positive safety culture actively seeks improvements, is constantly aware of hazards and uses adequate units for continuous monitoring, analysis and investigation. Other elements of positive safety culture include the personnel and management being committed to safety responsibilities and the existence of a documented set of rules and policies. Several studies prove that management's strong commitment to safety ensures the establishment of and adherence to sound safety practices (Nielsen, 2014; Koivupalo et al., 2015; Nordlöf et al., 2015). It is important to note that a safety culture cannot be effective without devolving to organizational culture (Järvis, 2013; Yourio et al., 2015). Therefore, the SMS should not rely on a pure paperwork system—rather it should reflect the overall safety culture and be consistent with the mitigation of occupational hazards gained from the risk assessment.

Poor safety culture will encourage an atmosphere of non-compliance to safe operating practices. Violations are likely to be most common in organizations where the unspoken attitudes and beliefs are that production and commercial goals should get priority, rather than safety. Several studies illustrate the cultural expression where there is a constant competition between productivity and safety—e.g. taking shortcuts without using the appropriate units or ignoring safe procedures to increase productivity (Brown et al., 2000; Atak & Kingma, 2011; Nazaruk, 2011). Managers tend to perceive the resources for OHS as expenditures rather than investments. Therefore, it remains difficult to convince the management of the benefits of investing into safety activities—implementation costs are often overestimated and potential failure costs underestimated (Amador-Rodenzo, 2005). Effective SMS should promote the achievement of an acceptable level of safety while balancing the distribution of resources between

production and protection. In any manufacturing organization, production and safety risks are strongly linked (Fig. 1). According to James Reason (1997), when production increases, safety risks may also increase if the necessary resources or process enhancements are not available. A company should determine its key objectives of production and safety by balancing the output with acceptable safety risks. If the resources are excessively allocated for protection or risk controls, it may result in the product becoming unprofitable, thus jeopardizing the viability of the organization. On the other hand, favouring the allocation of resources for production at the expense of protection might have an impact on the safety performance and it might ultimately lead to an accident. Perhaps the most extensive effect of a poor safety culture will be evident in an unwillingness to be proactive with no deficiencies—safety shortcomings will be worked around and allowed to persist.

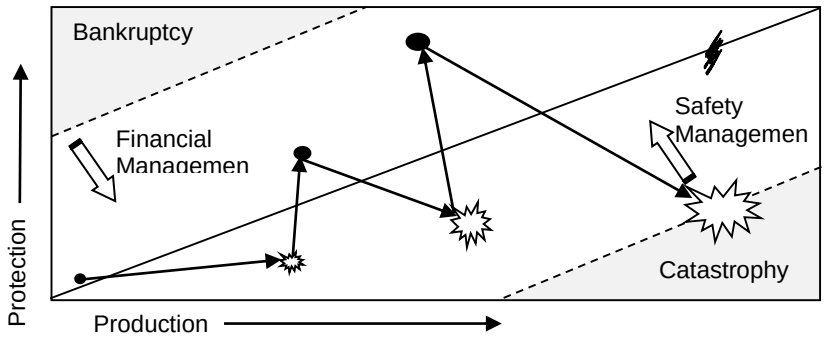


Figure 1. Relationship between safety and financial management to ensure positive safety practice (adopted from James Reason 1997).

Good safety culture should have favourable characteristics that contribute to a positive, desirable and primarily stable state of safety. According to Silva & Lima (2005), an implemented prescriptive safety culture involves not only the congruence between *Safety values exposed* and *Safety values in use*, but a complete real and positive safety response encompassing values, behaviours, organisation and engineering. Naturally, manufacturing companies with relatively high level of hazards should declare safety values and compose the safety policy as a part of formal safety. However, this does not ensure a prescriptive safety culture. According to some researchers (Granerud & Rocha, 2011; Meliá et al., 2012), a formal accent on safety can sometimes be used as an internal and external marketing procedure. It may thus hide some of the real safety weaknesses and lead to window coupling. Some of the flaws which may affect the safety response negatively are: 1) a formal but inefficient use of safety programmes; 2) the existence of general safety instructions not adopted to the company's real needs; 3) hazard analyses existing only on paper without any further action plans or activities being created; 4) lack of real safety communication including immediate intervention and 5) group specific descriptive safety cultures against safety procedures, which sometimes result in developing poor behaviours and attitudes towards safety practices.

The aim of this research was to assess via safety audit in what extent OHSAS 18001 contributes to the real and formal safety elements of SMS in manufacturing companies.

The main objectives were: (1) to examine the impact of OHSAS 18001 on real and formal safety elements, (2) to conduct a safety audit in 16 industrial companies (eight OHSAS 18001-certified companies (OHSAS), four non-certified locally established and owned companies (NOHSASL) and four organisations which belong to a larger corporation or concern but are not OHSAS 18001-certified (NOHSASC)) in order to find the relationships between company type and safety activities and (3) to perform a statistical analysis to find out the significant difference in formal, real and formal+real (combined) safety elements based on company type.

MATERIALS AND METHODS

In 2014, 16 safety audits were conducted in manufacturing companies in Estonia by means of the MISHA method (Method for Industrial Safety and Health Activity Assessment) (Kuusisto, 2000) in the form of quantitative assessment (scale 0–3 for each item) and qualitative interviews. OHSAS companies were selected using the database of Estonian Association for Quality (2014). In order to compare the results with non-certified organizations, eight companies with a similar background were selected—four represented organisations which belong to a larger corporation or concern but are not OHSAS 18001-certified and four that were non-certified, locally established and owned companies representing main manufacturing areas in Estonia such as printing, textile, metal, food, furniture, plastic, glass, heat and electronics industry.

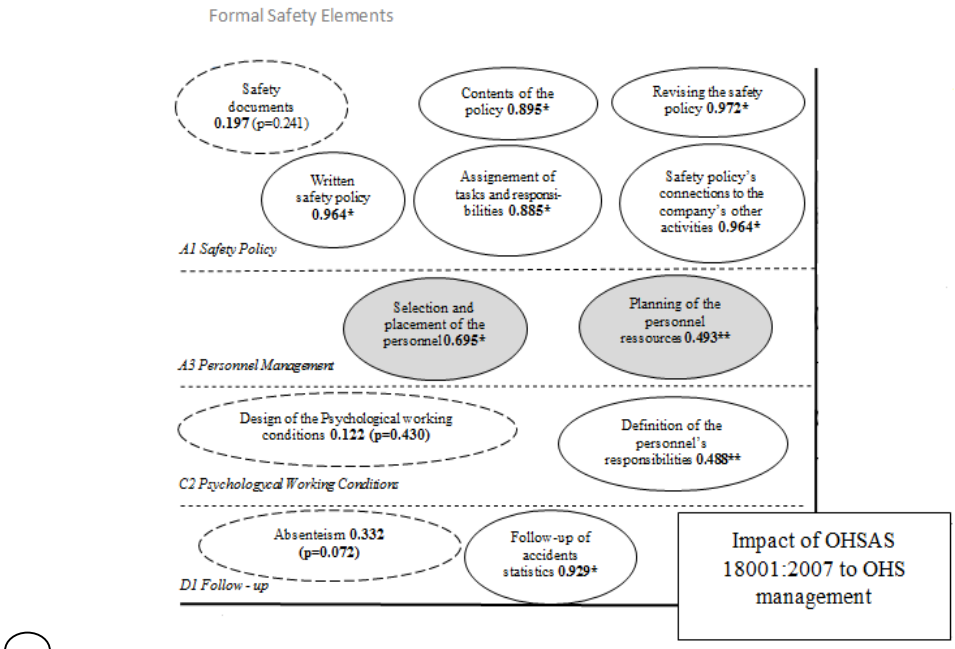
In order to see whether there is difference in OHSAS 18001 impact for formal and real safety performance, the authors interviewed top and line managers and also safety specialists and workers' representatives in enterprises by the MISHA method. As a result, it was determined (using statistical methods) whether the safety element contributes to formal, real or combined safety. Some of the elements indicated possessed properties from both groups, which formed the third group—combined safety elements (Fig. 2b).

A total of 55 questions were asked from each of the person interviewed (MISHA method). Once data collection had ceased, the first author and the interviewer (ÕP) re-listened to the records, checked the coding strategy used for consistency and ensured that all questions had been answered. The second author (KR) then listened to the records and made notes about understanding the answers. After that, the first two authors discussed the answers of each company in order to come to a good level of agreement on the results. The enterprises' number of workers varied from 50 to 250 (Paas et al., 2015b).

Statistical analyses were prepared using the programme *IBM SPSS Statistics 22.0 and R 2.15.2*. The following statistical methods were used: correlation, *MANOVA* and *Factor Analysis Principal Component method* (Field, 2013).

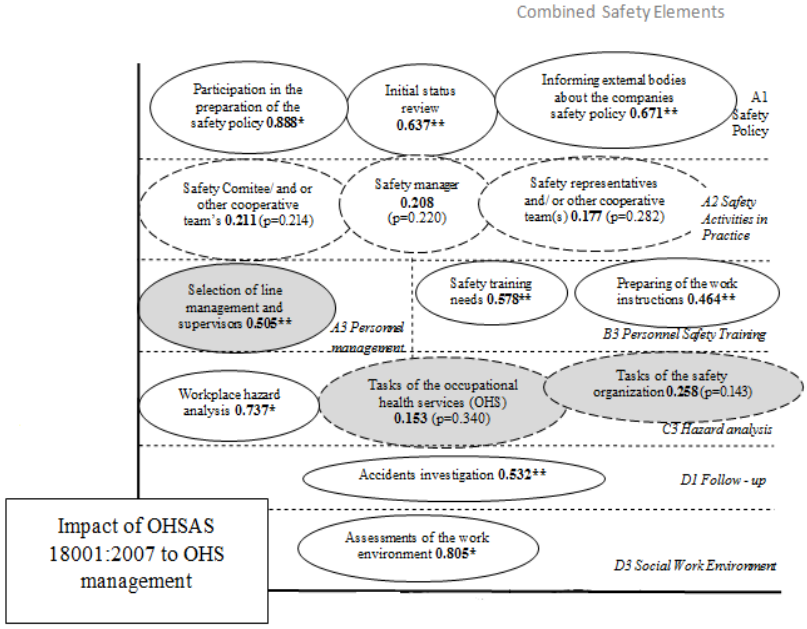
RESULTS AND DISCUSSION

This section presents the empirical findings of the study. For determination of the impact of OHSAS 18001 on formal and real safety performance, a statistical analysis was conducted. As a result, a conceptual model was created based on whether the safety element contributes to formal, real or combined safety (Fig. 2a, 2b, 2c).



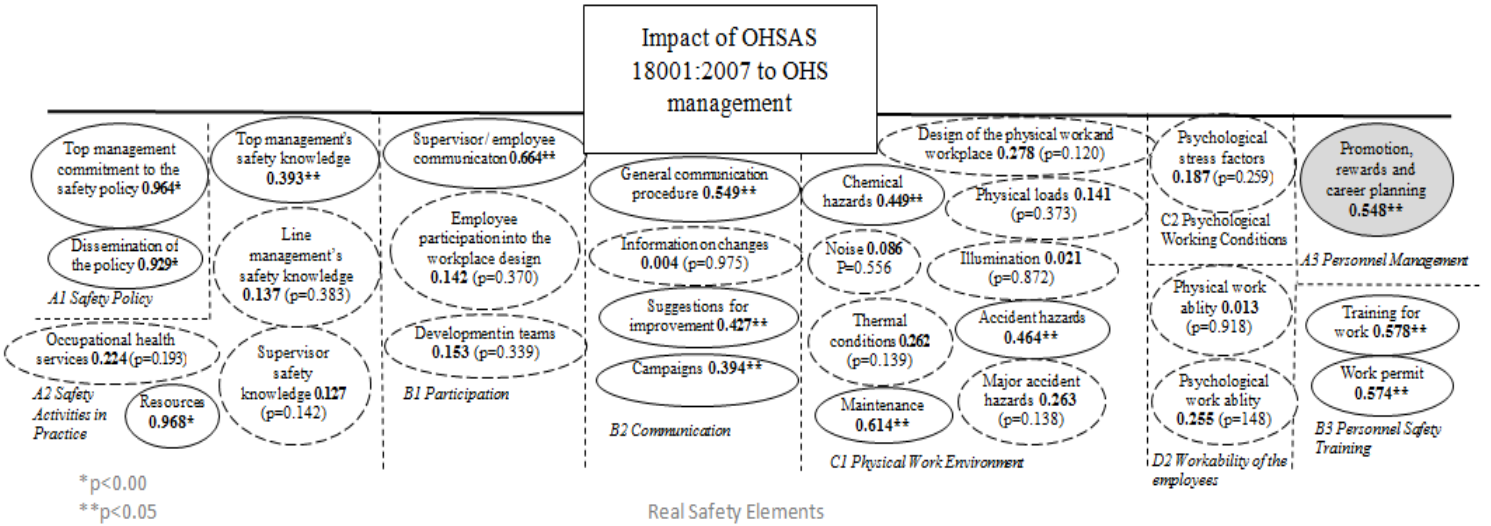
Safety elements covered in OHSAS 18001
Safety elements examined through audit but not covered with OHSAS 18001

Figure 2a. Formal safety elements.



Safety elements covered in OHSAS 18001
Safety elements examined through audit but not covered with OHSAS 18001

Figure 2b. Combined safety elements.



Safety elements covered in OHSAS 18001
Safety elements examined through audit but not covered with OHSAS 18001

Figure 2c. Real safety elements.

Testing the significant impact of company type (OHSAS NOHSASL, NOHSASC) on the abovementioned safety elements with Multivariate Analysis *MANOVA*, the results demonstrate that there was a significant multivariate main effect of company type on formal safety performance ($p < 0.05$). The results also showed that there was a significant difference in real safety performance as well as in combined safety performance between different company types *($p < 0.1$).*

A conceptual model (Fig. 2 SUM): OHSAS 18001 and the impact of the safety elements in the scope of formal, real or combined safety can be combined from Fig. 2a, 2b, 2c.

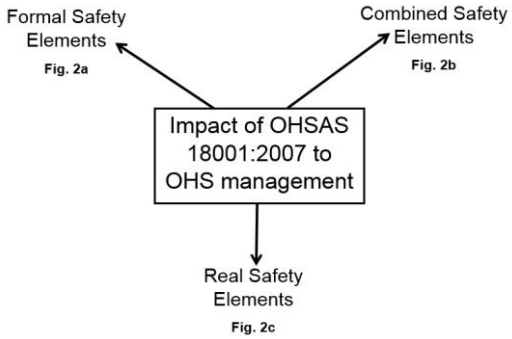


Figure 2 SUM. A conceptual model: OHSAS 18001 and the impact of the safety elements in the scope of formal, real or combined safety.

a) Formal Safety Elements

MANOVA analysis showed that there was a statistically significant difference in formal safety performance based on the company type (OHSAS, NOHSASL, NOHSASC), $F(22, 6) = 10.047$, $p < 0.05$; *Wilk's $\Lambda = 0.001$, partial $\eta 2 = 0.974$*. The power to detect the effect was *0.988*. Fig. 2a shows three formal safety elements—safety documents, absenteeism and design of the psychological working conditions—were not dependent on company type since they did not show any correlation. The majority of safety documents are required by OHS legislation and therefore OHSAS 18001 does not play a significant role in implementing basic safety documents. Absenteeism investigation is required by OHSAS 18001, however this is complicated to conduct in practice due to restrictions in Estonian Personal Data Protection Act (2007), and therefore our study showed that all types of companies have difficulties reaching absenteeism. The active approach to dealing with psychological working conditions is still low in all Estonian companies with no differences between three company types. This was also supported by the qualitative interviews conducted by the authors, in addition to the current research (Paas et al, 2015a).

All other formal safety elements were dependent on company type. The highest impact was shown on written safety policy (0.964, $p < 0.00$), revising the safety policy (0.972, $p < 0.00$), safety policy's connections to the company's other activities (0.964 $p < 0.00$) and follow-up of accidents statistics (0.929, $p < 0.00$).

Company type also showed significant impact on contents of the policy (0.895, $p < 0.00$), assignment of tasks and responsibilities (0.885, $p < 0.00$), selection and placement of the personnel (0.695, $p < 0.00$), planning of the personnel resources (0.493,

$p < 0.05$) and definition of the personnel responsibilities (0.488, $p < 0.05$). This means that implementing OHSAS 18001 contributes to a higher formal safety performance—safety activities are systematically planned and it guarantees higher preconditions for formal safety performance.

Fig. 3 presents the results of each formal safety element calculated by the MISHA method according to company type. From there we can conclude that for some elements OHSAS 18001 does not give the expected added value. For instance, organisations which belong to a larger corporation or concern but are not OHSAS 18001-certified (NOSHASC) show higher results in defining personnel's responsibilities and planning personnel resources. This shows that these elements are more strongly related to the company's general personnel management and the content of job descriptions. Some of the corporated companies have applied a strong content for safety policy which indicates that if the top management reports full engagement to safety, the content of safety policy may be more comprehensive and far-reaching than required by OHSAS 18001. Non-certified, locally established and owned companies (NOHSASL) show considerably lower results than OHSAS 18001 certified (OHSAS) and NOHSASC companies in formal safety elements which can be explained by more random attitudes and activities towards OHS management. Only a few of NOHSASL companies possess a written safety policy or deal with regular personnel resources and selection. Additionally, the follow-up of accidents statistics is very low among NOHSASL companies. Meliá et al. (2012) conducted an in-depth analysis of a NOHSASL company dealing in process industry in Southern Europe and identified several safety flaws such as formal use of preventive observations, formal but not useful safety programmes, lack of safety communication etc.

Safety audits revealed that NOHSASC companies gained slightly higher results preparing safety documents, such as work instruction, instructions for safety training, training of new employees, instruction for supervisors' safety duties etc. than OHSAS companies. The reason behind this might rather depend on the size of the company than its type as smaller firms tend to put less effort into the bureaucracy of safety documents.

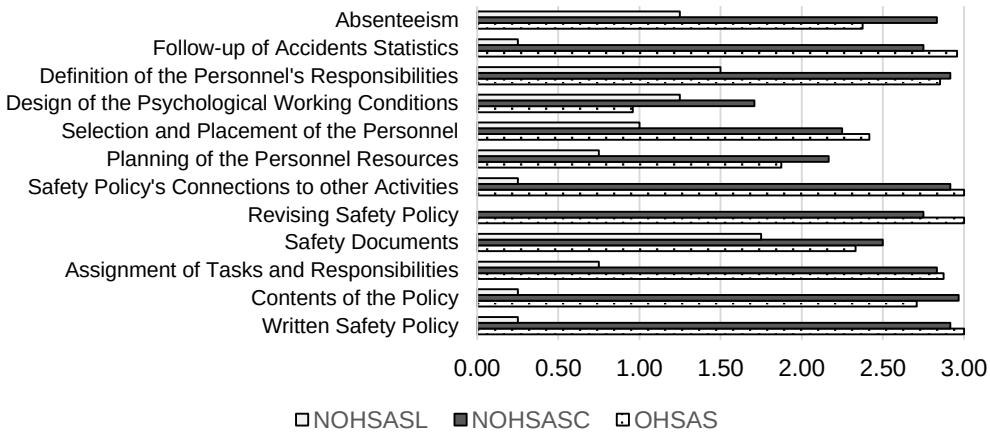


Figure 3. Descriptive statistics of formal safety elements providing mean (calculated using the MISHA method) for the dependent variables according to company type. Scale 0–3.

b) Real Safety Elements

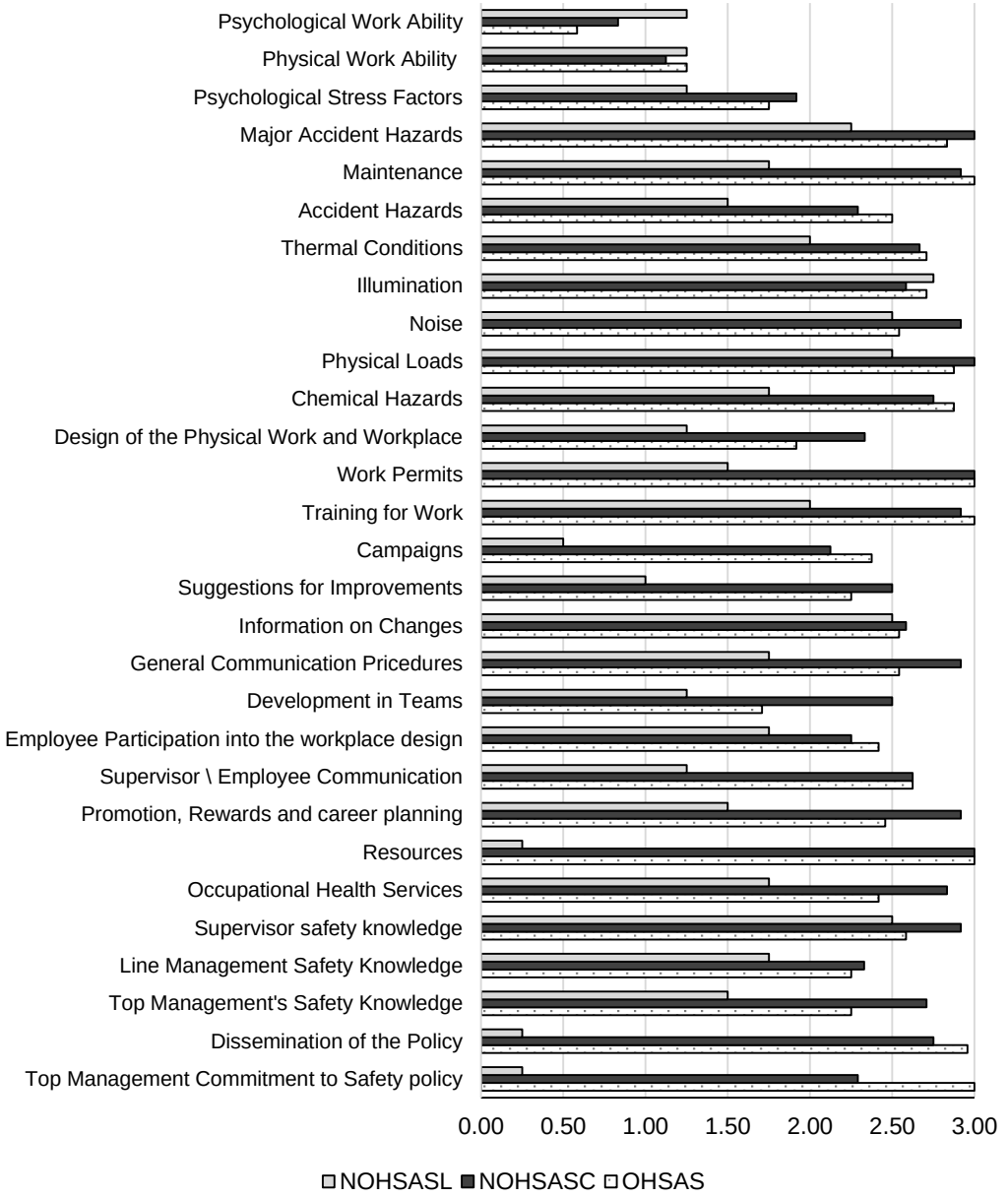


Figure 4. Descriptive statistics of real safety elements providing mean (calculated using the MISHA method) for the dependent variables according to company type. Scale 0–3.

Examining real safety elements, there was a statistically significant difference in real safety performance based on the company type (OHSAS, NOHSASL, NOHSASC), $F\ (26, 2) = 17.311$, $p < 0.1$; $Wilk's\ \Lambda = 0.000$, partial $\eta^2 = 0.996$. The power to detect the effect was 0.854. Among real safety elements, statistical analysis showed a lot more

safety factors which do not depend on company type (Fig. 2): in activity area A2 of occupational health services, supervisor safety knowledge, line management safety knowledge; in B1employee participation in workplace design, development in teams; in B2 information on changes; in C1 noise, thermal conditions, illumination, physical loads, major accident hazards and design of physical work and workplace; in C2 psychological stress factors; in D2 physical workability and psychological workability.

This indicates that OHSAS 18001 does not contribute to a great extent to many of the real safety activities. For example, dealing with physical work environment (C1) is a strict requirement derived from the OHS act and it is one of the main focuses of the annual visit of the labour inspector. Employee participation in workplace design is rarely used in all three types of companies due to the common belief that there is low OHS knowledge among employees. Therefore, companies prefer to rely on engineers rather than involving employees in the stage of design, with a few exceptions (Paas et al., 2015a). Development in teams is also seldom practiced among companies as it is not supported by Estonian OHS legislation.

Other real safety elements were dependent on company type: in activity area A1: top management commitment to the safety policy and dissemination of the policy; A2: resources, top management's safety knowledge, line management's safety knowledge and supervisor safety knowledge; A3: promotion, rewards and career planning; B1: supervisor\employee communication; B2: general communication procedure, suggestions for improvement and campaigns; B3: training for work and work permits; C1: chemical hazards, maintenance and accident hazards.

Very high influence emerged in top management's commitment to the safety policy (0.964, $p < 0.00$), dissemination of the policy (0.929, $p < 0.00$) and OHS resources (0.964, $p < 0.00$). There are several other real safety elements that significantly depend on company type: top management's safety knowledge, supervisor employee communication, promotion, rewards and career planning, training for work, work permits, and so on. From Fig. 4, all scores for real safety element according to company type can be seen. From these results we can conclude that implementing the OHSAS 18001 standard contributes only partly to real safety elements such as top management commitment to the safety policy, dissemination of safety policy and resources. For many real safety elements (Fig. 4), strong demands from corporations influence safety activities more than requirements derived from the OHSAS 18001 standard, for example suggestions for improvements; general communication procedures; promotion, rewards and career planning and safety knowledge among supervisors, line managers and top managers.

In 2011, Granerud and Rocha conducted in-depth analyses in five OHSAS manufacturing companies. One of the companies (plastic production) used several formal safety elements, but in practice it was difficult to find visible signs of safety activities—formal feedback channels and written procedures were not used, employees were not involved in suggesting or making improvements and several physical and chemical risks were inadequately mitigated. This example shows that the OHSAS 18001 certificate is used merely as a window dressing for the company's customers. In other four OHSAS companies, both formal and real safety elements were handled with top management's commitment, as safety is seen as a high priority, and workers were actively participating in the enhancement of health and safety.

There was a statistically significant difference in combined safety performance based on the company type (OHSAS, NOHSASL, NOHSASC), F *(26, 2) = 11.472*, p < *0.1; Wilk's Λ = 0.000, partial* η^2 *= 0.993*. The power to detect the effect was 0.730. Fig. 5 presents the results of each real and formal safety element calculated by the MISHA method according to company type.

c) Elements from Combined Safety

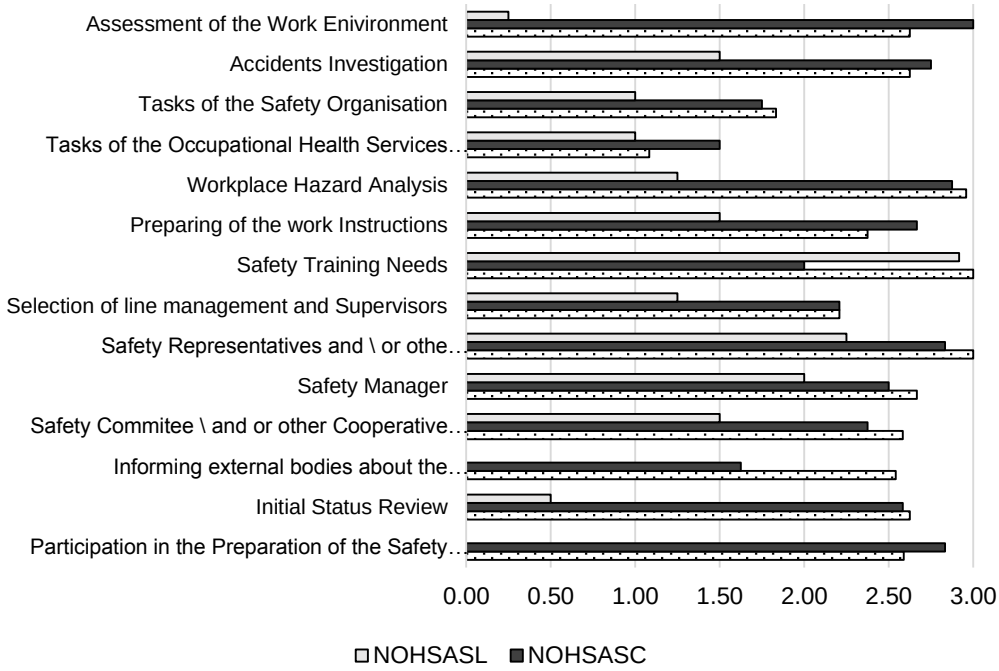


Figure 5. Descriptive statistics of real and formal safety elements providing mean (calculated using the MISHA method) for the dependent variables according to company type. Scale 0–3.

The results indicate that all elements of the safety policy (A1) depended on the company type while all elements from safety activities in practice (A2) had no significance for the company type. From hazard analysis procedures (C3), two elements—tasks of the occupational health services and tasks of the safety organization—did not correlate with company type, while workplace hazard analysis was dependent on company type. Additionally, elements from personnel safety training, accident investigation and assessment of the work environment showed significant difference. It is clear why the OHSAS 18001 standard contributes to participation in the preparation of the safety policy as it is reasonable to engage employees in the preparation stage in order to strengthen the relationship between employees' safety principles and employers' safety standards. The assessment of work environment was strongly dependent on the company type, although NOHSASC companies tend to carry out comprehensive risk assessment and occupational hazards measurements even more regularly than OHSAS companies, while NOHSASL companies hardly perform regular

activities in this field. Interestingly, accident investigation is performed more actively by NOHSASC companies. Obviously, the need to report and compare numeric results between subunits determines it. Clearly, elements from A2 (presence of a safety manager, safety committee and safety representatives) are required by the general OHS law which every company, irrespective of its type, has to follow.

d) OHSAS 18001 contribution to overall safety

Our conceptual model presented in Fig. 2 highlights (in grey colour) those important safety elements that should be covered in safety audits but fall out of the scope of OHSAS 18001. The statistical analysis showed that four out of six mentioned elements were dependent on company type and OHSAS 18001 certification. This indicates that OHSAS companies tend to have higher commitment to OHS and therefore readily solve additional OHS related topics not required by the OHSAS 18001. This result may increase the attractiveness of OHSAS 18001 certification for managers and companies may see it as a strategic unit for improving safety performance. Those results are in line with other similar studies. Abad et al. (2013) proved via various statistical assessments that the work accident rate was lower in OHSAS 18001 certified companies and the certification had positive impact on operational performance as well as productivity. Fernandez-Muniz et al. (2009) stated in their study among Spanish OHSAS companies that occupational safety depends on managerial decisions related to preventive activities, and confirm that effective safety management system is a factor of productivity and essential ingredient for improving the firms' position in the market. From this we can conclude that certified safety experience may have long-term benefits and OHSAS 18001 adds value not only to safety performance but also to overall business performance.

CONCLUSIONS

In conclusion, following statements can be presented:

1. Based on the research on 16 manufacturing companies in Estonia, a conceptual model of the contribution of OHSAS 18001 to companies' safety activities is created. We can say that OHSAS 18001 certification contributes significantly to formal safety elements such as the existence of safety policy, the follow-up procedures of accidents statistics, assigning safety tasks and responsibilities for employees. OHSAS 18001 contributes to some of the real safety elements as well, but most of them do not depend on whether the company possess the OHSAS 18001 certification or not. Concerning combined elements, many of them—such as workplace hazard analysis, working environment assessments, evaluation of safety training needs etc.—are dependent on the OHSAS 18001 certification.

2. Some of the elements examined by the safety audit that do not fall into the scope of OHSAS 18001 are still dependent on company type: selection and placement of the personnel, planning of the personnel resources, selection of line management, supervisors and promotion, rewards and career planning. This result shows that the OHSAS 18001 certification facilitates a company's commitment to health and safety activities and leads to dealing with additional topics promoting workplace health and safety. Therefore, OHSAS 18001 might be seen as a strategic unit for improving safety performance.

3. Conducting safety audits and determining the company's tendency to lean its focus either towards formal or real safety assists the company in reallocating the resources in a way that all possible safety elements are covered. It is essential to deal with real safety, as this is often most visible and forms the employee's safety attitudes and performance, but also with formal and combined safety as those elements often add value to the systematic health and safety work in a company.

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