



DE GRUYTER
OPEN

Scientific Annals
of the "Alexandru Ioan Cuza" University of Iași
Economic Sciences
62 (3), 2015, 325-342
DOI 10.1515/aicue-2015-0022



SAFETY MANAGEMENT IMPROVEMENT POSSIBILITIES IN SMEs

Õnnela PAAS*, Karin REINHOLD**, Jelena HARTŠENKO***, Piia TINT§

Abstract

The safety management system in 16 Estonian manufacturing companies (eight certified and eight non-certified in OHSAS (occupational health and safety management systems standard) 18001; four of the last corporated to the foreign firms) were investigated using the MISHA method. The results showed that if the advanced safety methods (like proposed by OHSAS 18001) are implemented by the initiative of the employers of the locally-owned Estonian SMEs, the level in safety performance, comparable with OHSAS certified companies could be achieved. The regression analysis showed strong correlation between the personnel management, safety activities in practice, communication, physical work environment, psychological working conditions, hazards analysis procedures and the safety level, $R^2=0.7312-0.9596$; medium correlation between the participation, personnel safety training, occupational accidents and illnesses, social work environment and the safety level ($R^2=0.3133-0.6044$). Low correlation ($R^2=0.2139$) was recorded between the safety policy and the safety level and there was no correlation between the work ability of the employees and the safety level. The methods to improve the locally-owned enterprises' safety level up to the corporated and OHSAS 18001 certified level are proposed. The cost of suitable safety measures is calculated. The MISHA method improvement possibilities for the use in the SMEs (small and medium size companies) are presented.

Keywords: Safety management, Safety measures, Safety performance, Risk assessment, Safety training, SMEs (small and medium size companies)

JEL classification: A13, B41, F64, I15

1. INTRODUCTION

The number of work accidents (with ≥ 3 days of disability) is ~ 4000 per year in Estonia (workforce 600,000); the number of the fatal accidents per 100,000 workers was 3.2-3.4 during 2008-2010 (National Labour Inspectorate of Estonia, 2015a). With these accident levels Estonia takes the middle position in the list of the European Union countries. The numbers slightly increase or decrease with the economic upturn or downturn. The number of

* Faculty of Economics and Business Administration, Tallinn University of Technology (TTU), Estonia; e-mail: onnela.paas@gmail.com.

** Faculty of Economics and Business Administration, TTU, Estonia; e-mail: karin.reinhold@ttu.ee.

*** Faculty of Economics and Business Administration, TTU, Estonia; e-mail: jelena.hartsenko@ttu.ee.

§ Faculty of Economics and Business Administration, TTU, Estonia; e-mail: piia.tint@ttu.ee.

occupational diseases in Estonia is 10/100,000 workers and the number of work-related diseases (which do not give irreversible health damage) is 25-30/100,000 workers ([National Labour Inspectorate of Estonia, 2015b](#)).

The main tool for improvement the situation in the safety area in the Estonian small and medium-size enterprises (SMEs) is to promote the safety management. The activities in this direction begin with risk analysis as settled in the [Parliament of Estonia \(1999\)](#). The quality of the risk assessment in the work area gives the overview of the health hazards existing in the enterprise and of the workers at risk.

Safety management seizes a large area in the enterprises' activities and includes as technical as psychological risk assessment and management. Risk management in the industrial enterprises has been investigated by a large number of researchers abroad and domestically ([Ballou, 1992](#); [Peterson, 2000](#); [Geller, 2005](#); [Leiter *et al.*, 2009](#); [Traumann *et al.*, 2013](#); [Reinhold *et al.*, 2009](#)).

Safety climate is considered to be a sub-component of the "safety culture" ([Cooper, 2000](#)). The leading indicators for safety performance are the size of the safety budget, safety audit scores, the number of safety inspections and the number of safety meetings involving management ([Tomlinson *et al.*, 2011](#)). Young workers are more likely to be injured at work than older ones ([Breslin and Smith, 2005](#); [Lagerge and Ledoux, 2011](#)) and this appears to be related to inexperience. [Sorock *et al.* \(2001\)](#) showed that work accidents happen more frequently while the worker is performing an unusual task.

The objectives of the study are:

1. To clarify the advantages in the safety level at enterprises where OHSAS (occupational health and safety management systems standard) 18001 has been implemented or the enterprises that belong to the big international corporations compared with the locally-owned companies;

2. The implementation of OHSAS 18001 is expensive. Therefore the goal of the study is to show the ways for locally-owned companies (often SMEs), in which areas the changes are more needed to gain the better safety level.

2. THE SCIENTIFIC BASIS FOR COMPILE THE QUESTIONNAIRE IN THE INVESTIGATION OF SAFETY PERFORMANCE

2.1. Safety culture, climate and performance

Safety culture is a subset of organizational culture. It is thought to affect the attitudes and safety-related behaviour of the members of an organization ([Cooper, 2000](#); [Fernandez-Muniz *et al.*, 2007](#); [Luria and Rafaeli, 2008](#)). However, there is another closely linked concept: safety climate. Safety climate is often understood as the surface expression of safety culture, and is said to be measured directly through the perceptions and attitudes of the employees ([Flin *et al.*, 2000](#)). One has never clearly distinguished these two terms, and indeed, many authors use them interchangeably ([Wu *et al.*, 2010](#)). "A Guide to measuring health & safety performance" ([HSE, 2001](#)) is a guide document for employers who understand the principles of health and safety (H&S) management and wish to improve the measurement of H&S in their organizations. Information from H&S performance measurement is needed by the people in the organization who have particular responsibilities within the H&S management system: the leadership, senior managers, line managers, supervisors, H&S professionals and employees/safety representatives. Each organisation must create and communicate performance measures that reflect its unique strategy.

What to measure?: 1) the health and safety management system; 2) the safety policy; 3) the organizing of the work in H&S; 4) planning and implementation of safety measures; 5) the measurement of the safety performance; 6) the measurement of the failure- reactive monitoring.

One field is to measure the activities designed to prevent the occurrence of injuries and work-related ill-health (active monitoring). Failures in the risk control as the reactive monitoring, provide the opportunities for organizations to check performance, learn from failures and improve the health and safety management system. The measurement of the H&S culture includes control, communication, co-operation and competence (Cooper, 2000).

The term health and safety climate has been used to describe the tangible outputs of an organization's H&S culture. H&S climate survey tool has been worked out by Health and Safety Executive (Great Britain). Measuring progress with plans and objectives is facilitated by defining who does what, when and with what result. This means that regular checks on progress can be made at appropriate intervals against a defined performance standard. Measuring is ongoing activity, the process is continuous. H&S performance needs to be measured at each management level in an organization, starting with the most senior management. The measurement process can gather information through the direct observation of conditions and of peoples' behaviour; talking to people to elicit facts and their experiences as well as gauging their views and opinions; and examining written reports, documents and records. These information sources can be used independently or in combination. Direct observation includes inspection activities and the monitoring work environment (e.g. temperature, dust levels, solvent levels, noise levels) and people's health and safety-related behaviour. This may be achieved by developing checklists or inspection forms which covers the key issues to be monitored in a particular area of the organisation within a particular time period.

The checklists contain: premises, including access/escape, housekeeping, work environment; plant and substances, including machinery guarding, local exhaust ventilation, use/storage/separation of materials/chemicals; procedures, including permits to work, use of personal protective equipment, procedures followed; people, including health surveillance, people behaviour, appropriate authorised person.

Many authors have addressed the dimension structure of safety culture/climate and its effect on safety performance. Some of the authors suggest that safety leadership is a causal factor for safety climate (Zohar and Luria, 2005; Luria and Rafaeli, 2008).

Different grades of managers play different roles. Higher-level managers generally deal with policy and strategy; mid-level managers mainly take care of safety procedure and tactics; low level managers work on safety practice and operations. An organization that wants to improve the safety in their enterprises, have to found the appropriate safety managers: safety caring, safety coaching and safety controlling predict a good safety culture.

Today (Wu *et al.*, 2010), the middle management plays a more important role in safety than lower level supervisors. The management's three roles in creating a good safety climate at the enterprise are: collection of information, dissemination of information and creating an open environment in which safety issues can be discussed (Peterson, 2000).

Measurement of safety performance is notoriously problematic as measures such as accident rates and compensation costs tend to be reactive (after the event). The links between the safety climate and safety behaviour are not strong (Cooper and Phillips, 2004).

2.2. Safety training

Safety training and informing can significantly improve employee's safety-related behaviour. Safety informing includes three aspects: safety monitoring, safety dissemination and safety representing. Safety monitoring means acquiring safety information through the different type of learning methods. The workers have to get the newest information.

Training has received much attention in the safety literature, and several comprehensive reviews exist (Jonston *et al.*, 1994; Cohen and Colligan, 1998; Wirth and Sigurdsson, 2008). The one-time and traditional trainings might not be official if there is no program how to motivate behaviour of the worker (). The newer training tools are also available (Sinclair *et al.*, 2003; Wallen and Mulloy, 2006; Wirth and Sigurdsson, 2008; Paas *et al.*, 2015b). The new direction for training is blended learning (Stanca and Lacurezeanu, 2012), but it is suitable only for the leadership, not in the safety education of the industrial workers. Safety training and injury prevention are closely connected (Jonston *et al.*, 1994; Bell and Grushecky, 2006). The human factor and worker's behaviour have to be considered (Dermol, 2013). The videos and interviews are useful in safety learning process (Laberge *et al.*, 2014).

2.3. Risk assessment tools

Another area in safety research concerns the evaluation and development of new risk assessment tools that safety professionals can use. Various tools, such as root cause analysis of injuries (AbsConsulting, 2005) and PIC/NIC analysis of consequences (Angew and Snyder, 2002; Daniels and Daniels, 2006) have been developed to identify the risky behaviours. The authors of the present paper have worked out a flexible risk assessment method (Reinhold *et al.*, 2006) in 2006. It differs from the general risk assessment method proposed by the British Standard Association (BS8800) and is suitable for the use in SMEs (small and medium size enterprises).

Safety is a very complicated matter and needs thorough research in the certain areas of the industrial activities. Safety management is a multi-level control problem (Wahlstrom and Rollenhagen, 2014). Safety culture is identified to safety climate in the analysis of the causal relationships between its key dimensions.

3. THE MATERIAL AND METHOD

To select industrial companies for the research, the database of Estonian Association for Quality (2014) was scanned. By January 2014, 178 Estonian companies owned OHSAS 18001 certification. The scan showed that 32 % of certified firms come from manufacturing sector. The authors contacted each of these firms and explained briefly the purpose and the scope of the research. Finally eight companies (representing main manufacturing areas in Estonia such as printing, textile, metal, food industry etc.) agreed to participate which was enough to perform a qualitative study. In order to compare the results with non-certified organizations, eight companies with similar background were selected. The research objective was assess the safety level at the enterprise. 16 enterprises were chosen. The top managers, middle-stage managers, work environment specialists and work environment representatives were interviewed (Table 1).

During 2014, eight (OHSAS 18001-certified organizations, group I) + eight (non-certified organisations, group II) Estonian enterprises from different branches of manufacturing participated in 25 interviews with employers, middle-level safety personnel and with safety responsible persons (Table 1). Altogether 55 questions (presented in Kuusisto, 2000) were asked from each of the person interviewed. The MISHA (method for industrial safety and health activity assessment) method (scale 0-3) was used for assessment as the safety auditing method (Kuusisto, 2000). The interviews were carried out by the expert-interviewer (the first author of the paper). The MISHA method consists the following safety areas:

- A. Organization and administration
 - A1. Safety policy
 - A2. Safety activities in practice
 - A3: Personnel management
- A. Participation, communication , and training
 - B1. Participation
 - B2. Communication
 - B3. Personnel safety training
- B. Work Environment
 - C1. Physical work environment
 - C2. Psychological working conditions
 - C3: Hazard analysis procedures
- C. Follow-up
 - D1. Occupational accidents and illnesses
 - D2. Work ability of the employees
 - D3. Social work environment.

Each area give 25% of the total, so maximum total score (safety level) is 100. Each safety sub-area (like A1, A2 etc.) includes different numbers of questions (from three to 20) according to the MISHA method.

Table no. 1 – The characterisation of enterprises investigated (N=16)* (Paas et al., 2015)

Id. of the company	The activity area	Life-time, years	Size, employees	The overall assessment on safety** Likert scale***	OHSAS 18001 implemented	The persons interviewed: position, age
K (Int 1)	Textile industry	11-25	50 - 249	3	-	Production manager, 38
L (Int 2-4)	Plastic industry	11-25	50 - 249	4	+	Quality manager, 41 Safety manager, 62 WER, 25
M (Int 5)	Furniture industry	> 50	50 - 249	4	+	Personnel manager, 64
N (Int 6)	Heat industry	> 50	50 - 249	5	+	Quality and environment manager, 58
O (Int 7)	Printing industry	1-10	< 50	2	-	Production manager, 36
P (Int 8-9)	Metal industry	> 50	≥ 250	5	-	Safety manager, 35 Trade union representative, 60

Id. of the company	The activity area	Life-time, years	Size, employees	The overall assessment on safety** Likert scale***	OHSAS 18001 implemented	The persons interviewed: position, age
Q (Int 10-12)	Electronics industry	11-25	≥ 250	5	-	Quality manager, 36 Safety specialist, 42 WER, 53
R (Int 13-15)	Food industry	> 50	≥ 250	4	-	Safety specialist, 62 WER I, 34 WER II, 39
S (Int 16-18)	Electronics industry	11-25	≥ 250	5	+	Quality manager, 59 Safety manager, 39 WER, 66
T (Int 19)	Metal industry	> 50	≥ 250	5	+	Safety manager, 64
U (Int 20)	Food industry	> 50	≥ 250	5	+	Safety manager, 37
V (Int 21)	Metal industry	1-10	< 50	4	-	Production manager, 36
W (Int 22)	Wood processing industry	1-10	≥ 250	4	+	Quality manager, 47
X (Int 23)	Food industry	> 50	≥ 250	5	+	Safety chief specialist, 68
Y (Int 24)	Glass industry	11-25	< 50	3	-	Production manager, 41
Z (Int 25)	Textile industry	11-25	≥ 250	2	-	Health and safety manager, 67

*Companies are listed and coded in chronological order;

**assessed by expert-interviewer;

***Likert scale: 1 – poor, 2 – average, 3 – good, 4 – very good, 5 – excellent;

Abbreviations: Id. – identification; Int – interview, WER – working environment representative.

In the present study the non-certified companies have been taken into special observation with the aim to present the key areas in the safety and health management which improvement can gain on the safety level without the implementation of the expensive OHSAS 18001 certification system. The non-certified companies were from the following areas of manufacturing: **K**- textile industry, **O** – printing industry, **Y**- glass processing industry, **Z**- textile industry, **P**- metal industry, **R**- food processing industry, **Q**- electronics industry, **V**- metal processing industry. The number of workers in the enterprises was from 50 to 250.

The research question is: what we have to do in the locally-owned Estonian SMSs to raise the safety level and improve the occupational health system until the corporated enterprises level. As a rule, the standard OHSAS 18001 is not implemented in the Estonian enterprises because of the high implementation and surveillance costs.

In **Table 2**, the non-certified companies (eight) are divided into two groups: IIa (locally-owned) and IIb (corporated to some of the international companies).

4. THE RESULTS OF THE ANSWERS TO THE QUESTIONNAIRE (MISHA)

The results (Table 2) show that for the non-certified companies, the subdivision into two groups is reasonable. Four (4) companies (**K, O, Y** and **Z**, group IIa) which are locally established and owned have the total safety level scores 29.10...52.73 (Anova, $p=0.034$) and the other four companies (**P, Q, R** and **V**, group IIb) belonging to the Nordic or global corporations have scores 79.80...88.08 of 100 (T-test, p -value 0.03 in the question group D).

It shows that the safety management systems owned and run by the local businessmen may lack in several OHS activity areas. The reasons may lay behind lack of the resources, knowledge, skills and time, while the companies belonging to the corporations are able to prioritize safety more. The total safety level scores among group I (OHSAS 18001-certified organisations, eight) are between 74.1 and 93.3 (Anova, $p=0.026$), so very similar to the corporated group IIb (enterprises **P, Q, R, V**).

This demonstrates that the companies who have implemented OHSAS 18001 or whose management approaches great attention to the safety matters (group IIb) benefit from it in safety performance as the activity scores are considerably higher than for the locally-owned non-certified companies. The results show that the safety level depends on the ownership, size of the company, dedication and attitudes of the top management, knowledge and resources availability and the consistency of safety activities in the company. However, the scores also show that some companies with no OHSAS 18001 certification can function as safely as the ones having the certification; mainly due to the affiliation to a larger international consolidated company with developed safety systems (Paas *et al.*, 2015).

The regression analysis between the safety performance components and the safety level are given in Table 3.

Table no. 2 – The initial data for regression analysis: the scores of MISHA method audit in Estonian enterprises (K, O, Y, Z, P, Q, R, and V)

Scores/ enterprises	K	O	Y	Z	P	Q	R	V
A1	12.12	24.24	12.12	3.03	89.39	91.92	91.92	84.85
A2	54.17	25.00	75.00	70.83	87.50	88.89	81.94	100.00
A3	50.00	25.00	41.67	33.33	79.17	80.56	75.00	83.33
∑A	33.33	24.64	39.13	31.88	86.96	88.89	85.51	89.86
B1	55.56	33.33	33.33	66.67	94.44	92.59	85.19	55.56
B2	50.00	33.33	58.33	50.00	95.83	100.00	83.33	58.33
B3	66.67	33.33	83.33	50.00	100.00	100.00	91.67	91.67
∑B	57.58	33.33	60.61	54.55	96.97	97.98	86.87	69.70
C1	74.07	48.15	77.78	70.37	98.15	90.12	95.19	88.89
C2	44.44	22.22	66.67	44.44	83.33	70.37	59.26	77.78
C3	33.33	11.11	66.67	33.33	72.22	66.67	55.56	77.78
∑C	60.00	35.56	73.33	57.78	90.00	81.48	74.07	84.44
D1	44.44	22.22	55.56	11.11	77.78	100.00	92.59	100.00
D2	50.00	33.33	50.00	33.33	41.67	50.00	5.59	33.33
D3	33.33	00.00	0.00	0.00	100.00	100.00	100.00	100.00
∑D	44.44	22.22	16.67	44.44	69.44	83.33	64.81	77.78
Total*	46.67	29.09	41.82	52.73	87.88	88.08	80.40	83.03

*The total score= safety level is get from $Ax0.25 + Bx0.25 + Cx0.25 + Dx0.25$

A, B, C, D are get from A1, A2, A3 etc., for example: $A1x0.33 + A2x0.33 + A3x0.33$

Table no. 3 - Results of the regression analysis
(linear dependences between the safety level (y) and the safety sub-areas (x))

Component A	R ²	Component B	R ²	Component C	R ²	Component D	R ²
A1	0.2139	B1	0.5838	C1	0.8738	D1	0.3133
A2	0.7312	B2	0.7835	C2	0.7865	D2	0.0600
A3	0.9596	B3	0.6044	C3	0.7555	D3	0.5797

5. THE WORK TASK

The work task is to present the possibilities to raise the safety level in the locally-owned non-certified companies (**K, O, Y, Z**, group IIa) up to the safety level in corporated enterprises (**P, Q, R, V**, group IIb) ([Figure 1](#)). The qualitative analysis of the safety sub-areas (as a result of MISHA method use) are given below.

The safety sub-areas scores in the locally-owned enterprises and the scores to achieve (corporated enterprises, group IIb and OHSAS 18001 certified, group I) are presented in [Table 4](#). The numerical data have been derived from the analysis of the questionnaires. The analysis of the safety performance begins from the lowest score in the locally-owned Estonian enterprises.

The lowest value in locally-owned companies is expressed in **D3 (8.33)**: social work environment; there is no politics for measuring the social climate in these enterprises and no corrective actions implemented if the problems in social relations between the workers have been observed. The best mark in locally-owned companies has been measured in **C1 (67.59)**: physical work environment. This result is in accordance with the Estonian reality: if something at all has been done for improvement the situation in the safety area (particularly in SMEs), then the hazards in the work environment have been identified and the risk analysis have been carried out ([Tint et al., 2009](#)). The risk analysis are demanded by the [Parliament of Estonia \(1999\)](#).

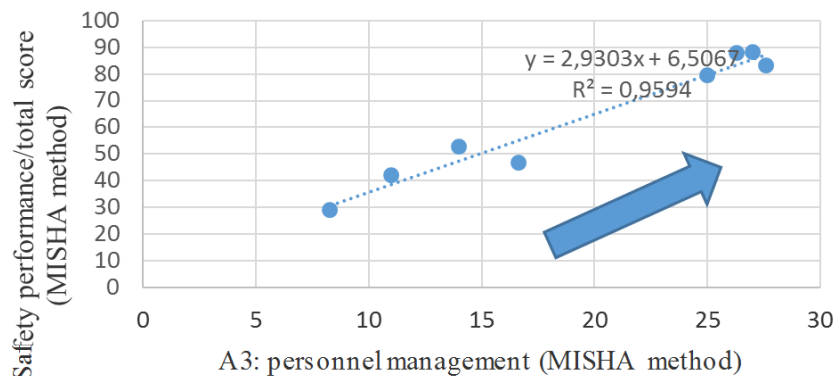



Figure no. 1 – The dependence of the safety level from the personnel management (A3)

Table no. 4 – The numerical data of the safety sub-areas in the locally-owned, corporated and OHSAS 18001 certified companies (mean values)

Component/company group	Group IIa K, O, Y, Z; Locally-owned enterprises mean value	Group IIb P,Q, R, V; Corporated enterprises mean value	Group I L, M, N, S, T, U, W, X OHSAS 18001 certified enterprises, mean value
D3: social work environment	8.33	100	87.50
A1: safety policy	12.83	89.51	92.80
D1: occupational accidents and illnesses	33.33	 41.67	88.43
C3: hazard analysis procedures	36.11	68.06	65.25
A3: personnel management	37.50	79.52	74.65
D2: work ability of the employees	37.50	32.65	30.56
C2: psychological working conditions	44.44	72.69	58.80
B1: participation	47.22	81.94	75.00
B2: communication	47.92	84.37	80.90
A2. safety activities in practice	56.96	89.58	86.40
B3: personnel safety training	58.33	95.84	94.79
C1: physical work environment	67.59	93.09	88.73

6. THE POSSIBILITIES FOR IMPROVEMENT THE SAFETY LEVEL IN LOCALLY-OWNED ESTONIAN MANUFACTURING ENTERPRISES

The scores (taken from Table 4) are given in the 100 point scale as maximum. The analysis begin with the lowest score in the locally-owned enterprises (group IIa); the scores to gain on for these companies are the scores of the corporated (group IIb) and OHSAS 18001 implemented companies (group I) (initial data in Paas *et al.*, 2015).

D3: Assessment of the social work environment: 8.3 (group IIa) → 100 (group IIb); 87.5 (group I)

It is recommended for the group IIa companies to have a system for measuring the social climate. The management is obliged to react on shortages in the social climate if the conflict situations have come obvious; it is obligatory to carry out periodically the questionnaires that explain to the management the satisfaction of the workers with the social climate in the workplace and out of it (care after children, flexible work time etc.). It is recommended to use the work-breaks for the communication between the workers to help to improve the social satisfaction at the workplace.

A1: Safety policy: 12.8 (IIa) → 89.5 (IIb); 92.8 (I)

The written safety policy is the prerequisite for the improvement of H&S in the workplace. It is more directed to the top management, high, medium and low level safety responsible personnel. It is hard to believe that workers will read the SP, but it is likely that more active and highly educated work environment representatives (elected by the workers) are able to do it and are interested; the top management has to be committed to the SP; the compilers (including the top managers) of the policy document have to settle the roles for

each of the safety responsible, so that the responsibilities are very clear. The main safety activities and procedures have to be settled in the policy. Very important is to make clear to the compilers of the policy the initial status values in the workplace: current health and safety level in the company, typical and potential hazards in the company; the state of the safety documents, instructions.

D1: Follow-up of occupational accidents and illnesses: 33.3 (IIa) → 61.7 (IIb); 88.4 (I)

The group IIa companies usually hold the statistics in written form on accidents and occupational diseases, but it is not a highly desirable information and not distributed to the workers in the form of meetings. Sometimes there is an attempt from the side of the employers to conceal the accident from the workers. The precaution measure and recommendations are not on the wallboards. These are the areas that is recommended to improve to get a better safety level. It is settled in the Estonian legislation that accidents are investigated by the enterprises themselves, only in the case of fatal or group accidents, the investigation is leaded by the Labour Inspectorate representative. There has to be settled in the policy, who are the members of the investigation committee if the accident or occupational illnesses has happened. The safety level could be improved and the accidents number decreased if the near-accidents are reported and investigated. This policy component has to be announced to the workers. Otherwise, they do not announce the near-accidents. The plan for corrective actions after the near accident has to be available to the workers and lean managers. The data for fulfilment the correcting actions have to be written into the safety policy. The reasons for absenteeism are not available for the employers in Estonia, but the data, how long the worker is absent from the work, are known to the employer in the occurrence of the easier accidents.

C3: Hazard analysis procedures: 36.1 (IIa) → 68.1 (IIb); 65.3 (I)

This part includes the measurement in the work environment and risk assessment, but also the occupational health professional's activities and services. As it is seen from the scores, the activities in the group IIa enterprises constitute a half of these in the corporated and OHSAS 18001 implemented enterprises. The goals to achieve: carry out questionnaires among the workers for clarification, what troubles the workers. The company itself (the managers) can settle the intervals between the risk analyses, not to wait, until the labour inspector comes. The risk assessment is obligatory by the law, but the measurements of occupational health hazards have also to be carried out. To get better and faster results in the work environment improvements, the safety specialist should be to supplied with a combined work environment hazards analyser, possible to measure noise, lighting, microclimate factors. It has to be written in the policy, that the results of the measurements and risk analysis have to be announced to the top management and to the workers and the discussion between these parties have to be organized in reality (during the work-breaks or business days in summer-time). Action plan has to be prepared and the surveillance after the fulfilment of the plan has to be settled in the policy.

There are great problem in the co-operation of the managers and occupational health service providers. The medical service providers are not interested in walk-throughs in the enterprises to get acquainted with the hazards in the work environment and the employer is not interested to pay more for getting better occupational health service. The goal for implementation in all the investigated enterprises is: to include the occupational health personnel into the workers safety training. In some enterprises rehabilitation from the

musculoskeletal disorders (massage, mud and hot treatment) are available (it does not depend on the certification in OHSAS 18001).

A3: Personnel management: 37.5 (IIa) → 79.5 (IIb); 79.7 (I)

The job market is very changeable. Everything depends on the (often foreign) customer. Therefore, it is difficult to plan the personnel resources. Usually in the successful enterprises, there are short-term and long-term plans for the number of needed personnel resources. Such enterprises also can allow the workers who make investigations of economic development. It is not a question of safety only. Ageing workforce use: some of the enterprises use older workforce, but it is not connected with the certification in OHSAS 18001. The actions for the enterprises when the economy goes down-size are not directly (but they influence on the workers) connected with the safety and health management. These tendencies make people more nervous and stressful that could be a cause of an accident or occupational illness.

D2: Physical ability of the employees: 37.5 (IIa) → 32.7 (IIb); 30.6 (I)

The [Estonian Ministry of Social Affairs \(2001\)](#) (based on the directives of the EU) settles that the employer has to carry out the risk assessment on manual lifting of loads. The scores (30.6 to 37.5) show that in all enterprises it has been done very formally. In some enterprises the system for rehabilitation has been introduced. Usually it is not possible to find a new job for the persons whose illnesses are not recoverable. The workers mental ability is investigated only if there are some neurotoxic chemicals in the air of the work environment and these investigations are carried out by the occupational health doctor. The enterprises do not carry out the investigations particularly on the mental health, therefore the scores (30.6 to 37.5) are low for all of the enterprises. The questions in MISHA method in this section are not appropriate.

C2: Psychological working conditions: 44.4 (IIa) → 72.8 (IIb); 58.8 (I)

The scores (group IIa) are higher than in the previous safety component (D2). It is difficult to justify the reasons, why the scores here differ from D2 (particularly for the groups I and IIb), although the questions asked are very similar. The question about the designers abilities to foresee the psychological risk factors at workplace. The designers usually are not able to foresee the psychological risk factors as they are not educated for this matter. Nevertheless, these factors are certainly recommended to take into consideration if possible in the design of the machines and instruments. In some enterprises (groups I and IIb) for the special group of engineers- designers, the knowledge of physiological risk factors is included into their work obligations, but it is impossible for them to foresee the psychological risk factors before the machine is in the workplace and ready to work.

B1: Participation: 47.2 (IIa) → 81.9 (IIb); 75.0 (I)

The scope of the supervisor and the employees' communication depends on the company size: if the company is large, then the supervisor itself is not communicating with the employees, the communication is more expressed between the line manager and the employee. Sometimes the line managers forget about the safe work methods because of the productivity needs. The employees participate in the workplace design in the groups I and IIb enterprises when the machines and other equipment is already reserved. The employees' opinions and suggestions are asked when the work processes and work environment are

redesigned. In these enterprises sometimes the small work-teams for development are developed. These teams could often work actively if they have the necessary management support. The score in the group IIa (47.2) and the content of the answers to the questions shows that the safe work methods are shown to the workers by the line manager; the workers are instructed in the safe work methods, but over 50% of the maximum score (100%) is possible to progress.

B2: Communication: 47.9 (IIa) → 84.4 (IIb); 80.9 (I)

The management arranges the information meetings for all personnel only during the implementation of OHSAS18001 (group I). The information in the group IIb is spread from the top managers to the safety personnel and line managers. In the group IIa the information is spread only through the line managers to the employers. The communication from the employee level to the upper organizational levels is arranged through the WE representatives (group I and II). In the group IIa, the WE representative's activities are at a very low level, depending on the character of the responsible itself and also the character of the industrial activities. The wall-boards and e-mails are effectively used on the employers level, but not on the employees level. The personnel (in the groups I and IIb) is aware of the hazard reporting systems. The personnel is informed in advance on the new work practices and procedures. In the safety policy (exists in the groups I and IIb) there is a systematic procedure for informing the employees about the changes in the technological process and the change of the hazardousness of the chemicals in the process. Campaigns: the certified companies arrange the health and safety campaigns twice a year, where they focus on the potential hazards. The campaigns are organized after the safety personnel's or top management's participation in different conferences, high level meetings and it is possible with the support of the top management also to use external experts in the campaigns.

A2: Safety activities in practice: 57.0 (IIa) → 89.6 (IIb); 86.4 (I)

The top management's safety knowledge is satisfactory in the certified enterprises, but the score 57.0 from 100 (group IIa) is some more than a half of the achievable for the locally-owned enterprises. Health and safety is usually considered in the design of the new workplaces (rarely machines); buying of suitable chairs according to the workers desire (or working in the standing position is also ergonomically recommended) to prevent MSDs (musculo-skeletal disorders). The ergonomic design of machines is also developing and if the employer has been educated and has the desire to buy better work instrument, it is usually possible, but not always. The workers are mentally not satisfied with the repaired workrooms or new buildings in the educational institution or public buildings, but that kind of situation is rear in the industrial buildings. They are used to work, where they get more money.

The costs of occupational accidents and illnesses were first calculated by [Heinrich \(1941\)](#). Afterwards some authors have worked on this topic and the conclusion is that there are direct and non-direct costs of accidents, the last is difficult to see for the managers. The education and also investigations in this field are very few. The cost-effectiveness of the safety activities ([Abrahamsen et al., 2009](#); [Tint et al., 2010](#)) is presented in [Fig. 2](#). We have to consider beside the cost also the risk reducing effect, the number of people who will take advantage of this measure and the uncertainty of the accident appearance.

The methodology is presented in [Abrahamsen et al. \(2009\)](#). The cost-effectiveness of safety measures can be calculated considering three factors: the expected cost of the

measure C; the effect of the safety measure Z (using Likert scale: zero to five) and the uncertainty of the measure N (zero to one).

The scale for expected cost (EUR) of the measures is divided as follows:

- very low cost- < 350;
- low cost- ≥ 350 -650;
- medium cost- ≥ 650 -3500;
- high cost- >3500.

The problem of using these expected values is that the expected values are conditional and could produce poor predictions of the real outcomes. As a result, uncertainties need to be taken into account in addition to the expected values. High uncertainty may indicate that the expected risk reducing effect can give a poor prediction of the real risk reducing effect. For uncertainty dimension, three categories are used:

- 1) low uncertainty;
- 2) high uncertainty;
- 3) medium uncertainty.

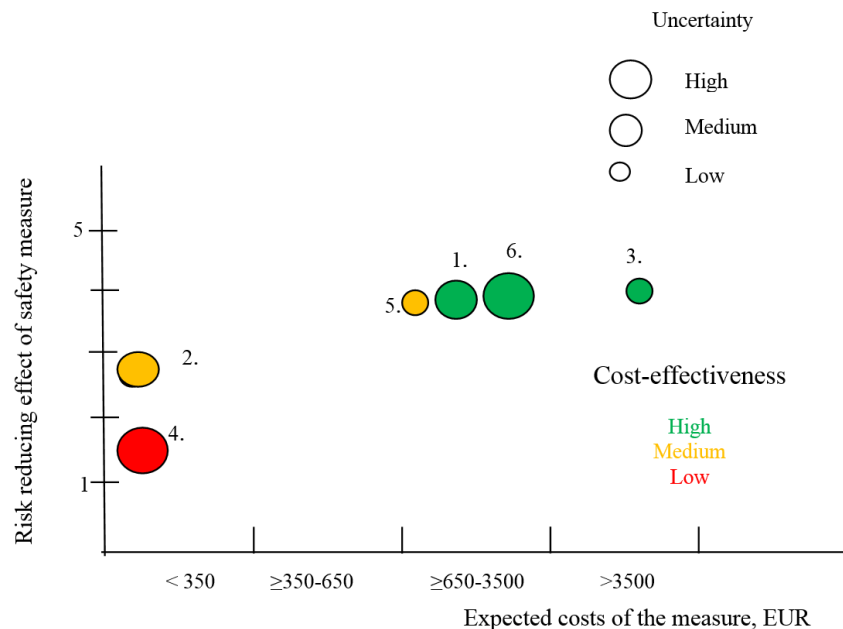


Figure no. 2 – Cost-effectiveness of safety measures in metal processing industry

The data for the metal processing industry (Figure 2):

- 1) Installation of a wall around the guillotine saw (C/Z-N): 300 /4-0.5
- 2) Installation of raw materials and half-products properly, not on the walking area: 300/3-0.5
- 3) To modernize the washing rooms: 10.000/5-0.1
- 4) Re-arrangement of the local-ventilation equipment for welding activities: 4.000/2-0.8
- 5) Analysis of chemicals' hazardousness by welding activities: 600/4-0.1
- 6) Provide the workers with protective footwear: 3.000/4-0.8

The most cost-effective of previously listed safety measures is No. 6 as the uncertainty is very high (we do not exactly know how many hazardous situations may occur in the metal industry).

B3: Personnel safety training: 58.3 (IIa) → 95.8 (IIb); 94.8 (I)

The safety training of employees, work environment specialists, representatives, the members of the work environment committee are settled in the Estonian legislation ([Estonian Ministry of Social Affairs, 2000](#)). Usually the employees cannot participate in the evaluation of the safety training needs. The top management usually do not undergo the safety training (24 hours) except the situation when the manager is in the same time responsible for the safety management and matters (small enterprises). Usually the supervisors are not able to estimate the need for safety training themselves, but they are able to estimate it through the line managers and safety specialists. The safety training usually covers the industrial workers safety training. The office-workers are trained separately ([Estonian Government, 2000](#)). The need for first-aid training is also settled in the Estonian law ([Estonian Ministry of Social Affairs, 2000](#)). All employees, including temporary workers, have to be trained before their work at the workplace. The work instructions in the company are compiled by the safety engineer (work environment specialist) or the service is bought from the external service providers. In all the enterprises, the work instructions are in the written form and they are available at the workplace. The employees have seen the instructions, and can operate according to them. In the group IIa, the employees and supervisors have not participated in the preparation of the instructions. They have been trained by the work environment specialist or the line manager. The instructions are regularly renewed. Development in teams is a method used for improvements in the group IIb and I. These groups manage effectively and they are working actively. These groups have the necessary management support. The last is the goal for the enterprises of the group IIa to raise the safety level.

C1: Work environment: 67.6 (IIa) → 93.1 (IIb); 88.7 (I)

The workplace designers (in the group I, in some enterprises, the engineers) have passed the advanced training for considering the health and safety aspects from the initiative of the employer. This area seizes also the risk assessment of occupational health hazards (analogous to C3). The maintenance question: the floors are clean or dirty, it depends on the character of the manufacturing. The maintenance of the machines and equipment is at the adequate level in all enterprises' groups, but nevertheless the accidents happen. Major accident hazards are usually assessed (needed for the fire risk assessment). The handling of hazardous chemicals is settled by the law in different documents. The companies have plans for the evacuation of the personnel.

A very high dissatisfaction from the side of the employers was directed to the occupational health service providers. In 2014, the targeted inspections of occupational health service providers by the National Labour Inspectorate of Estonia were carried out and this inspection revealed that 21% of the companies had not conducted with the medical staff for medical examinations of the workers working in hazardous conditions, in 37% of the cases the occupational physician was not familiar with the hazards in the work environment and in 44% of the cases ([National Labour Inspectorate of Estonia, 2015b](#)). The initial medical examinations were not carried out during the first month of employment as it is needed by the law ([Estonian Ministry of Social Affairs, 2003](#)).

7. DISCUSSION AND CONCLUSIONS

The results of the work show that the implementation of OHSAS 18001 or affiliation to the international corporation give 4 to 10 times higher safety level scores (part 4) than in locally-owned companies (SMEs), but there are several safety measures that can be implemented without high financial expenses. They are listed in the part 6. The list of safety measures is connected with finance, but also with the probability of the safety risks in enterprise depending on the character of the process carried out in the industrial building (part 6, A2).

The improvement of safety level at SMSs in Estonia is possible if there is the intention from the side of the employer and subsequently the high, medium-level safety personnel and the direct manager in the workplace are interested in. More thorough assessment of workers' safety knowledge (after the safety training) is needed. The safety budget has to be settled.

The key questions in the improvement are: the existence of a written safety policy; management and employees' communication in the safety policy compile process, the participation of employees and the employer in the solution of the safety problems, near-accidents notation, the improvement of the risk assessment documents, the work-out of the risk reduction measures and fulfilment of these measures. The cost-effectiveness analysis have to be taken into consideration.

The MISHA method is a good method for assessment of safety level, except in some areas that are connected with scientific investigations, like assessment of the social work environment (D3), work ability of the employees (D2), psychological stress factors' investigation (C2.2), psychological working conditions (C2). These assessments are not realistic to carry out on the enterprise level in the current economic development stage in the Estonian SMEs.

The occupational health and safety system in Estonia is not very strong from the officials (The Ministry of Social Affairs of Estonia) side. The work of occupational health doctors is not appreciated. The policy for the use of the ageing workforce continuously is worked out only in some of the enterprises. Usually the employers recruit only young workers. In some enterprises the engineers have also obligations for designing of workplaces and these designers consult with the supervisors, and the health and safety personnel.

The critical overview of the MISHA method: the safety areas are chosen on the scientific basis: A: organization and administration; B: participation, communication and training; C: work environment; D: follow-up. All these areas have three sub-areas, but the number of questions in these sub-areas is different. This fact influences on the total score of the sub-area. Furthermore, there are questions, that repeat each other. The questionnaire has also questions on the activities not-achievable at the enterprise level that are more oriented to the scientific research and so resolvable, like: Is the personnel encouraged to make suggestions for the improvement of communication? Are the best suggestions awarded (in the area of communication)? Some of the questions have to be removed to make the MISHA questionnaire suitable and popular among the companies for the safety level assessments.

Acknowledgements

The work has been carried out with the help of the project SF0140022s10 "Chemical Engineering Aspects in Environmental Risk Assessment" (Estonia).

References

- Abrahamsen, E. B., Aven, T., and Roed, W., 2009. Communication of cost-effectiveness of safety measures by use of a new visualizing tool. *Reliability & Risk Analysis: Theory & Applications*, 2(December), 38-46.
- AbsConsulting, 2005. *Root Cause Analysis Handbook: A Guide to Effective Incident Investigation*. Brookfield, CT: Rothstein Associates Inc.
- Angew, J. L., and Snyder, G., 2002. *Removing obstacles to safety*: Performance management Publications.
- Ballou, R. H., 1992. *Business Logistics Management* (3rd ed.). Eaglewood Cliffs: Prentice-Hall International Editions.
- Bell, J. L., and Grushecky, S. T., 2006. Evaluating the effectiveness of a logger safety training program. *Journal of Safety Research*, 37(1), 53-61. DOI: <http://dx.doi.org/10.1016/j.jsr.2005.10.019>
- Breslin, F. C., and Smith, P., 2005. Age-related differences in work injuries: A multivariate, population-based study. *American Journal of Industrial Medicine*, 48(1), 50-56. DOI: <http://dx.doi.org/10.1002/ajim.20185>
- Cohen, A., and Colligan, M. J., 1998. *Assessing occupational safety and health training. A literature review*: DHHS (NIOSH).
- Cooper, M. D., 2000. Towards a model of safety culture. *Safety Science*, 36(2), 111-136. DOI: [http://dx.doi.org/10.1016/S0925-7535\(00\)00035-7](http://dx.doi.org/10.1016/S0925-7535(00)00035-7)
- Cooper, M. D., and Phillips, R. A., 2004. Exploratory analysis of the safety climate and safety behavior relationship. *Journal of Safety Research*, 35(5), 497-512. DOI: <http://j.safetyresearch.com/doi/10.1016/j.jsr.2004.08.004>
- Daniels, A. C., and Daniels, J. E., 2006. *Performance Management: Changing behaviour that drives organizational effectiveness* (4th ed.): Atlanta, GA: Performance Management Publications.
- Dermol, V., 2013. Relationship between learning, knowledge creation and organizational performance. *Scientific Annals of "Alexandru Ioan Cuza" University of Iasi Economic Sciences*, 60(1), 79-93. DOI: <http://dx.doi.org/10.2478/aicue-2013-0008>
- Estonian Association for Quality, 2014. Database of Certificates. <http://eaq.ee/sisu/sertifikaatide-andmebaas>
- Estonian Government, 2000. *Resolution No.362 of 15 November 2000. The demands for working with the monitors*. State Gazette of Estonia.
- Estonian Ministry of Social Affairs, 2000. *Resolution No.80 of 14 December 2000. Procedure for training and advanced training regarding occupational health and safety*. State Gazette of Estonia.
- Estonian Ministry of Social Affairs, 2001. *Resolution No.26 of 27 February 2001. Occupational health and safety requirements for manual lifting of loads*. State Gazette of Estonia.
- Estonian Ministry of Social Affairs, 2003. *Resolution No.74 of 24 April 2003. The procedure for health examination of workers*. State Gazette of Estonia.
- Fernandez-Muniz, B., Motnes-Peon, J. M., and Vazquez-Ordas, C. J., 2007. Safety culture: Analysis of the causal relationships between its key dimensions. *Journal of Safety Research*, 38(6), 627-641. DOI: <http://dx.doi.org/10.1016/j.jsr.2007.09.001>
- Flin, R., Mearns, K., O'Connor, P., and Bryden, R., 2000. Measuring safety climate: identifying the common features. *Safety Science*, 34(1-3), 177-192. DOI: [http://dx.doi.org/10.1016/S0925-7535\(00\)00012-6](http://dx.doi.org/10.1016/S0925-7535(00)00012-6)
- Geller, S. E., 2005. Behavior-based safety and occupational risk management. *Behavior Modification*, 29(3), 539-561. DOI: <http://dx.doi.org/10.1177/0145445504273287>
- Heinrich, H. W., 1941. *Industrial accident prevention*. New York: McGraw-Hill Book Company Inc.
- HSE, 2001. Health and safety climate survey tool. Information pack. Health and safety laboratory. <http://www.hsl.gov.uk/products/safety-climate-tool>

- Jonston, J. J., Cattledge, G. T., and Collins, J. W., 1994. The efficacy of training for occupational injury control. *Occupational Medicine*, 9(2), 147-158.
- Kuusisto, A., 2000. *Safety management systems. Audit tools and reliability of auditing*: VTT Publications.
- Laberge, M., and Ledoux, E., 2011. Occupational health and safety issues affecting young workers: A literature review. *Work (Reading, Mass.)*, 39(3), 215-232. DOI: <http://dx.doi.org/10.3233/WOR-2011-1170>
- Laberge, M., MacEachen, E., and Calvet, B., 2014. Why are occupational health and safety training approaches not effective? Understanding young worker learning processes using an ergonomic lens. *Safety Science*, 68, 250-257. DOI: <http://dx.doi.org/10.1016/j.ssci.2014.04.012>
- Leiter, M. P., Zanaletti, W., and Argentero, P., 2009. Occupational risk perception, safety training, and injury prevention: Testing a model in the Italian printing industry. *Journal of Occupational Health Psychology*, 14(1), 1-10. DOI: <http://dx.doi.org/10.1037/1076-8998.14.1.1>
- Luria, G., and Rafaeli, A., 2008. Testing safety commitment in organizations through interpretations of safety artefacts. *Journal of Safety Research*, 39(5), 519-528. DOI: <http://dx.doi.org/10.1016/j.jsr.2008.08.004>
- National Labour Inspectorate of Estonia, 2015a. Statistics: Fields of activity with the largest no. of work accidents in Estonia. from <http://www.ti.ee/est/meedia-trukised-statistika/statistika/toonnetused>
- National Labour Inspectorate of Estonia, 2015b. Statistics: Work accidents, occupational diseases, work-related diseases in the Republic of Estonia in 1995-2013. from <http://www.ti.ee/est/meedia-trukised-statistika/statistika/toonnetused-kutsehaigus-toost-pohjustatud-haigestumised-eesti-vabariigis-1995-2013>
- Paas, O., Reinhold, K., and Tint, P., 2015. Estimation of safety performance by MISHA method and the benefits of OHSAS 18001 implementation in Estonian manufacturing industry. *Agronomy Research*, 13(3), 792-809.
- Paas, O., Reinhold, K., Tint, P., and Siirak, V., 2015b. Safety auditing role in the improvement of safety performance at enterprises. *Entrepreneurial Business and Economics Review*.
- Parliament of Estonia, 1999. *Estonian Act for Occupational Health and Safety*. State Gazette of Estonia Retrieved from <https://www.riigiteataja.ee/en/eli/511112013007/consolide>.
- Peterson, D., 2000. Safety management 2000: Our strengths and weaknesses. *Professional Safety*, 45(1), 16-18.
- Reinhold, K., Jarvis, M., and Tint, P., 2009. Risk observatory- a tool for improvement safety and health at the workplace. *International Journal of Occupational Safety and Ergonomics (JOSE)*, 15(1), 101-112.
- Reinhold, K., Tint, P., and Kiivet, G., 2006. Risk assessment in textile and wood, processing industry. *International Journal of Reliability, Quality and Safety Engineering*, 13(02), 115-125. DOI: <http://dx.doi.org/10.1142/S021853930600215X>
- Sinclair, R. C., Smith, R., Colligan, M., Prince, M., Nguyen, T., and Stayner, L., 2003. Evaluation of a safety training program in three food service companies. *Journal of Safety Research*, 34(5), 547-558. DOI: <http://dx.doi.org/10.1016/j.jsr.2003.03.003>
- Sorock, G. S., Lombardi, D. A., Gabel, C. L., Smith, C. L., and Mittleman, M. A., 2001. Case-crossover studies of occupational trauma: Methodological caveats. *Injury Prevention*, 7, 38-42. DOI: http://dx.doi.org/10.1136/ip.7.suppl_1.i38
- Stanca, L. M., and Lacurezeanu, R., 2012. Continuous training possibilities in a company through blended learning. *Scientific Annals of "Alexandru Ioan Cuza" University of Iasi Economic Sciences*, 59(2), 173-181. DOI: <http://dx.doi.org/10.2478/v10316-012-0040-7>
- Tint, P., Jarvis, M., Reinhold, K., and Paas, O., 2009. Risk assessment and measurement of hazards in Estonian enterprises. *Environmental Engineering and Management Journal*, 8(5), 1165-1170.
- Tint, P., Paas, O., and Reinhold, K., 2010. Cost-effectiveness of safety measures in enterprises. *Inzinerine Ekonomika- Engineering Economics*, 21(5), 485-492.

- Tomlinson, C. M., Craig, B. N., and Meehan, M. J., 2011. *Enhancing safety performance with a leading indicators program*. Paper presented at the Human Factor in Design & Operation Conference, November 2011, London, UK. http://www.he-alert.org/filemanager/root/site_assets/standalone_article_pdfs_0905-/HE01055.pdf
- Traumann, A., Reinhold, K., and Tint, P., 2013. The model for assessment of health risks of dust connected with wood manufacturing in Estonia. *Agronomy Research*, 11(2), 471-478.
- Wahlstrom, B., and Rollenhagen, C., 2014. Safety management- A multi-level control problem. *Safety Science*, 69, 3-17. DOI: <http://dx.doi.org/10.1016/j.ssci.2013.06.002>
- Wallen, E. S., and Mulloy, K. B., 2006. Computer-based training for safety: Comparing methods with older and younger workers. *Journal of Safety Research*, 37(5), 461-467. DOI: <http://dx.doi.org/10.1016/j.jsr.2006.08.003>
- Wirth, O., and Sigurdsson, S. O., 2008. When workplace safety depends on behaviour change: Topics for behavioural safety research. *Journal of Safety Research*, 39(6), 589-598. DOI: <http://dx.doi.org/10.1016/j.jsr.2008.10.005>
- Wu, T. C., Lin, C. H., and Shiau, S. Y., 2010. Predicting safety culture: The roles of employer, operations manager and safety professional. *Journal of Safety Research*, 41(5), 423-431. DOI: <http://dx.doi.org/10.1016/j.jsr.2010.06.006>
- Zohar, D., and Luria, G., 2005. A multilevel model of safety climate: Cross-level relationships between organizations and group-level climates. *The Journal of Applied Psychology*, 90(4), 616-628. DOI: <http://dx.doi.org/10.1037/0021-9010.90.4.616>