



A cross-sectional study of factors influencing occupational health and safety management practices in companies



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ABSTRACT

Companies need to ensure a functioning occupational health and safety management (OHSM) system to protect human health and safety during work, but generally there are differences in how successful they are in this endeavor. Earlier research has indicated that factors like company size, safety culture, and different measures of financial performance may be related to the quality of OHSM practices in companies. Therefore, the aim of this study was to investigate whether these factors are associated with OHSM practices in companies. A postal questionnaire was used to collect data from a sample of Swedish manufacturing companies, and complementary data regarding the companies were retrieved from a credit bureau database. The statistical analysis was performed with ordinal regression analysis using generalized estimating equations. Different predictor variables were modeled with OHSM practices as the outcome variable, in order to calculate *p*-values and to estimate odds ratios. Company size, safety culture, and creditworthiness were found to be associated with better, as well as worse, OHSM practices in companies (depending on directionality). Practical implications for industry and future research are discussed.

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1. Introduction

1.1. Occupational health and safety management

Companies are obliged to manage risks and hazards in the workplace in order to protect human health and safety (OSH Act, 1970; SFS, 1977; 89/391/EEC). Risks need to be systematically assessed, analyzed, and corrected. If a risk cannot be corrected right away, an action plan must be established and later followed up upon. Companies differ in how successful they are in achieving a functioning systematic occupational health and safety management (OHSM) system (Duijm et al., 2008; Nordlöf et al., 2015b). Functioning OHSM practices in companies save lives and protect health in organizations all over the world (Arocena and Nunez, 2010). Swedish national data suggest that about 50% of companies have an ongoing, systematic OHSM (Swedish Work Environment Authority, 2014, 2012, 2010). Several factors have been proposed to explain why companies struggle in having functioning systematic OHSM practices. Among these are lack of commitment

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(Arocena and Nunez, 2010; Biggs et al., 2013; Fernández-Muñiz et al., 2007a), lack of knowledge (Salminen, 1998), lack of financial resources (Larsson et al., 2007; Salminen, 1998), and lack of formalized routines (Arocena and Nunez, 2010; Holte and Kjestveit, 2012), as well as letting OHS take a back seat to productivity and profitability (Duijm et al., 2008; Karlton, 2004; Nordlöf et al., 2015a). Many of these factors tend to inversely correspond to the size of companies, in that smaller companies struggle more than larger ones (Champoux and Brun, 2003; Hasle and Limborg, 2006; Wilson and Koehn, 2000), and thus, company size is considered a proxy variable for the factors mentioned above (Beer, 1964; Nordlöf et al., 2015b). Indications in earlier studies suggest that the prevalence of different OHSM practices tends to increase with company size (Sönderstrup-Andersen et al., 2010; Torp and Moen, 2006; Saksvik et al., 2003), but further research is necessary to demonstrate the proposed association between company size and OHSM practices (Nordlöf et al., 2015b).

There is also some earlier evidence that research results may differ depending on how occupational health and safety (OHS) performance in companies is measured and evaluated (DeArmond et al., 2010; Holte and Kjestveit, 2012; Nordlöf et al., 2015b). It is presumably a significantly different measure to obtain information on factual circumstances regarding the management of OHS than to obtain personal views of respondents regarding the matter

(DeArmond et al., 2010; Nordlöf et al., 2015b). Facts about which OHSM practices are implemented and functioning within an organization constitute arguably different information than, for instance, an individual's perceptions of his or her own work situation, or someone's personal views on whether OHSM practices are sufficient or not.

1.2. Safety culture

The concept of safety culture is often used to illustrate that there are social processes in organizations that help or hinder certain behaviors or outcomes regarding OHS (Antonsen, 2009; Choudhry et al., 2007; Edwards et al., 2013). There are shared values and norms (culture) among humans that are learned through socialization in the workplace (Cialdini and Trost, 1998; Giddens, 1989; Mullen, 2004). Culture is, however, one out of several factors that influence behavior (Myers et al., 2014). The aspect of culture at a workplace that concerns health and safety, risks and hazards, is hence called safety culture (Antonsen, 2009; Nordlöf et al., 2015a). Earlier research has linked safety culture to accidents and safe/unsafe behavior (Brown et al., 2000; CAIB, 2003; IAEA, 1992; Watson et al., 2005), and safety culture is assumed to be associated with OHSM practices in companies, but this needs to be investigated further to establish a relationship (Cox et al., 1998; Fernández-Muñiz et al., 2007a; Guldenmund, 2010). Safety culture in organizations has previously been studied using questionnaires (perception surveys), or with qualitative and ethnographic methods, as well as by investigating accidents (Hopkins, 2006). To date, several different safety culture questionnaires have been employed in research and organizational development (Choudhry et al., 2007; Hopkins, 2006). Furthermore, a consensus has started to form around which primary factors (indicators) of a positive or negative safety culture are the most relevant (Choudhry et al., 2007; Frazier et al., 2013; IAEA, 2002; Walker, 2008), for example, management commitment, employee involvement, risk acceptance, and productivity pressure.

1.3. Financial performance

There is potentially a multitude of factors in companies that may be associated with functioning OHSM practices (Arocena and Nunez, 2010; Hasle and Limborg, 2006). Company size and safety culture could be two, as discussed above, and financial performance of companies could be another.

Financial performance of companies is often assumed to be associated with OHS adjustments in the workplace in general (Kelloway and Day, 2005; Rose et al., 2013; Salminen, 1998; Tompa et al., 2010), and sometimes to OHSM practices in particular (Larsson et al., 2007). The assumption is that if humans operate in a good work environment that is safe, healthy, ergonomically sound, creative, and so on, these beneficial factors will be reflected in the financial performance of the company. It is not easy to demonstrate such a relationship, and the direction of causality could be debated: Do already financially prosperous companies more easily designate resources for a functioning OHSM, or do OHSM investments/costs pay off in a manner that serves the ability of the whole organization to achieve more profits? Both scenarios could be accurate, and the chain of causality may be cyclical.

Earlier studies have, it seems, not explicitly investigated the possible association between financial performance of companies and OHSM practices as outcome.

1.4. Research focus and aim

To protect human health and safety in the workplace, it is essential that companies handle risks and hazards systematically;

still, many companies struggle to achieve the requirements. It is important to better understand which factors play a part (and to what extent) in functioning OHSM practices.

The aim of this study was to investigate different factors (e.g., company size, safety culture, and financial performance) that may influence occupational health and safety management practices in companies.

2. Methods

2.1. Study design

This study has a cross-sectional design, and data were collected with a postal questionnaire sent to manufacturing companies with 10 employees or more, in a Swedish county. Questionnaires were to be answered by one manager and one safety delegate per company. Complementary data concerning the companies were retrieved from a credit bureau database (UC.se, 2015). The statistical analysis was performed with ordinal regression analysis using generalized estimating equations (GEE).

2.2. Measures

2.2.1. OHSM practices

No generally established instrument to measure OHSM practices was found when reviewing the literature. We therefore designed this measure by reviewing legislation and earlier studies, and extracting from them the essentials of OHSM (e.g., AFS, 2001; Battaglia et al., 2015; Fernández-Muñiz et al., 2007b; SFS, 1977; 89/391/EEC). We formulated 13 items regarding different OHSM practices, which were to be answered with *yes/no/don't know* (Appendix). The items were together calculated as a joint index by summing the number of yes answers to produce the outcome variable OHSM practices.

2.2.2. Safety culture

Safety culture has been investigated with questionnaires in several earlier studies (Choudhry et al., 2007; Hopkins, 2006). In our survey of the literature we uncovered no safety culture instrument that effectively produces one global safety culture measure for analysis. We therefore decided to formulate items on primary factors for safety culture that together formed an index to use as a predictor variable. By systematically going through literature and earlier questionnaires, we found 13 primary factors that are most commonly used to indicate the state of safety culture in an organization (e.g., Antonsen, 2009; Choudhry et al., 2007; Frazier et al., 2013; IAEA, 2002; Nordlöf et al., 2015a; Ostrom et al., 1993; Walker, 2008). We then formulated items, expressed as statements, for each of the primary factors (Appendix). The items were to be answered using a Likert-type scale with the alternatives *yes, absolutely/yes, partly/no, not really/no, not at all*.

2.2.3. Work environment priority

To measure perceived priority of the work environment we used items developed by Nordlöf et al. (2012). In that study 42 items were used to measure a broad spectrum of primary factors related to perceived work environment priority in companies, which formed seven different indexes. To reduce the number of items in the questionnaire, we reformulated the seven indexes into seven items to use in this study. The items were written as statements and were to be answered using the same Likert-type scale as used for the safety culture items (Appendix). The seven items were together calculated as an index in order to produce the predictor variable work environment priority.

2.2.4. Company size

Either numbers of employees or company turnover is normally used to measure company size (Commission of the European Communities, 2003). In this study we used the more common gauge, numbers of employees (Nordlöf et al., 2015b). Respondents of the questionnaire were asked to estimate the number of employees at their company (at the worksite).

2.2.5. Financial performance

In business many different indicators are used to analyze financial performance of a company. Three different categories of financial performance were used in this study: company profitability, solvency, and creditworthiness.

Profitability is the ability of a company to give return on invested resources and was measured with two variables retrieved from the credit bureau database (UC.se, 2015), return on sales (ROS) and return on assets (ROA). ROS is a profitability key performance indicator (KPI) calculated as $100 \times \text{earnings before interest and taxes (EBIT)}/\text{operating income}$. ROA is a profitability KPI calculated as $100 \times (\text{EBIT} + \text{financial income})/\text{balance sheet total}$. Both ROS and ROA are expressed in percentages. Profitability was also measured with an item in the questionnaire. It was a question about whether the respondent perceived the company to be profitable at the moment, and was to be answered using a Likert-type scale with the alternatives *yes, absolutely/yes, partly/no, not really/no, not at all*.

Solvency is the ability to mobilize resources when costs arise and was measured by two variables retrieved from the credit bureau database, quick ratio and equity ratio. Quick ratio is a KPI for short-term solvency calculated as $100 \times (\text{current assets} - \text{inventory})/\text{current liability}$. Equity ratio is a KPI for long-term solvency calculated as $100 \times (0.78 \times \text{untaxed reserves} + \text{equity})/\text{balance sheet total}$. Both quick ratio and equity ratio are expressed in percentages.

Creditworthiness, which usually is calculated by an external agent, was also provided by the credit bureau database, and is an important measure of the financial performance of a company. The creditworthiness variable was expressed on a five-point ordinal scale ranging from 5 (very low risk) to 1 (high risk). These were the predictor variables on financial performance used in this study.

2.2.6. Other measures

Information on whether the company was part of a corporate group was retrieved from the credit bureau database. The questionnaire also entailed sociodemographic items of sex and age, and whether the respondent had had any external training in OHS management for a minimum of eight hours (Table 1).

2.3. Sample and data collection

All manufacturing companies in a Swedish county, registered as having 10 employees or more ($N = 238$), were sampled from the credit bureau database. Two postal questionnaires were sent to each company in the sample, one to be answered by a manager (representative of employer) and one to be answered by a safety delegate (representative of employees) ($N = 476$). Each questionnaire was accompanied by an information letter explaining the purpose of the study, details about participating, and the handling of data, as well as a response envelope. The data were collected during the months of February and March 2015. Companies also received two reminder letters encouraging participation, as well as telephone calls asking if they would like to participate. To enhance the number of participating companies, an option to participate by answering a shorter version of the questionnaire by telephone was offered, which 53 individuals accepted. That version included the questions regarding OHSM practices and the single

Table 1
Description of the respondents.

		n	Proportion (%)
Respondents		280 ^a	
Role	Managers	191	68.2
	Safety delegates	89	31.8
Sex	Men	217	79.2
	Women	57	20.8
	Missing info	6	
Age	Mean (SD)	48 (9.6)	
	Min–Max	22–69	
	Missing info	55	
Have had minimum 8 h of OHSM training	Yes	159	70
	No	68	30
	Missing info	51	
Consider own knowledge regarding OHSM to be sufficient	Yes, absolutely	51	22.7
	Yes, partly	132	58.7
	No, not really	35	15.6
	No, not at all	7	3.1
	Missing info	55	
Questionnaire answered	By telephone	53	18.9
	By post	227	81.1

^a The 280 respondents represent 197 different companies. SD = standard deviation.

question about whether the respondent perceived the company to be profitable at the moment, but it did not include the questions regarding safety culture and work environment priority.

2.3.1. Response rate

Of the sampled companies, 197 provided information via questionnaire, a response rate of 82%. Of the two respondents approached at each of the sampled companies, a total of 280 respondents answered the questionnaire, a response rate of 59%. A description of the respondents is presented in Table 1. A total of 114 companies were each represented by one respondent, 77 companies by two respondents, and 3 companies by three respondents.

2.3.2. Non-response analysis

The strategy to use reminder letters and telephone calls was successful in improving the response rate. Data obtained from the credit bureau database (UC.se, 2015) were used to perform a non-response analysis. There were no significant differences between participating and non-participating companies across the variables of creditworthiness, quick ratio, equity ratio, return on sales, or return on assets ($p = \text{range: } 0.878\text{--}0.403$, Mann–Whitney U test). There was also no significant difference between participating and non-participating companies regarding where they were located throughout the ten municipalities in the county studied ($p = 0.663$, Pearson's chi-square test). It was, however, a bit more usual for larger companies than smaller to participate in the study ($p = 0.014$, Mann–Whitney U test), and also somewhat more usual for companies belonging to a corporate group to participate ($p = 0.001$, Pearson's chi-square test).

2.4. Validity and reliability

Several steps were taken to validate the different measures in the questionnaire, by systematically going through the literature (legislation, earlier research, theory, and earlier questionnaires), and by receiving feedback and advice on the questionnaire from 22 individuals (15 university researchers within the field of occupational health sciences, two safety delegates and one OHS coordinator at a university, two officers from the Swedish Work Environment Authority, and two OHS managers from manufacturing companies). For reliability, Cronbach's alpha test statistic was calculated to test the internal consistency of the index measures—OHSM practices (0.73), safety culture (0.85), and work environment priority (0.91)—which was found to be satisfactory.

2.5. Preparation of the variables before analysis

The measures were prepared before they were used as variables in analysis, and they are presented separately within Fig. 1 (1a to 1g) and Fig. 2 (2a to 2h).

OHSM practices: For each of the 13 items, *yes* was coded as 1, and *no* and *don't know* were coded as 0. The scores for each of the separate items are presented in Table 2. The items were summed together to create the index (scores 0–13) (Fig. 1a). Before analysis, OHSM practices were recoded into a variable with four categories (Fig. 1b), as outcome variable in the analysis.

Safety culture: For each of the 13 items, *yes, absolutely* and *yes, partly* were coded as 1 (*yes*), and *no, not really* and *no, not at all* were coded as 0 (*no*) (Table 2). The items were summed together to create the index (scores 0–13) (Fig. 1c), as predictor variable in the main analysis. For a complementary analysis, safety culture was also recoded into a four-category variable (Fig. 1d).

Work environment priority: For each of the seven items, *yes, absolutely* and *yes, partly* were coded as 1 (*yes*), and *no, not really* and *no, not at all* were coded as 0 (*no*) (Table 2). The items were summed together to create the index (scores 0–7) (Fig. 1g).

Company size: Information regarding numbers of employees was obtained via the questionnaire. Information was missing in nine cases, but it was possible to correct this missing information by using data from the answers of the other respondent from the same company (when applicable), or by inquiring about the company size registered in the credit bureau database. This variable is presented as Fig. 1e. For a complementary analysis company size was recoded into a five-category variable (Fig. 1f).

Financial performance variables: The creditworthiness variable needed no further preparation (Fig. 2a). Perceived profitability, with the response categories of *yes, absolutely*; *yes, partly*; *no, not really*; and *no, not at all* was coded as 4, 3, 2, and 1 (Fig. 2c). This variable was also recoded into two categories (Fig. 2d). For the KPIs of quick ratio, equity ratio, return on sales, and return on assets, data were available for the three latest years for each company. A mean value score of the three years was calculated for each of these variables (Fig. 2e–h).

Part of corporate group: The variable of being part of a corporate group needed no further preparation (Fig. 2b).

2.6. Analysis

2.6.1. Statistical model

Generalized estimating equations were used to estimate parameters in ordinal regression analysis for the main analysis of this study. GEE is considered a robust method, and it is used to adjust for clustered data (Hanley et al., 2003), in the case of this study, having more than one respondent per company. In GEE, the regression parameters are of primary interest, but the imposed correlations are of no specific interest. By including the correlations in

the estimation process the clustering is accounted for, and the standard errors of the regression parameters are estimated more accurately. Thereby, “company” was chosen as subject variable in the model, and “respondents” at the companies were chosen as within-subject variable, in order to analyze the data. OHSM practices with four categories were set as the outcome variable (Fig. 1b). We used the unstructured specification of the correlation matrix in the GEE model specification. The ordinal regression model we used was the proportional odds model. The predictor variables used in the analyses are described in Figs. 1 and 2, and listed in Table 3. The aim was to investigate whether these factors are associated with better OHSM practices in the companies. The statistical software PASW Statistics 22.0 (SPSS Inc., Chicago, IL) was used for the analyses. Alpha level for statistical significance was set to $p < 0.05$.

2.6.2. Statistical analyses step-by-step

Firstly, each of the predictor variables was run one-by-one in GEE in univariate analyses to investigate possible associations with the outcome variable (Table 3). The significant variables in the univariate analyses were then used in a multivariate analysis (Table 3). As a complementary analysis, the significant variables from the multivariate analysis in Table 3 were used in another multivariate analysis, where company size and safety culture were changed to have categories (Table 4). The use of categories helps to illustrate how estimated odds may change from one category to another, and to show non-linearity in logits. The intention was also to check whether these quantitative variables had a linear relation to the log odds.

The analyses in Tables 3 and 4 evaluate whether the predictor variables are associated with *better* OHSM practices. To further penetrate the research aim, we reversed the outcome variable and the predictor variables from Table 4, to investigate whether they also might be associated with *worse* OSHM practices (Table 5).

3. Results

3.1. Factors associated with better OHSM practices (univariate analyses)

The following variables were found to have a statistically significant association with better OHSM practices, one-by-one: company size, safety culture, work environment priority, quick ratio, return on assets, perceived profitability with two categories, creditworthiness, and being part of a corporate group (univariate analyses in Table 3). For creditworthiness it was specifically the category *very low risk* that had a statistically significant odds ratio. Perceived profitability with four categories was not significant, but there was a tendency towards the categories *yes, absolutely* and *yes, partly*, which probably explains why perceived profitability with two categories was significant.

3.2. Factors associated with better OHSM practices when adjusted for one another (multivariate analysis)

The following variables, which were significant one-by-one, were then found to be significantly associated with better OHSM practices when adjusted for one another: company size, safety culture, creditworthiness, and part of corporate group (multivariate analysis in Table 3). The analysis estimates that for every 10 additional employees in a company there were 3% increased odds that the company has better OHSM practices. For every additional score in safety culture there were 30% increased odds that the company has better OHSM practices. For a company with *normal*, *low*, or *very low risk* in creditworthiness there were three to six times increased

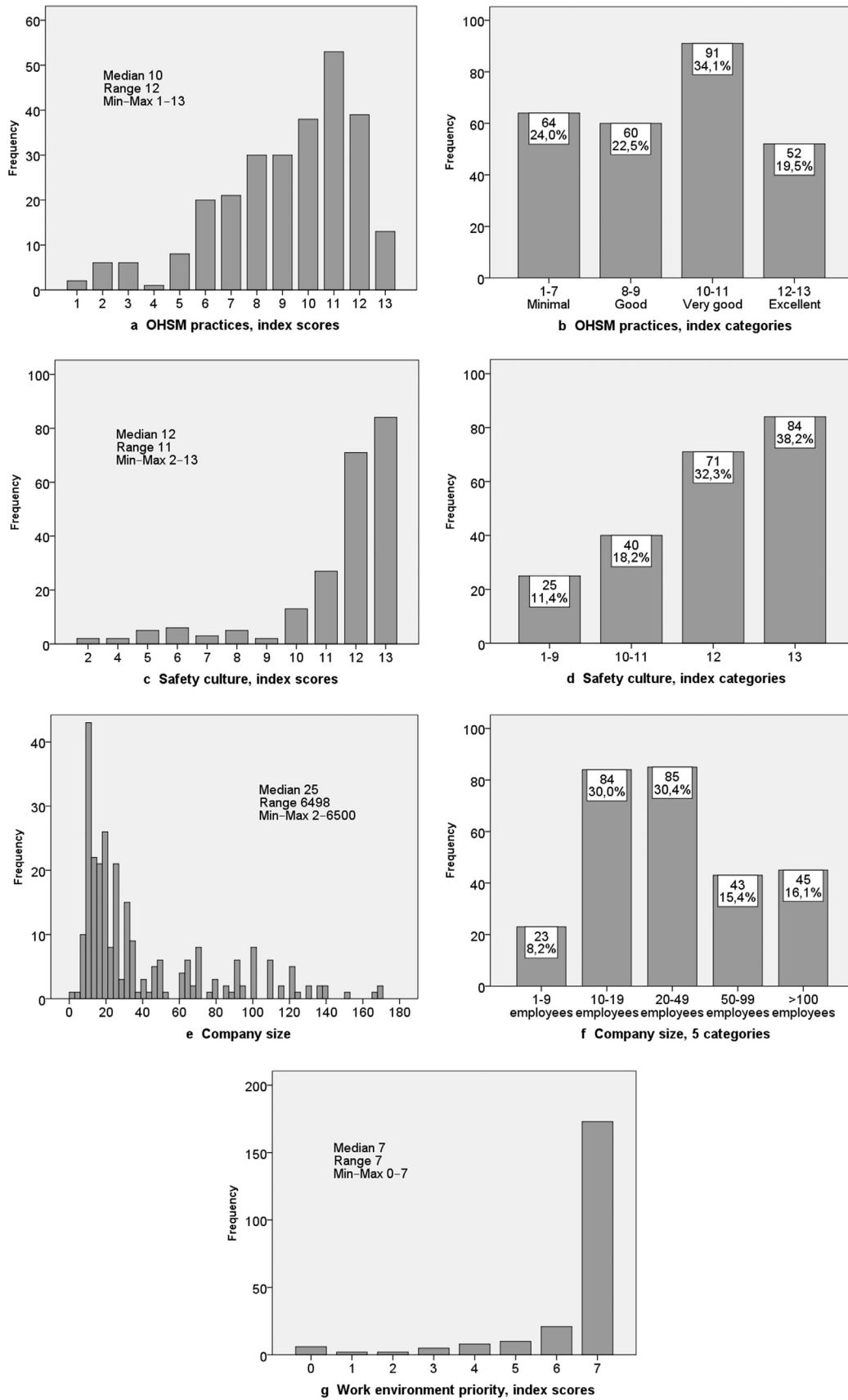


Fig. 1. Variable description I: The variables of OHSM practices, safety culture, company size, and work environment priority (n = 280). The category variables are based on the score variables. *Missing information:* OHSM practices (n = 13), safety culture (n = 60), work environment priority (n = 53).

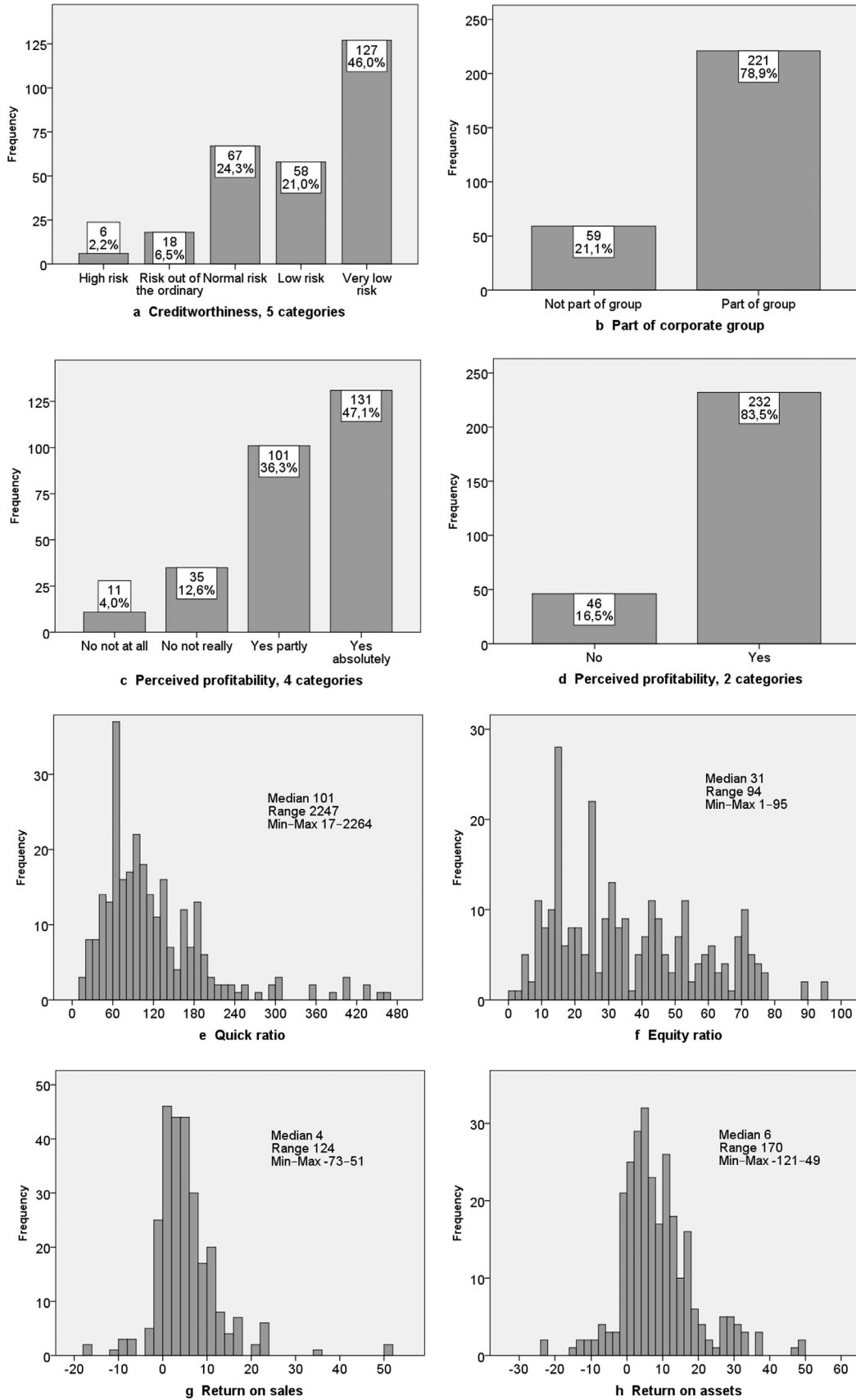


Fig. 2. Variable description II: The variables of creditworthiness, part of corporate group, perceived profitability with four and two categories, quick ratio, equity ratio, return on sales, and return on assets (n = 280). *Missing information:* creditworthiness (n = 4), perceived profitability (n = 2), quick ratio (n = 2), equity ratio (n = 6), return on sales (n = 8), return on assets (n = 6).

Table 2

Overview of the items composing the indexes of OHSM practices, safety culture, and work environment priority (n = 280).

Items	n (Proportion, %)		
<i>OHSM practices index</i>	Yes	No/Don't know	Missing info
Written routines	238 (85.6)	40 (14.4)	2
Safety delegates	245 (87.5)	35 (12.5)	–
Risk assessment	225 (80.4)	55 (19.6)	–
Collaboration for risk assessment	250 (89.6)	29 (10.4)	1
Written action plan	179 (63.9)	101 (36.1)	–
Action plan follow-up	165 (59.1)	114 (40.9)	1
Reporting incidents	262 (93.9)	17 (6.1)	1
Emergency plan	191 (69)	86 (31)	3
Safety training	248 (89.2)	30 (10.8)	2
OHS policy statement	228 (82)	50 (18)	2
OHSAS 18001 certification	46 (16.7)	230 (83.3)	4
Occupational health services	229 (82.1)	50 (17.9)	1
Budget item for OHSM	58 (21.2)	216 (78.8)	6
<i>Safety culture index</i>	Yes	No	Missing info
Safety rules	216 (95.6)	10 (4.4)	54
No risk acceptance	188 (83.6)	37 (16.4)	55
Management commitment	200 (88.5)	26 (11.5)	54
No productivity pressure	177 (78.7)	48 (21.3)	55
Employee involvement	209 (92.5)	17 (7.5)	54
Individual responsibility	220 (97.3)	6 (2.7)	54
Incident reporting	220 (97.3)	6 (2.7)	54
No fatalism	177 (78.3)	49 (21.7)	54
No blaming	177 (78)	50 (22)	53
Peer feedback	204 (90.3)	22 (9.7)	54
Safety training	197 (87.6)	28 (12.4)	55
Communication	197 (86.8)	30 (13.2)	53
Continuous improvements	209 (92.5)	17 (7.5)	54
<i>Work environment priority index</i>	Yes	No	Missing info
Physical working conditions	207 (91.2)	20 (8.8)	53
Psychosocial working conditions	197 (86.8)	30 (13.2)	53
Organizational functionality	205 (90.3)	22 (9.7)	53
OHSM routines	212 (93.4)	15 (6.6)	53
Communication & interaction	211 (93)	16 (7)	53
Leadership	204 (89.9)	23 (10.1)	53
Health	204 (89.9)	23 (10.1)	53

See Appendix for how the items were formulated in the questionnaire. Missing information for safety culture and work environment priority items is mainly due to the fact that 53 individuals participated by telephone and were not asked those questions.

odds that the company has better OHSM practices, compared to companies with *high risk* in creditworthiness. Being part of a corporate group showed three times increased odds that the company has better OHSM practices.

3.3. Association with better OHSM practices when company size and safety culture have categories (second multivariate analysis)

In a second multivariate analysis, company size and safety culture were found to remain significantly associated with better OHSM practices as category variables (Table 4). The trend for company size was that the larger the company, the higher the estimated odds for better OHSM practices. This was especially obvious for the category *50–99 employees*, with 18 times increased odds, and *>100 employees*, with 26 times increased odds that the company has better OHSM practices. The trend for safety culture was also that the higher the score, the higher the odds for better OHSM practices. The category of most positive safety culture (*score 13*) showed seven times increased odds that the company has better OHSM practices.

Creditworthiness did not remain significant in this analysis when company size and safety culture were category variables, but there was a tendency for the categories *normal*, *low*, and *very low risk* to be significant (Table 4).

3.4. Factors associated with worse OHSM practices when adjusted for one another (third multivariate analysis)

Company size, safety culture, and creditworthiness were also found to be significantly associated with worse OHSM practices when adjusted for one another (Table 5). The reversed trend was shown for company size and safety culture: the smaller the company and more negative the safety culture, the higher the odds that the company has worse OHSM practices. The category *1–9 employees* showed 21 times higher odds that the company has worse OHSM practices. The category *1–9 score* in safety culture showed seven times higher odds that the company has worse OHSM practices. For a company with *high risk* in creditworthiness there were nine times higher odds that the company has worse OHSM practices.

4. Discussion

Of the different factors investigated in this study, company size, safety culture, and creditworthiness were found to be associated with better, as well as worse, OHSM practices (depending on directionality of the predictor variables and outcome).

4.1. Better and worse OHSM practices in companies

Being a large company and having a positive safety culture as well as low risk in creditworthiness were shown to be **protective factors** for better OHSM practices. Being a small company and having a negative safety culture as well as high risk in creditworthiness were shown to be **risk factors** for worse OHSM practices. Among the participating companies there were a variety of scores for OHSM practices, a few having *minimal* index scores (0–7), the majority having *good* to *very good* scores (8–11), and a few having *excellent* scores (12–13) (Fig. 1a and b). The most common item regarding OHSM practices was *having routines for reporting incidents that occur*, which 93.9% of the respondents indicated with yes (Table 2).

It is interesting to consider that company size can be viewed as both a protective factor as well as a risk factor for OHSM practices in companies. This has also been indicated in earlier research: the prevalence of OHSM practices is higher in larger companies (Sönderstrup-Andersen et al., 2010; Torp and Moen, 2006; Saksvik et al., 2003), and smaller companies struggle more with OHSM practices (Champoux and Brun, 2003; Hasle and Limborg, 2006; Wilson and Koehn, 2000). A study by Arocena and Nunez (2010) has shown that it is more common for large companies to use formal practices, and that smaller companies often use informal or non-systematic practices for OHS. OHSM practices therefore seem to gradually advance as company size increases (Champoux and Brun, 2003). Also, it has been shown that companies with more than 100 employees are almost twice as likely as companies with fewer employees to have implemented health promotional programs of some sort (Wilson et al., 1999). The reason company size appears to matter regarding level of functioning OHSM practices is probably that there are several other underlying factors in an organization that change when size changes, and company size is a proxy variable for these other factors (Beer, 1964; Nordlöf et al., 2015b). Such factors are, for example, structure, commitment, incentives, knowledge, available resources, routines, and other priorities (Arocena and Nunez, 2010; Champoux and Brun, 2003; Duijm et al., 2008; Holte and Kjestveit, 2012; Larsson et al., 2007; Salminen, 1998).

As with company size, safety culture was found to be a protective factor as well as a risk factor for OHSM practices in companies. A majority of the participating companies in this study had quite a

Table 3
The predictor variables associated with better OHSM practices.

Predictor variables	Univariate analyses					Multivariate analysis ^b		
	nc ^a	n	OR	95% CI	P-value	OR	95% CI	P-value
Company size	193	267	1.004	1.001–1.006	0.006	1.003	1.001–1.004	0.003
Safety culture, scores	146	208	1.495	1.333–1.676	0.000	1.299	1.020–1.654	0.034
Work environment priority, scores	149	214	1.493	1.280–1.741	0.000	1.283	0.838–1.962	0.251
Quick ratio	192	265	1.001	1.000–1.003	0.011	1.001	1.000–1.002	0.181
Equity ratio	190	261	1.002	0.988–1.016	0.789	–	–	–
Return on sales	188	259	1.033	0.980–1.088	0.231	–	–	–
Return on assets	190	261	1.026	1.004–1.048	0.020	1.015	0.993–1.038	0.182
Perceived profitability, 4 categories	193	265	<i>Model</i>	–	0.065	–	–	–
Yes, absolutely	–	–	3.952	1.288–12.131	0.016	–	–	–
Yes, partly	–	–	2.698	0.867–8.390	0.086	–	–	–
No, not really	–	–	2.024	0.592–6.918	0.261	–	–	–
No, not at all	–	–	1	–	–	–	–	–
Perceived profitability, 2 categories	193	265	<i>Model</i>	–	0.049	<i>Model</i>	–	0.624
Yes	–	–	1.955	1.004–3.810	0.049	1.214	0.558–2.640	0.624
No	–	–	1	–	–	1	–	–
Creditworthiness, 5 categories	191	263	<i>Model</i>	–	0.019	<i>Model</i>	–	0.007
Very low risk	–	–	6.395	1.185–34.520	0.031	6.126	1.867–20.105	0.003
Low risk	–	–	2.883	0.512–16.226	0.230	3.551	1.011–12.469	0.048
Normal risk	–	–	2.898	0.527–15.941	0.221	5.281	1.674–16.657	0.005
Risk out of the ordinary	–	–	2.045	0.335–12.468	0.438	1.474	0.345–6.302	0.601
High risk	–	–	1	–	–	1	–	–
Part of corporate group	193	267	<i>Model</i>	–	0.003	<i>Model</i>	–	0.009
Yes	–	–	3.518	1.531–8.086	0.003	3.245	1.342–7.848	0.009
No	–	–	1	–	–	1	–	–

Statistical test: Ordinal regression analysis using GEE. OR indicate odds ratios for better OHSM practices. Numbers in bold indicate statistically significant association.

^a nc = number of companies.

^b In the multivariate analysis, number of companies = 142; n = 198 respondents.

Table 4
Second multivariate analysis: predictor variables with categories associated with better OHSM practices.

Predictor variables	OR	95% CI	P-value
Company size, 5 categories	<i>Model</i>	–	0.000
>100 employees	26.285	5.613–123.076	0.000
50–99 employees	18.058	3.967–82.197	0.000
20–49 employees	4.454	0.995–19.931	0.051
10–19 employees	4.846	1.158–20.289	0.031
1–9 employees	1	–	–
Safety culture, 4 categories	<i>Model</i>	–	0.009
13	6.942	2.146–22.451	0.001
12	5.610	1.962–16.040	0.001
10–11	4.410	1.548–12.564	0.005
1–9	1	–	–
Creditworthiness, 5 categories	<i>Model</i>	–	0.051
Very low risk	9.329	2.030–42.873	0.004
Low risk	6.222	1.257–30.810	0.025
Normal risk	7.077	1.488–33.658	0.014
Risk out of the ordinary	3.674	0.461–29.296	0.219
High risk	1	–	–
Part of corporate group	<i>Model</i>	–	0.244
Yes	1.624	0.718–3.673	0.244
No	1	–	–

Statistical test: Ordinal regression analysis using GEE. OR indicate odds ratios for better OHSM practices. Numbers in bold indicate statistically significant association. Number of companies = 144; n = 204 respondents.

positive safety culture with high index scores (10–13), and few companies had lower scores (2–9) (Fig. 1c and d). The two items that were most agreed on were that it is *important to report incidents that occur* (97.3%), and that *the individual's own responsibility is very important for working safely* (97.3%) (Table 2). The belief that it is the individual's own responsibility to be sure to work safely has earlier been emphasized by workers in a study where focus group interviews were conducted (Nordlöf et al., 2015a), which makes it appear as a critical dimension for positive safety culture.

Table 5
Third multivariate analysis: predictor variables with categories associated with worse (reversed) OHSM practices.

Predictor variables	OR	95% CI	P-value
Company size, 5 categories	<i>Model</i>	–	0.001
1–9 employees	21.194	4.127–108.848	0.000
10–19 employees	4.620	1.737–12.288	0.002
20–49 employees	4.012	1.507–10.682	0.005
50–99 employees	1.587	0.594–4.236	0.357
>100 employees	1	–	–
Safety culture, 4 categories	<i>Model</i>	–	0.001
1–9	6.943	2.721–17.713	0.000
10–11	2.346	1.068–5.155	0.034
12	1.733	0.922–3.258	0.088
13	1	–	–
Creditworthiness, 5 categories	<i>Model</i>	–	0.045
High risk	9.430	2.037–43.647	0.004
Risk out of the ordinary	2.434	0.549–10.786	0.242
Normal risk	1.515	0.756–3.078	0.250
Low risk	1.724	0.719–4.132	0.222
Very low risk	1	–	–
Part of corporate group	<i>Model</i>	–	0.092
No	1.944	0.898–4.209	0.092
Yes	1	–	–

Statistical test: Ordinal regression analysis using GEE. OR indicate odds ratios for worse OHSM practices. Numbers in bold indicate statistically significant association. Number of companies = 144; n = 204 respondents.

Safety culture has earlier been shown to be associated with accidents and safe/unsafe behavior (Brown et al., 2000; CAIB, 2003; IAEA, 1992; Watson et al., 2005), and the present study could successfully link safety culture with OHSM practices, which therefore confirms assumptions in earlier research (Cox et al., 1998; Fernández-Muñiz et al., 2007a; Guldenmund, 2010). The shared values and norms regarding safety in an organization are what constitute the safety culture (Antonsen, 2009; Choudhry et al., 2007; Edwards et al., 2013). Since safety culture was associated

with OHSM practices in this study, it sheds light on the important role values and norms play for better or worse management practices. On the one hand, we have culture, which often comprises unspoken rules within an organization, and on the other hand, we have OHSM practices, which are the expressed rules for health and safety. If safety is highly valued (a positive safety culture), it is a protective factor for better OHSM practices, and if safety is lowly valued (a negative safety culture), it is a risk factor for worse OHSM practices.

Creditworthiness was also found to be associated with OHSM practices and can be considered a proxy variable for financial performance in companies. There is not much earlier research on financial performance and OHSM practices in general, or on creditworthiness and OHSM practices in particular. Nevertheless, Fernández-Muñiz et al. (2009) studied the relationship between occupational safety management and different firm performance outcomes, and found that safety management was associated with better competitiveness and financial performance in companies (subjectively measured, though). Similar to the way we demonstrated an association between creditworthiness and OHSM practices, Larsson et al. (2007) showed an association between companies' share values and their OHSM practices: "competent management of occupational health and safety in the corporation is a strong indicator of the share value of the company" (p. 270). It appears reasonable to assume that companies with low risk in creditworthiness would have more financial resources available to invest in OHSM practices, and that companies with high risk in creditworthiness would have fewer financial resources to invest in OHSM practices. This study is to our knowledge the first to report that creditworthiness is associated with OHSM practices.

In summary, all three of these factors can be said to be proxy variables for other underlying factors that taken together influence OHSM practices: company size, a proxy for structural aspects in companies; safety culture, a proxy for social aspects; and creditworthiness, a proxy for financial aspects. Adjusted for one another, and depending on directionality, these variables were found to be protective factors, as well as risk factors, for better and worse OHSM practices.

4.2. The relationship between company size and being part of a corporate group

There was quite a range in size among the companies participating in the study, with 25 as the median number of employees (Fig. 1e). The majority of the companies were, however, small (<49 employees); some were medium-sized; and some were large (Fig. 1f), which could be expected, since 99% of companies in the European Union are SMEs (small- and medium-sized enterprises) (ENWHP, 2001). However, 78.9% of the companies were found to be part of a corporate group, which could be an indication of their potentially having access to resources and knowledge regarding OHSM practices that the other 21.1% do not have (Fig. 2b). Being part of a corporate group was significantly associated with OHSM practices in the first multivariate analysis (Table 3), but not in the analyses thereafter, where company size and safety culture had categories (Tables 4 and 5). Being part of a corporate group could be considered a proxy for the company being likely to have access to better OHSM practices. Company size and being part of a corporate group therefore both seem to be proxy variables for some of the same underlying factors that influence OHSM practices, which could explain why being part of a corporate group did not remain significant when the company size variable had categories, and why the effect instead was sufficiently explained by the size categories.

4.3. Creditworthiness as a proxy for financial performance

The relevance of different financial performance indicators for OHSM practices was partly supported by this study. Return on assets was one of the profitability measures for financial performance, and had a median value of 6% (Range 170) among the participating companies (Fig. 2h), which lies under the recommended 10% limit that is usually considered as good profitability (UC.se, 2015). Return on sales, quick ratio, and equity ratio provided a similar illustration of the financial performance of the participating companies. These measures had been calculated based on the last three years, and it is important to provide such a time span, since the economy may fluctuate from year to year, and it would have been insufficient to have data from only one of the years.

Quick ratio, ROA, perceived profitability, and creditworthiness were all significant in the univariate analyses, but only creditworthiness remained significant in the multivariate analysis (Table 3). Then, in the analysis where company size and safety culture had categories, creditworthiness had only a tendency towards a significant association with better OHSM practices (Table 4), but did, however, have a significant association with worse OHSM practices (Table 5). Creditworthiness should therefore be interpreted with care in this study. Few of the participating companies (8.7%) had high risk or risk out of the ordinary for their creditworthiness (Fig. 2a). Normal and low risk were common (45.3%), but most of the companies were in the category of very low risk (46%). That there were considerably few observations in the category of high risk may explain why the statistical analysis only showed a tendency towards association between creditworthiness and better OHSM practices.

4.4. Methodological discussion and limitations

This study had a cross-sectional study design and can therefore demonstrate only cross-sectional association, and not causality.

Considerations regarding the statistical analyses: The statistical analyses with proportional odds model within the framework of GEE were used to handle the ordinal structure of the outcome variable and the possible correlations of data within companies. Although a relevant model, it is difficult to check the assumptions for the model when using GEE, since the arsenal of diagnostic tools within GEE is scarce. GEE modeling is, however, regarded as robust against misspecification of the correlations. The outcome variable (OHSM practices) was recoded to have categories (minimal, good, very good, and excellent) to better fit an ordinal model (Fig. 1a and b). We judged it as reasonable to treat the outcome variable as a four-category factor, since, when we inspected the data (Fig. 1a), the companies appeared to group, almost equally in number, around four separate categories: minimal, good, very good, and excellent OHSM practices (Fig. 1b). The proportional odds model was also motivated by considering the outcome variable to be a latent continuous variable. We also tested the linearity in logit odds for the quantitative variables company size and safety culture by using them with categories as well. We were, however, not able to formally test the proportional odds assumption because of the scarcity of diagnostic tools available. We found it interesting to be able to report results both for better outcomes as well as worse. The results of reversing the order of outcome variable categories, as well as the predictor variables categories, gave similar conclusions; this still, however, leaves us with some uncertainty about whether the logit link was the most appropriate link function.

The non-response analysis did not indicate that there would be any large deviations between the participating companies ($n = 197$) and the ones that did not participate ($n = 41$), or that it would pose any systematic differences in the results of this study.

There was, however, a statistically significant trend for larger companies, and companies belonging to a corporate group, to participate in the study when compared to the companies that did not. This may be explained by the fact that being a larger organization, or belonging to a group of organizations, increases the likelihood that the organization has an infrastructure where the risk of a questionnaire disappearing along the way and not finding its intended recipient is decreased. It may also be more likely that there is a professional in the organization who would make the time to answer a questionnaire.

Regarding generalizability and transferability of the results of this study to other contexts, we think that the following should be considered. The context of this study is small, medium, and large manufacturing companies in a county in Sweden. We have no reason to believe that the participating companies would not be representative of other manufacturing companies in Sweden. It can be difficult to transfer research results between nations because of differences in cultural and societal circumstances, and the reader alone must try to judge to which other contexts these results may reasonably be generalized. The results could especially be valid in contexts with similar national legislation regarding OHS management, and where there is a tradition of close cooperation between trade union organizations and employers.

Company size (number of employees) was available in the credit bureau database when the sampling was made. We also asked the respondents in the questionnaire to specify the number of employees at the company. Even though the companies sampled were selected as having 10 employees or more, some of the participating companies turned out to have fewer employees than that, according to the answers obtained in the questionnaire. We judge that the size data in the database were fine to use when drawing the sample, but that the size data collected with the questionnaire were more appropriate to use as variable. Information on company size could have limitations in accuracy depending on where it's collected from, which may be important to consider in future research designs.

The use of telephone reminders for companies to participate turned out well. Offering respondents the alternative to answer a shorter version of the questionnaire by telephone was a successful strategy that we recommend for future research. It is necessary, though, to limit the total number of questions asked by telephone. Practically speaking, this will often mean that it is necessary to select the most important questions for the telephone version, which we did in this study.

The results of this study should be interpreted bearing in mind that the index scales for OHSM practices, safety culture, and work environment priority were designed for this study and have not been used in earlier research. Therefore, we took several steps to address validity and reliability, as mentioned under Sections 2.2 and 2.4, as well as to develop the items to appropriately reflect primary factors as they have been described in earlier research.

4.5. Future research

Future research should aim to replicate the results of this study in other settings: industries other than manufacturing, and other countries or a cross-national research project, preferably with a larger sample size.

Future research could also continue to focus on how companies' OHSM practices can be measured in a successful manner. Further validity and reliability testing of the OHSM practices and safety culture measures of this study is encouraged in other settings.

Efforts should be made in future research to achieve a unified theory of safety culture. The consensus regarding primary factors (indicators) for safety culture should continue to develop, as should efforts toward devising a short and relevant instrument

that successfully measures the global factor of safety culture within organizations.

More research is needed on how financial performance is connected to OHSM practices, as a predictor as well as an outcome: to not only look at financial performance as a prerequisite in these circumstances. More research is also needed on cost/benefit analyses of implemented OHSM activities. Future studies within this research field should continue the use of financial performance variables. There are many to choose from, and creditworthiness appears to be a relevant proxy variable for financial performance.

4.6. Practical implications for industry

The findings that company size, safety culture, and creditworthiness are associated with occupational health and safety management practices carry implications for industry.

Smaller companies generally find it harder to get functioning OHSM practices in place and should therefore ask for more help and support, for instance, by consulting occupational health services or benchmarking best practices with other companies within the same type of industry. More training and competence development is called for, considering that 30% of the respondents in this study had not had a minimum of eight hours of OHSM training, and that only 22.7% answered *yes, absolutely* with regard to whether they considered their own knowledge of OHSM to be sufficient.

As shown in this study, safety culture does seem to influence OHSM practices, and we therefore recommend that companies also focus on the culture at the workplace, in addition to striving for systematic OHSM practices and routines. Safety culture and OHSM practices go hand in hand, and it is reasonable for companies to put effort into both, in aiming for an excellent *total OHS performance*. We therefore advise companies to regularly measure and keep track of their own safety culture, and to openly discuss values and priorities regarding OHS within the organization.

Financial performance seems to be associated with better OHSM practices, as was demonstrated in this study regarding the creditworthiness of the companies. Better financial performance and better OHSM practices may reinforce one another in a positive and cyclical spiral, which makes the case that it is important to achieve good OHSM practices also from the point of view of financial performance. Only a few respondents in this study stated that their companies had a specific budget item for costs concerning OHSM (21.1%). We suggest as a practice that companies implement one if it is not already in use.

Professionals responsible for OHSM in an organization should consider how to succeed in using *best practices*. It is almost always possible to further improve management practices, and one way could be to certify the practices, considering that only 16.7% of the respondents in this study stated that their company is certified in accordance with the OHSAS 18001 standard.

4.7. Conclusions

This study investigated different factors that may influence occupational health and safety management (OHSM) practices in companies. Company size was found to be significantly associated with the outcome: the larger the company, the better the OHSM practices. The converse was also found to be true, that the smaller the company, the worse the OHSM practices. Company size is thought of as a proxy variable for other factors that are assumed to differ depending on size, for example, available resources, organizational structure and routines, management commitment, knowledge, and competence.

Safety culture was also found to be associated with the outcome, in that companies with a more positive safety culture had

significantly better OHSM practices. The more positive the safety culture, the better the OHSM practices. This also held for the other way around: the more negative the safety culture, the worse the OHSM practices. Safety culture has long been treated as a construct that helps to illustrate that there are social processes in organizations that help or hinder behaviors or outcomes regarding occupational health and safety. This study provides support for the notion that safety culture indeed is a measurable construct and that it influences occupational health and safety management in organizations.

Creditworthiness was also found to be associated with the outcome. A low risk in creditworthiness was associated with better OHSM practices. A high risk in creditworthiness was demonstrated to be significantly associated with worse OHSM practices. Financial performance of companies has been assumed to be associated with OHSM practices. This study demonstrates such a relationship and supports the position that creditworthiness can be used as a proxy variable for this purpose.

This study has found that company size, safety culture, and creditworthiness are associated with better, as well as worse, OHSM practices in companies.

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Appendix A

Translation of the original questionnaire items from Swedish.

A.1. OHSM practices

Response alternatives: yes/no/don't know.

Instructions: The questions in this survey regard how occupational health and safety are managed at the company for which you work. Please answer yes or no if you know for sure the situation at the company. In any other case, please use the option don't know.

Written routines: Does your company have written routines stating how your OHS management should be carried out?

Safety delegates: Is any employee appointed as a safety delegate/employee representative here?

Risk assessment: Has your company conducted any written risk assessment* during the last 12 months? (*To chart and evaluate sources of risk in the work environment that can lead to ill health or accidents)

Collaboration for risk assessment: Do both the employer and the safety delegates/employees participate when risk assessments are conducted?

Written action plan: Has your company during the last 12 months established a written action plan* to address a risk? (*A plan that specifies how, when, and by whom a risk shall be adjusted that could not be fixed right away)

Action plan follow-up: Has your company during the last 12 months followed up* on an action plan? (*To control whether planned actions have been carried out)

Reporting incidents: Does your company have routines to report occupational health and safety incidents that occur (e.g., deviation, near miss, accident)?

Emergency plan: Does your company have a written emergency plan to follow if a severe accident were to occur?

Safety training: Do new employees get an introduction to what risks there are at the workplace and how to protect themselves against them?

OHS policy statement: Is there an OHS policy statement* available? (*A written document that in general terms describes the ambitions regarding health and safety at the company)

OHSAS 18001 certification: Is your OHS management certified according to the OHSAS 18001* standard? (*A management system standard for organizing a functioning systematic OHS management)

Occupational health services: Is your company affiliated with an occupational health service (or does it have its own)?

Budget item for OHSM: Does your company have a specific budget item for costs concerning OHS management?

A.2. Safety culture

Response alternatives: yes, absolutely/yes, partly/no, not really/no, not at all.

Instructions: These are questions about how you generally perceive the occupational health and safety situation at your company. Please choose the response alternative that in your opinion best corresponds to the situation at the company.

Safety rules: In our company it is considered very important to follow safety regulations.

Risk acceptance: Here it is OK to sometimes ignore a safety regulation to perform a task.

Management commitment: In our company managers set a good example when it comes to following safety regulations.

Productivity pressure: Here it is OK that productivity sometimes gets priority over safety.

Employee involvement: In our company it is considered very important that employees are involved in safety management.

Individual responsibility: Here the individual's own responsibility is considered very important for working safely.

Incident reporting: In our company it is considered important to report incidents that occur (e.g., deviation, near miss, accident).

No fatalism: Here it is considered possible to completely prevent existing hazards.

Blaming: In our company we primarily try to identify who is at fault if any incident occurs (e.g., deviation, near miss, accident).

Peer feedback: Here colleagues appreciate being reminded to work in a safe manner.

Safety training: In our company it is considered very important that everyone gets proper training in working safely.

Communication: Here there is direct and clear communication regarding work tasks and performance, which contributes to safe work.

Continuous improvements: In our company there is engagement to constantly improve safety.

A.3. Work environment priority

Response alternatives: yes, absolutely/yes, partly/no, not really/no, not at all.

Instructions: These are questions about how you perceive the priority accorded to the following aspects at your company. Please choose the response alternative that in your opinion best corresponds to the situation at the company.

Physical working conditions: Here we work toward ensuring good physical working conditions.* (*e.g., physical workload on body, noise, light, temperature, machines)

Psychosocial working conditions: Here we work toward ensuring good psychosocial working conditions.* (*e.g., well-being, job security, collaboration with colleagues, support from manager, equal treatment)

Organizational functionality: Here we work toward ensuring that the organization* functions well. (*e.g., roles, working hours, competence, routines)

OHSM routines: Here we work toward ensuring that the occupational health and safety management system functions well.

Communication & interaction: Here we work toward achieving open communication* and dialogue. (*Generally speaking, not only regarding health and safety)

Leadership: Here we work toward having leadership* that is clear and unambiguous. (*Generally speaking, not only regarding health and safety)

Health: Here we work toward ensuring that everyone enjoys good health* at work. (*e.g., feeling fresh, feeling invigorated, experiencing well-being, not being exposed to risks for ill health or accident)

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