

1. Appendix A: Technical note on empirical analysis

Relationship between model and literature: Analytical strategy

It has been previously stated that there is no exact definition of what constitutes an OSH management system. This basic definitional problem is due to the fact that OSH management is neither a natural phenomenon in the pure sense of the word, nor a clear empirical phenomenon within the social realm. Although separate aspects of OSH management have received some attention in scientific literature, it has not been characterised empirically as a 'system'. Lack of definitional clarity is a serious obstacle to the investigation of any phenomenon. Offering a definition and translating it into empirical terms would be a prerequisite to any research attempting to establish the determinants of the scope of OSH management.

In this study, our basic analytical strategy is as follows:

1. We employ the conceptual framework of OSH management to investigate the possibility of generating an empirical construct which will efficiently summarise the features of OSH management. Such an empirical construct will effectively be a single variable that captures the scope of OSH management;
2. We then model the relationship between that variable (in the status of dependent variable), and selected determinants of OSH management (independent variables) in a multivariate setting. This allows us to identify the significant predictors of OSH management and to provide the policy makers with options for interventions.

A contemporary understanding of OSH is that it is an integrated set of organisational aspects operating as a whole in a continuous manner to ensure optimal levels of OSH provision, and is a relatively recent definition.

At an organisational level, the principal aspects within an OSH management system that are identified in the existing literature are:

- policy development;
- organisational development;
- planning and implementing;
- measuring performance;
- reviewing performance and auditing.

The operation of such systems is understood in terms of their integration and comprehensiveness. In order to enable the achievement of a necessary level of OSH provision, various aspects must be implemented together in a consistent and continuous manner.

The conceptual framework influenced policy makers in the area of OSH policy and ultimately found its way to ESENER, which is the largest ever survey of OSH management in the European Union and selected candidate countries. Judging by the relatively low level of non-response to questions in the survey, the key aspects of the framework are adequately understood at the managerial level across the surveyed establishments. Table 1 below presents 11 questions from the ESENER managerial (MM) questionnaire (and ESENER electronic dataset), that could be unambiguously identified with the elements of the conceptual framework. The last column of the table identifies the corresponding aspects of the conceptual framework, as outlined above.

Table 1: Aspects of OSH management

Question number (MM questionnaire)	Question content	Element of conceptual framework
MM150 (service_use)	1. What health and safety services do you use, be it in-house or contacted externally? 2. Response options: 3. 1. An occupational health doctor (Response options: 1. Yes, 2. No, 3. NA) 4. 2. A safety expert (Response options: 1. Yes, 2. No, 3. NA) 5. 3. A psychologist (Response options: 1. Yes, 2. No, 3. NA) 6. 4. An ergonomics expert, dealing with the set up of the workstation (Response options: 1. Yes, 2. No, 3. NA) 7. 5. A general health and safety consultancy (Response options: 1. Yes, 2. No, 3. NA)	(c)
MM152 (absence_analysis)	Does your establishment routinely analyse the causes of sickness absence? Response options: 1. Yes, 2. No, 3. No Answer	(d)
MM153 (supporting_return)	Do you take measures to support employees' return to work following a long-term sickness absence? Response options: 1. Yes, 2. No, 3. No Answer	(c)
MM154 (monitoring_health)	Is the health of employees monitored through regular medical examinations? Response options: 1. Yes, 2. No, 3. No Answer	(d)
MM155 (OSH_policy)	Is there a documented policy, established management system or action plan on health and safety in your establishment? Response options: 1. Yes, 2. No, 3. No Answer	(a)
MM158 (OSH_discussed)	Are health and safety issues raised in high level management meeting regularly, occasionally or practically never? Response options: 1. Regularly, 2. Occasionally, 3. Practically never, 4. No Answer	(b)
MM159 (managers_involvement)	Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety? Is it very high, quite high, quite low or very low? Response options: 1. Very high, 2. Quite high, 3. Quite low, 4. Very low, 5. No Answer	(b)
MM161 (risk_assessment)	Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure? Response options: 1. Yes, 2. No, 3. No Answer	(e)
MM173 (info_used)	Has your establishment used health and safety information from any of the following bodies or institutions? Response options: 1. Official institutes for health and safety at work (Response options: 1. Yes, 2. No, 3. NA) 2. The European Agency for safety and health at	(a)

	<p>work (Response options: 1. Yes, 2. No, 3. NA)</p> <p>3. In-house health and safety services (Response options: 1. Yes, 2. No, 3. NA)</p> <p>4. The labour inspectorate (Response options: 1. Yes, 2. No, 3. NA)</p> <p>5. Employers' organisations (Response options: 1. Yes, 2. No, 3. NA)</p> <p>6. Trade Unions (Response options: 1. Yes, 2. No, 3. NA)</p> <p>7. Contracted health and safety experts (Response options: 1. Yes, 2. No, 3. NA)</p> <p>8. Insurance providers (Response options: 1. Yes, 2. No, 3. NA)</p>	
MM175 (European_week)	Are you aware of the European Week for safety and health at work? Response options: 1. Yes, 2. No, 3. No Answer	(a)
HSR_exist: combined information from MM355 and MM358 (HRS_exist)	Does your establishment have an internal health and safety representative? Response options: 1. Yes, 2. No	(b)

* informative abbreviation of a question/variable name used throughout this report is given in brackets.

Table 1 shows that the ESENER questionnaire provides fair coverage of the aspects of the conceptual framework. Four out of the five aspects listed above (a,b,c,d) are covered by 10 questions, with (a,b) covered by three each and (c,d) covered by two each. The remaining aspect (e) is covered by a single question.

Introducing the model

In our analysis we pursue two distinct goals. First, we attempt to develop an empirical indicator of OSH management which would allow us to create a profile of OSH management and to characterise European establishments in terms of the quality of their existing OSH management. Second, we are trying to understand the determinants of OSH management and their impact on the quality of OSH provision.

The development of an empirical indicator of OSH management is the first stage of our analysis. Given the definitional uncertainties inherent in the OSH management system and the normative nature of its characterisation, it is reasonable to ask whether the development of a single empirical indicator is a sensible goal to pursue. In other words, although the literature identifies aspects of the conceptual framework and points out the desirability of their integration, the reality of such an integrated existence is something to question rather than to accept uncritically. We would like to know whether the various aspects of OSH management listed in Table 1 tend to co-exist in establishments' 'lives' or whether, on the contrary, these aspects are, in fact, disconnected features of OSH management. Confirmation of the integration of aspects (or a lack thereof) would have an immediate analytical value, as it would indicate an empirical (rather than normative) presence of an OSH management system (or a lack of it). It would also possess a methodological value as it would allow for the efficient characterisation of establishments in terms of the quality of their OSH management along a single dimension, instead of a laborious characterisation along at least 11 dimensions. This is because, in case the integration of elements is confirmed, the various aspects of OSH management could be averaged or summed to produce a single indicator of OSH management/performance: an OSH management composite score. Hence, our first practical task is to explore the correlations between various aspects of OSH management.

Technical Box 1. Factor analysis: technical aspects

Linear factor model for n observed variables and 2 factors (unobserved variables) takes the following form:

$$x_i = \alpha_{i0} + \alpha_{i1}f_1 + \alpha_{i2}f_2 + e_i \quad (i=1,2)$$

Here f_1 and f_2 are factors (unobserved variables) and α_1 and α_2 are factor loading –effectively these are correlations between x and the factors.

One should be aware that standard FA procedures available in modern statistical packages assume continuous distributions. Application of standard FA analysis directly on non-continuous variables will result in underestimated correlation coefficients. All candidate variables in our case are non-continuous. In this situation polychoric correlations should be estimated first. Due to the categorical or ordinal nature of the candidate variables, pre-processing was carried out by taking polychoric correlations. FA analysis was carried out on these polychoric correlations instead of the original scale of variables.

Investigation of the determinants of OSH management forms a second stage of our analysis. On a principal level, its methodology is independent of the findings obtained at a first stage. We are developing a multivariate analytical framework which allows the isolation of separate effects of an establishment's characteristics such as size, industry, sector and others, based on the level of its OSH performance. Obviously, a multitude of factors affect OSH performance. Some of these relationships (e.g. the negative link between the size of the establishment and the quality of OSH provision) have been well-documented in the literature. Other relationships are less well understood (e.g. the independent effect of being part of a larger firm irrespective of size). Still, others (e.g. the differential effect of size on OSH performance depending on industry or sector) are largely unknown. It is important to understand whether and how these factors shape OSH management and what makes certain establishments 'good' or 'bad' performers in terms of OSH.

The ability of international and national regulatory bodies to develop and implement policy in the area of OSH management depends critically on such an understanding. Hence, our second practical task is to examine the isolated effects of establishments' characteristics and a particular contextual feature on the quality of OSH management in establishments.

Technical Box 2. Regression model: technical aspects

The estimated model in its generic form can be specified as follows:

$$OSH_score = \alpha_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_kx_k + e$$

Here OSH_score denotes the outcome and $x's$ are explanatory variables (size of establishment, establishment's sector, demographics, country etc).

The linear modelling framework will be appropriate for modelling relationships of the basis of datasets with the number of cases exceeding 10,000. Central Limit Theorem applies almost always around 1000-10,000 cases, as long as that 1000-10,000 is the effective sample size.

Therefore, we implement linear modelling (OLS) as a technique of multivariate analysis.

Building on a particular strength of this survey, i.e. its cross-national nature (ESENER covered 31 countries), our analysis gives special attention to the identification of country effects. Naturally, there is great variation in regulatory practices, business environments and culture between countries. Therefore, we propose to capture the 'sum' of all possible country-specific features using 'country' as a special control variable in models of economic performance.

We explicitly favour a fixed-effects modelling framework to estimate country effects. We fully acknowledge the difficulty of working with models that include 30 country intercepts, especially in the context of testing for possible interactions. However, the super-population argument, which would

make a strong case for the use of a random effects model, is non-applicable here: countries are not sampled from the larger universe; also, the distributional assumptions of random effects models are unlikely to be met when the units are countries. Additionally, a fixed-effects modelling framework is advantageous when it comes to reporting the results, as it allows for the straightforward presentation of the main country effects.

Building the model

Task 1: Development of an empirical indicator of OSH management

Can we use the totality of information obtained through specific questions on OSH management to generate a single indicator, which can subsequently be used to characterise establishments? One approach to generating such an indicator would be factor analysis (FA). FA and other related methods are implemented when the direct measurement of a phenomenon of interest (e.g. the scope of OSH management) is not possible, or is difficult due to definitional vagueness, imprecision, or a diversity of constituting aspects.

What makes factor analysis a suitable technique for our purposes? OSH management is indeed a multifaceted and somewhat vague concept which cannot be adequately captured with a single question in a survey. ESENER included 11 questions relating to various aspects of OSH. However, we cannot observe the general pattern of OSH management potentially underlying the 11 variables. We do not have a firm idea of the existence and nature of OSH management systems. Co-existence of all or selected elements of OSH management in establishments' lives would constitute evidence of the existence of such a system and the ways in which it could be captured in a single indicator. FA, in practical terms, is a correlation test of the aspects of OSH management. Through its application, we test whether separate aspects of OSH management are indeed related to each other (i.e. whether they tend to occur together and to what extent). If the answer is affirmative, then the information from 11 manifest variables can be combined to render a smaller number of indicators of OSH management.

Below we present the tabulation of frequencies for 11 candidate variables for FA. As this is the first presentation of these frequencies, we present both unweighted and weighted frequencies side by side, demonstrating that the weighting does not significantly affect the relationships between categories.

Table 2: Candidate variables for factor analysis

MM150 What health and safety services do you use, be it in-house or contracted externally?				
An occupation health doctor				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2178694	20219	65.8	70.6
2 No	1115275	8336	33.7	29.1
3 NA	19732	94	0.6	0.3
A safety expert				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2245585	20017	67.8	69.9
2 No	1047159	8423	31.6	29.4
3 NA	20957	209	0.6	0.7
A psychologist				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	524398.67	6633	15.8	23.2
2 No	2754378	21737	83.1	75.9
3 NA	34924	279	1.1	1.0
An ergonomics expert dealing with the set up of the workstation				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	900159	10141	27.2	35.4
2 No	2382823	18265	71.9	63.8
3 NA	30718	243	0.9	0.9
A general health and safety consultancy				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1947337	17634	58.8	61.6
2 No	1341769	10780	40.5	37.6
3 NA	24594	235	0.7	0.8
MM152 Does your establishment routinely analyse the causes of sickness absence?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1664373	16210	50.2	56.6
2 No	1577422	11784	47.6	41.1
3 No answer	71905	655	2.2	2.3
Total	3313700	28649	100.0	100.0
MM153 Do you take measures to support employees' return to work following a long-term sickness absence?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2129653	19080	64.3	66.6
2 No	916914	7560	27.7	26.4
3 No Answer	267134	2009	8.1	7.0
Total	3313700	28649	100.0	100.0
MM154 Is the health of employees monitored through regular medical examinations?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2198812	20631	66.4	72.0
2 No	1095427	7862	33.1	27.4
3 No Answer	19463	156	0.6	0.5
Total	3313700	28649	100.0	100.0
MM155 Is there a documented policy, established management system or action plan on health and safety in your establishment?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2449823	22642	73.9	79.0
2 No	811914	5599	24.5	19.5
3 No answer	51964	408	1.6	1.4
Total	3313700	28649	100.0	100.0

Table 1 continued				
MM158 Are health and safety issues raised in high level management meeting regularly, occasionally or practically never?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Regularly	1333987	13426	40.3	46.9
2 Occasionally	1359375	11312	41.0	39.5
3 Practically never	540587	3333	16.3	11.6
4 No Answer	79751	578	2.4	2.0
Total	3313700	28649	100.0	100.0
MM159 Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Very High	654064	5797	19.7	20.2
2 Quite High	1770159	16161	53.4	56.4
3 Quite Low	581305	4626	17.5	16.2
4 Very Low	207209	1199	6.3	4.2
5 No answer	100965	866	3.1	3.0
Total	3313700	28649	100.0	100.0
MM161 Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2855152	25637	86.2	89.5
2 No	436550	2837	13.2	9.9
3 No Answer	21999	175	0.7	0.6
Total	3313700	28649	100.0	100.0
MM173 Has your establishment used health and safety information from any of the following bodies or institutions?				
Official institutes for health and safety at work				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1835491	16495	55.4	57.6
2 No	1320922	10964	39.9	38.3
3 NA	157287	1190	4.8	4.2
The European Agency for safety and health at work				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	374699	4489	11.3	15.7
2 No	2743321	22731	82.8	79.3
3 NA	195681	1429	5.9	5.0
In-house health and safety procedures				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1825849	17974	55.1	62.7
2 No	1374349	9874	41.5	34.5
3 NA	113504	801	3.4	2.8
The labour inspectorate				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1867432	18736	56.4	65.4
2 No	1349686	9231	40.7	32.2
3 NA	96583	682	2.9	2.4

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	weighted	unweighted	weighted	unweighted
1 Yes	1947337	17634	58.77	61.55
2 No	1341769	10780	40.49	37.63
3 NA	24594	235	0.74	0.82
MM152 Does your establishment routinely analyse the causes of sickness absence?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	1664373	16210	50.23	56.58
2 No	1577422	11734	47.6	41.13
3 No answer	71905	655	2.17	2.29
Total	3313700	28649	100	100
MM153 Do you take measures to support employees' return to work following a long-term sickness absence?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2129653	19080	64.27	66.6
2 No	916914	7560	27.67	26.39
3 No Answer	267134	2009	8.06	7.01
Total	3313700	28649	100	100
MM154 Is the health of employees monitored through regular medical examinations?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2198812	20631	66.36	72.01
2 No	1095427	7862	33.06	27.44
3 No Answer	19463	156	0.59	0.54
Total	3313700	28649	100	100
MM155 Is there a documented policy, established management system or action plan on health and safety in your establishment?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2449823	22642	73.93	79.03
2 No	811914	5599	24.5	19.54
3 No answer	51964	408	1.57	1.42
Total	3313700	28649	100	100
MM158 Are health and safety issues raised in high level management meeting regularly, occasionally or practically never?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Regularly	1333987	13426	40.26	46.86
2 Occasionally	1359375	11312	41.02	39.48
3 Practically never	540587	3333	16.31	11.63
4 No Answer	79751	578	2.41	2.02
Total	3313700	28649	100	100
MM159 Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Very High	654064	5797	19.74	20.23
2 Quite High	1770159	16161	53.42	56.41
3 Quite Low	581305	4626	17.54	16.15
4 Very Low	207209	1199	6.25	4.19
5 No answer	100965	866	3.05	3.02
Total	3313700	28649	100	100
MM161 Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Yes	2855152	25637	86	89.49
2 No	436550	2837	13	9.9
3 No Answer	21999	175	0.66	0.61
Total	3313700	28649	100	100
MM173 Has your establishment used health and safety information from any of the following bodies or institutions?				

There are a few important observations suggested by these results. First, the actual scope of missing cases (i.e. 'No Answer'/NA category) is rather small. It is up to around 3% of the total number of observations for most variables. This is a sound indication of good quality of response to these survey questions. Second, selected questions were less well addressed: 8% of respondents gave no answer to the question on measures to support employees' return to work (MM153) while 5-6% did not specify whether they used health and safety information from certain sources. This is a non-negligible proportion. To address the issue of non-response to questions reflecting measures of OSH management, we launched a special investigation (summarised in subsequent parts of this report).

For the purpose of factor analysis, all candidate variables should have a single response scheme. While the majority of variables were binary, some had different response schemes; for example, a variable describing the degree of involvement of line managers and supervisors in the management of health and safety had the response scheme: very high, quite high, quite low, and very low (MM159). This was also the case for a variable relating to the frequency of raising health and safety issues at high-level management meetings (MM158). To meet this condition of factor analysis we converted all non-binary variables into the binary response scheme. We also created two combined measures of the basis variables MM150 (health and safety services used) and MM173 (sources of information used), instead of using each of the response options of these variables. We first derived

summaries of services and sources used resulting in a single categorical variable. Following this, we converted the categorical variables into binary variables, using a median value as a cut-off point. The frequencies of the new derived variables are set out in Table 3.

Table 3: Frequencies of new derived variables

Service_use (MM150-derived): Use of health and safety services, be it in-house or contracted externally?				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Heavy user of services	1567042	15477	47.3	54.0
2 Light user of services	1732733	13061	52.3	45.6
3 No Answer	13926	111	0.4	0.4
Total	3313700	28649	100.0	100.0
Frequency of OSH issue being raised in high level management meetings (MM158-derived)				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
Regularly, occasionally	2693362	24738	81.3	86.4
Practically never	540587	3333	16.3	11.6
No answer	79751	578	2.4	2.0
Total	3313700	28649	100	100
Degree of involvement of the line managers and supervisors in the management of health and safety (MM159-derived)				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
Quite high, very high	2424222	21958	73.2	76.6
Quite low, very low	788514	5825	23.8	20.3
No answer	100965	866	3.1	3.0
Total	3313700	28649	100	100
Use of information (MM173-derived)				
	Frequency weighted	Frequency unweighted	Percent weighted	Percent unweighted
1 Heavy user of services	1316818	14069	39.7	49.1
2 Light user of services	1577549	11006	47.6	38.4
3 No Answer	419334	3574	12.7	12.5
Total	3313700	28649	100.0	100.0

Thus, for the purpose of factor analysis we ultimately arrived at a list of 11 variables (as listed in Table 1), with the four original variables being replaced by the derived version, as in Table 3.

There is an additional condition that the candidate variables for factor analysis should meet. Factor analysis procedures built in the standard software assume the continuous nature of variables. Initially, this condition was not satisfied as all of the ESENER variables are categorical. To meet this condition, we calculated tetrachoric correlations for all binary variables. The tetrachoric correlation coefficients are calculated based on the assumption that the observed binary variables represent continuous latent variables. Factor analysis is then applied to these tetrachoric correlations¹.

We initially derived five factors and then examined the variance accounted for by each factor. We found that the first factor alone accounted for about 80% of the common variance, and two factors accounted for just over 90% of it. This finding can be interpreted as the first indication that data reduction is a sensible technique in relation to the 11 selected OSH variables; a very significant amount of variance of these variables is shared. It further suggests that a single indicator of OSH management could be derived on the basis of estimated relationship between 11 selected variables and the first factor.

Table 4 shows the detailed information on factor loadings for the first three derived factors.

Table 4: Factor loadings

¹ More information on this issue can be obtained from Bartholomew et al. (2008, pp. 209-240).

Variable (questionnaire)	Abbreviated name	Factor 1	Factor 2	Factor 3
MM150	service_use	0.641	0.204	0.198
MM152	absence_analysis	0.607	-0.355	0.139
MM153	supporting_return	0.508	-0.458	0.171
MM154	monitoring_health	0.382	0.363	0.099
MM155	OSH_policy	0.697	0.097	-0.039
MM158	OSH_discussed	0.718	-0.127	-0.225
MM159	managers_involvement	0.632	-0.054	-0.345
MM161	risk_assessment	0.677	0.146	-0.092
MM173	info_used	0.647	0.042	0.097
MM175	European_week	0.369	0.157	0.058
HSR_exist	HSR_exist	0.583	0.092	0.085

As the solutions given by the factor analysis procedure are not unique, we experimented with orthogonal rotation to see whether more simple and interpretable matrices of factor loading could be obtained. We found that the unrotated solution is the simplest and the most straightforward to interpret. Rotations did not produce any new clearly defined factors.

What do the results of factor analysis tell us? Factor loadings in Table 4 can be interpreted as measures of the correlation between single variables and the underlying pattern of OSH management. The higher the absolute value, the more important a given variable is for a given factor. High factor loadings (conventionally, absolute values larger or equal to 0.6) suggest that a variable is strongly linked to the underlying pattern. Factor loadings in the range of 0.3-0.6 are considered to be of moderate size. The presence of such factor loadings in a number of variables (as in Factor 1, Table 4) indicates that the observable variables reflect the same hidden (latent) phenomenon. There were no meaningful patterns suggested by Factors 2 and 3.

In the course of analysis leading to choice of variables for construction of the composite OSH score, we experimented with additional variables and implemented some alternative definitions of certain variables. Specifically:

1. We attempted to derive a variable distinguishing establishments taking responsibility for OSH management and those outsourcing that responsibility (based on question MM150 describing service use). Factor loading of this variable was lower than that of the service use variable derived as a summary of services across all response options of MM150, indicating that the latter was a better method to capture services use;
2. We attempted to derive a new variable identifying a purely technical approach to OSH management. We treated high degree of involvement of line managers (MM159) without documented OSH policy (MM155) or discussions in high level management meetings (MM158) as an indication of such an approach. Factor loading of this variable was lower than those of variables describing degree of involvement of line managers and existence of policy/discussions at high level meetings separately. Additionally, it was felt that the capacity of the new variable to draw fine distinction between technical and non-technical approach to OSH management was questionable on analytical grounds;
3. We experimented with three filtered questions with high level of response (whether risk assessment is conducted by the establishment's staff or externalised, MM162, type of occasions on which risk assessment is carried out, MM163, and areas involved in these checks, MM164). Factor loading of these variables were below the conventional threshold allowing inclusion of these variables into the indicator of OSH management. Additionally, the answers to these questions were restricted to those establishments where regular risk assessments had been conducted. Limiting all subsequent analyses to this group only would have introduced a significant positive bias;
4. We introduced to FA a variable indicating that lack of awareness could be a difficulty in dealing with health and safety (MM172_2). Factor loading of this variable was significantly below the conventional threshold allowing its inclusion into the indicator of OSH management;

5. We experimented with variables relating specifically to psychosocial rather than to general risks (e.g. MM250-252, MM253, MM259, MM260, MM302). These variables formed a second factor in FA following rotation. This led us to the conclusion that management of psychosocial risks is a special aspect of OSH management that ought to be captured by a separate variable and analysed on its own.

We observed that 8 variables were, in conventional terms, strongly linked to each other, thereby forming a system of OSH management. These variables were *service_use*, *absence_analysis*, *OSH_policy*, *OSH_discussed*, *managers_involvement*, *risk_assessment*, *info_used*, and *HSR_exist*. Three variables (*supporting_return*, *monitoring_health* and *European_week*) had a medium-to-low strength link. On the basis of the insights provided by factor analysis we derived a composite score of OSH management (hereafter the 'OSH composite score' or 'OSH score' or 'OSH management score'). This was done by summing across 9 variables (8 variables with loadings of 0.6 or above and one variable, MM153, with a loading of 0.5). Thus, the resultant OSH composite score is a single indicator of the scope of OSH management, where 9 is the largest possible value, indicating that a given establishment implements 9 out of 9 possible aspects of OSH management with the highest association with the first factor, and 0 is the smallest possible value, indicating that an establishment implements none of these aspects.

Task 2: Exploration of determinants of OSH management

To establish the significant determinants of OSH management, we implemented two complementary techniques. First, we conducted bivariate analyses, calculation of mean OSH scores, with 99% confidence intervals, for a number of potential predictors of OSH management.

The OSH composite score, describing the scope of OSH management, is a dependent variable in this framework. In line with previous research on the determinants of risks, the following variables were treated as predictors of the OSH composite score (independent variables):

1. size of the establishment;
2. whether the establishment is part of a larger entity (company, firm);
3. sector (public or private);
4. gender composition of the establishment's workforce;
5. age composition of the establishment's workforce;
6. proportion of foreigners in establishment's workforce;
7. industry;
8. country;
9. age of the establishment (for non-public establishments only).

We also introduced controls over (a) the presence of actual risks to health and safety (indicated by variable MM200), and (b) the perceived presence of external and internal pressures towards the implementation of OSH (indicated by variable MM171).

Second, we implement conventional multivariate modelling. Regardless of whether there is a precise technique used to estimate them, the basic purpose of multivariate models is to determine if various factors (independent variables) exert independent influence on the behaviour of the variable of interest, i.e. an influence 'unpolluted' by the presence of other factors. In our application, we would like to establish, for example, whether the size of the establishment has an effect on OSH management, with other things (sector, being part of a larger firm etc.) being held constant, i.e. whether it has an independent effect. The same question applies to other factors, such as sector, industry, etc.

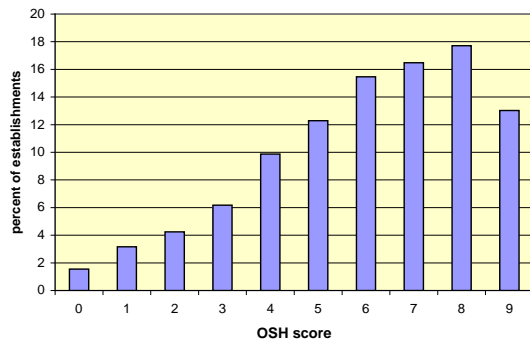
The results of our analyses are presented in the following section.

Findings

Univariate analysis

Figure 1 presents the distribution of the OSH composite score.

Figure 1: OSH composite score



Note: the results are weighted. N=2,717,234 (82% of the original

weighted sample).

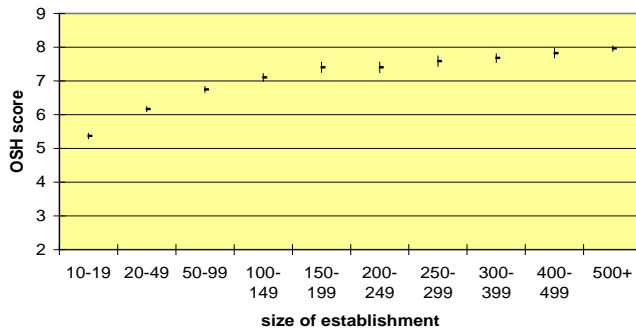
About half of all establishments across Europe implement at least 7 elements of OSH and around 13% implement all 9 elements. Establishments not implementing any elements of OSH are a very small minority (less than 2%), and establishments implementing just 1-2 elements of OSH constitute 7% of the total. Therefore, while there is a clear need to monitor and further improve the state of OSH in Europe, one can be confident that the scope of implementation of OSH is fairly satisfactory in a majority of establishments.

Bivariate analysis

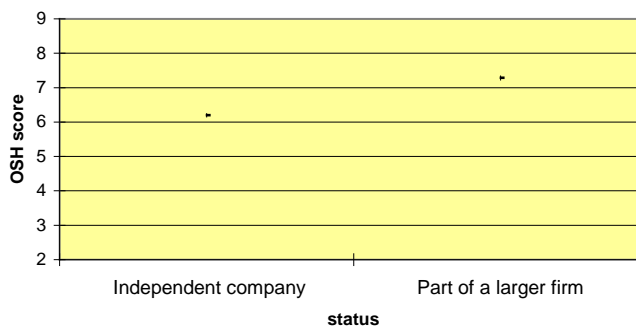
Figure 2 and Figure 3 present mean OSH scores, and 99% confidence intervals, for a number of potential predictors. First, we present mean OSH scores for well-established predictors of OSH outcomes: size of the establishment, being part of the larger firm (hereafter ‘status), sector (public or private), and industry.

Figure 2: OSH score by major predictors

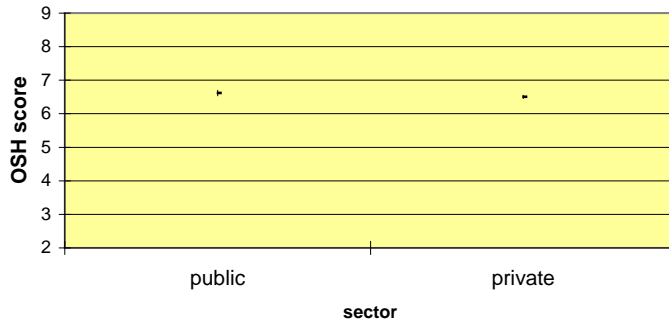
Panel A. OSH score by size



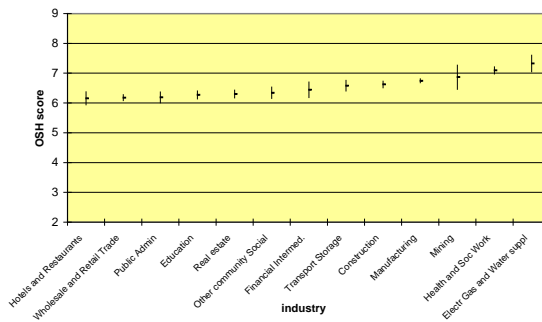
Panel B. OSH score by independent/non-independent status



Panel C. OSH score by sector



Panel D. OSH score by industry



Note: 99% confidence intervals are presented. N=21,856 (82% of the unweighted sample).

Some of the observed relationships are in line with what is known from the literature:

1. poorer management of OSH is observed in small establishments, and better management in large establishments;
2. independent companies manage OSH worse than establishments constituting part of larger firms;
3. public establishments manage OSH somewhat better than private establishments.

Hotel and restaurant businesses, as well as the wholesale and retail trade and public administration are characterised by the worst degree of OSH management, while industries such as health and social work, electricity, and gas and water supply appear as the best. Interestingly, manufacturing and mining, both being sectors with a relatively high prevalence of work-related accidents, have relatively high scores in relation to OSH management.

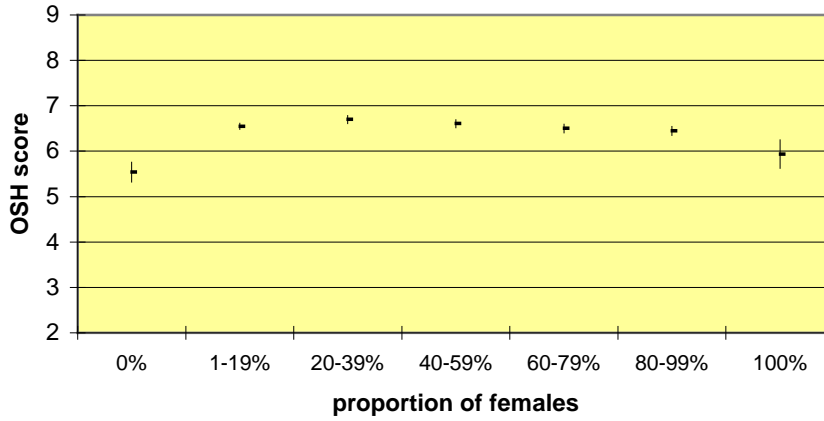
Not all of these relationships appear to be statistically significant (judging by the overlapping confidence intervals for some categories) but the principal ones are: the difference between the smallest and the largest establishments; independent and non-independent establishments (with 95% confidence intervals), public and private establishments, and the ‘best’ and ‘worst’ industries².

Figure 3 presents mean OSH scores for establishments’ demographics and country.

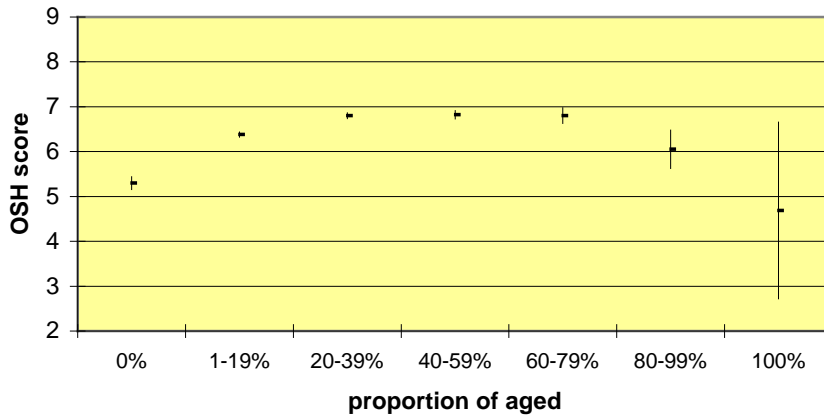
Figure 3: OSH score by establishments’ demographics and country

² In this report we favour presentation of the confidence intervals over other means of illustration of bivariate relationships. We also conducted t-tests (for 2 level predictors) and ANOVA for categorical and ordinal predictors.

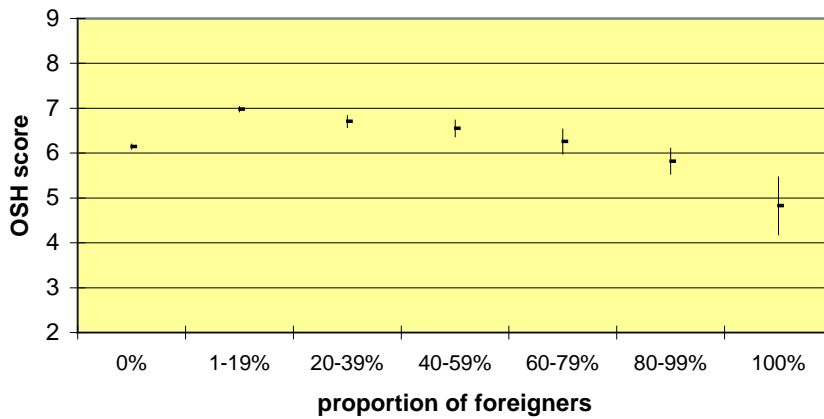
Panel A. OSH score by percentage of females



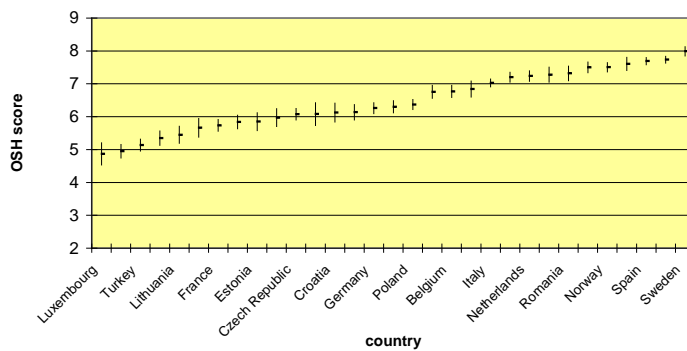
Panel B. OSH score by proportion of aged (50 years and over)



Panel C. OSH score by proportion of foreigners



Panel D. OSH score by country



Note: 99% confidence intervals are presented. N=21,856 (82% of the unweighted sample).

It is quite clear that establishments' demographics are associated with the scope of their OSH management:

1. Male-dominated establishments are worse than those that are non-male dominated; an increase in the proportion of female does not, however, have an indefinite effect and exclusively female establishments are not the 'best' from the point of view of OSH management. This relationship, therefore, become less strong with an increase in the proportion of females;
2. Having a large proportion of workers over 50 years of age is associated with better OSH management. This relationship, too, seems to become more moderate for establishments with a very large proportion of workers aged 50 years and over: largely 'old' establishments are not the 'best' from the point of view of OSH management;
3. A large proportion of foreigners is linked to worse OSH management;
4. Selected countries in Southern and Eastern Europe (Greece, Turkey, Cyprus, and Lithuania) as well as Luxembourg and Switzerland are the 'worst' managers of OSH and the Northern European countries (UK, Sweden, Ireland, and Norway) and Spain are the 'best'.

In the next section we present the results of the modelling of the OSH score in a multivariate setting, using all predictors and some control variables.

Multivariate analysis

We used linear regression to model the relationship between the OSH score and a set of predictors. We followed a step by step approach in relation to predictors: we run 4 models in total, gradually adding new predictors. We examine change in size, direction and statistical significance of coefficients in transition from model to model, as well as change in the proportion of variance explained.

We related to sector and industry, establishment size and establishment being part of a large company, as 'basic' establishment characteristics predictors. These variables appear in our Model 1. The relationships between these variables and the management of OSH are reasonably well documented in the literature. We expected the size of an establishment to be inversely associated with OSH management and the fact of being part of a large company to be positively associated with management of risks. We also expected establishments in the public sector to possess higher OSH scores (better management) and that we would find marked differences between industries.

In Model 2, we add establishments' employee demographics. This is a less well explored domain and we have no specific hypotheses in relation to these variables. In Model 3, we add 'country' as a way to control for differences in cultural and social background as well as in regulatory environment. Finally, in Model 4, we introduce (1) the reported presence of risks, (2) whether or not visits are paid to the establishment by the labour inspectorate and (3) the perceived presence of different types of external (e.g. labour inspectorate) and internal (e.g. employees') pressures on an establishment to deal with OSH risks. The introduction of variables (1) and (2), above, represents an attempt to control for 'objective' circumstances, i.e. the presence or absence of real risks and (3) is conceived as capable of capturing some of the regulatory characteristics.

Table 5: Results of multivariate analysis (all establishments): Models 1-4

Variable name in the dataset	Informative name	Categories labels	Model 1		Model 2		Model 3		Model 4	
			Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t
size_10D2	size of establishment	20-49 emp	0.759	0.000	0.696	0.000	0.676	0.000	0.604	0.000
size_10D3		50-99 emp	1.303	0.000	1.187	0.000	1.201	0.000	1.091	0.000
size_10D4		100-149 emp	1.624	0.000	1.484	0.000	1.503	0.000	1.338	0.000
size_10D5		150-199 emp	1.897	0.000	1.743	0.000	1.763	0.000	1.580	0.000
size_10D6		200-249 emp	1.887	0.000	1.720	0.000	1.788	0.000	1.561	0.000
size_10D7		250-299 emp	2.061	0.000	1.889	0.000	1.902	0.000	1.708	0.000
size_10D8		300-399 emp	2.126	0.000	1.966	0.000	2.006	0.000	1.736	0.000
size_10D9		400-499 emp	2.294	0.000	2.103	0.000	2.205	0.000	1.951	0.000
size_10D10		500+ emp	2.404	0.000	2.218	0.000	2.273	0.000	1.970	0.000
MM100D2		whether part of larger estab	branch	0.800	0.000	0.757	0.000	0.452	0.000	0.402
MM100D3	No answer		-0.545	0.028	-0.600	0.015	-0.324	0.155	-0.187	0.388
MM103D2	Public or private	private	-0.071	0.105	-0.046	0.300	-0.084	0.041	-0.095	0.015
MM103D3		No answer	-0.059	0.799	-0.044	0.849	-0.192	0.363	-0.326	0.104
rev1_1diD1	Industry	Mining	-0.165	0.306	-0.162	0.310	0.195	0.185	0.206	0.141
rev1_1diD2		Manufacturing	-0.318	0.000	-0.295	0.000	-0.079	0.080	-0.051	0.234
rev1_1diD3		Electr Gas and Water suppl	-0.081	0.520	-0.126	0.317	0.093	0.419	0.198	0.070
rev1_1diD5		Wholesale and Retail Trade	-0.616	0.000	-0.549	0.000	-0.314	0.000	-0.220	0.000
rev1_1diD6		Hotels and Restaurants	-0.536	0.000	-0.338	0.000	-0.036	0.652	-0.041	0.589
rev1_1diD7		Transport Storage	-0.533	0.000	-0.508	0.000	-0.361	0.000	-0.290	0.000
rev1_1diD8		Financial Intermediation	-0.882	0.000	-0.773	0.000	-0.507	0.000	-0.230	0.007
rev1_1diD9		Real estate	-0.713	0.000	-0.646	0.000	-0.566	0.000	-0.372	0.000
rev1_1diD10		Public Admin	-1.090	0.000	-1.023	0.000	-0.763	0.000	-0.452	0.000
rev1_1diD11		Education	-0.604	0.000	-0.556	0.000	-0.294	0.000	-0.116	0.083
rev1_1diD12		Health and Soc Work	-0.087	0.192	-0.058	0.429	0.098	0.154	0.145	0.026
rev1_1diD13		Other community Social	-0.549	0.000	-0.510	0.000	-0.276	0.000	-0.104	0.136
MM400C2D2		Percent of female	1-19%			0.264	0.001	0.216	0.003	0.210
MM400C2D3	20-39%				0.250	0.002	0.207	0.006	0.235	0.001
MM400C2D4	40-59%				0.119	0.149	0.010	0.900	0.081	0.262
MM400C2D5	60-79%				0.039	0.644	-0.050	0.521	0.010	0.888
MM400C2D6	80-99%				0.165	0.055	0.041	0.612	0.066	0.384
MM400C2D7	100%				0.263	0.046	0.017	0.886	-0.019	0.872
MM400C2D8	missing %				0.287	0.198	0.107	0.601	0.080	0.679
MM401C2D2	Percent of aged 50+		1-19%			0.425	0.000	0.221	0.000	0.185
MM401C2D3		20-39%			0.600	0.000	0.335	0.000	0.297	0.000
MM401C2D4		40-59%			0.646	0.000	0.296	0.000	0.256	0.000
MM401C2D5		60-79%			0.779	0.000	0.367	0.000	0.315	0.000
MM401C2D6		80-99%			0.431	0.003	0.051	0.706	0.033	0.796
MM401C2D7		100%			-0.452	0.340	-0.665	0.126	-0.502	0.224
MM401C2D8		missing %			0.602	0.000	0.207	0.057	0.113	0.275
MM405C2D2		Percent of foreigners	1-19%			0.180	0.000	0.051	0.087	0.029
MM405C2D3	20-39%				0.041	0.408	0.063	0.192	0.012	0.799
MM405C2D4	40-59%				-0.020	0.769	0.232	0.000	0.112	0.072
MM405C2D5	60-79%				-0.253	0.007	0.101	0.261	0.001	0.986
MM405C2D6	80-99%				-0.516	0.000	0.064	0.505	-0.026	0.779
MM405C2D7	100%				-0.953	0.000	-0.375	0.033	-0.433	0.010
MM405C2D8	missing %				0.360	0.001	0.413	0.000	0.372	0.000

Main factors associated with effective management of OSH – An empirical analysis

Table 5 -continued Variable name in the dataset	Informative name	Categories labels	Model 1		Model 2		Model 3		Model 4		
			Coef.	P>t	Coef.	P>t	Coef.	P>t	Coef.	P>t	
countryD1	Country	Belgium					-0.192	0.015	-0.554	0.000	
countryD2		Denmark					0.273	0.001	-0.075	0.355	
countryD3		Germany					-0.865	0.000	-1.274	0.000	
countryD4		Greece					-1.732	0.000	-2.143	0.000	
countryD5		Spain					0.601	0.000	0.243	0.001	
countryD6		Finland					0.443	0.000	-0.152	0.058	
countryD7		France					-1.355	0.000	-1.701	0.000	
countryD8		Ireland					0.521	0.000	0.393	0.000	
countryD10		Luxembourg					-1.754	0.000	-1.804	0.000	
countryD11		Netherlands					0.056	0.497	-0.183	0.022	
countryD12		Austria					-1.082	0.000	-1.441	0.000	
countryD13		Portugal					-0.148	0.074	-0.690	0.000	
countryD14		Sweden					0.735	0.000	0.400	0.000	
countryD15		United Kingdom					0.577	0.000	0.414	0.000	
countryD31		Bulgaria					0.447	0.000	0.174	0.098	
countryD32		Cyprus					-0.774	0.000	-1.183	0.000	
countryD33		Czech Republic					-0.761	0.000	-0.968	0.000	
countryD34		Estonia					-0.753	0.000	-1.060	0.000	
countryD35		Hungary					-0.528	0.000	-0.909	0.000	
countryD36		Latvia					-0.896	0.000	-1.240	0.000	
countryD37		Lithuania					-1.415	0.000	-1.687	0.000	
countryD38		Malta					-0.627	0.000	-0.920	0.000	
countryD39		Poland					-0.701	0.000	-0.959	0.000	
countryD40		Romania					0.395	0.000	-0.391	0.000	
countryD41		Slovak Republic					-0.056	0.610	-0.404	0.000	
countryD42		Slovenia					-0.730	0.000	-0.823	0.000	
countryD43		Turkey					-1.511	0.000	-2.114	0.000	
countryD46		Croatia					-0.821	0.000	-0.336	0.001	
countryD51		Switzerland					-1.753	0.000	-2.000	0.000	
countryD52		Norway					0.543	0.000	0.072	0.369	
MM200C1		whether OSH risks are major concern	some concern no concern							-0.306 -0.609	0.000 0.000
MM170D2		Visits by Labour inspectorate	no visits by LI							-0.558	0.000
MM170D3	No answer								-0.405	0.000	
MM171_1BD2	Reason for dealing -legal obligation	No or Minor							-0.348	0.000	
MM171_1BD3		No answer							-0.445	0.023	
MM171_2BD2	Reason for dealing -requests from employes	No or Minor							-0.516	0.000	
MM171_2BD3		No answer							-0.882	0.000	
MM171_3BD2	Reason for dealing -staff ret and absenteesm	No or Minor							-0.360	0.000	
MM171_3BD3		No answer							-0.507	0.000	
MM171_4BD2	Reason for dealing - economic perform	No or Minor							-0.159	0.000	
MM171_4BD3		No answer							-0.107	0.331	
MM171_5BD2	Reason for dealing - clients or reputation	No or Minor							-0.413	0.000	
MM171_5BD3		No answer							-0.244	0.058	
MM171_6BD2	Reason for dealing - pressure from LI	No or Minor							0.029	0.247	
MM171_6BD3		No answer							0.163	0.050	
_cons			5.700	0.000	5.010	0.000	5.700	0.00	6.853	0.00	
R2			21.0		22.3		35.0		41.4		
N			21856		21856		21856		21856		

Note: reference categories are 1-19 employees (size), being independent (whether part of larger establishment), public (whether public of private), construction (industry), 0% (percent of female, percent of age above 50 years, percent of migrants), Italy (country), OSH risks are major concern (whether OSH risks represent a concern), establishment visited by labour inspectorate (whether or not visited by labour inspectorate), major reason for dealing with risks (legal obligation, request from employees, staff retention and absence management, economic performance, clients or reputation, pressure from labour inspectorate).

Below is a concise summary of the principal findings from the multivariate analysis. Note that the findings reported below are 'isolated' effects of each predictor holding the levels of all other variables constant.

1. The larger size of an establishment is associated with better management of OSH; this effect is significant in all models and the introduction of further variables in Models 2-4 has little impact

- on its effect. Other things being equal, the OSH score of establishments with 250+ employees, for example, is about 2 units above that for those with up to 20 employees.
2. Being part of a larger establishment (as opposed to being an independent establishment) is associated with better management of OSH; this effect is also significant in all models, but in Models 2-4, a significant reduction in the size of its coefficients is observed.
 3. Public establishments are only slightly better at OSH management than private establishments.
 4. OSH management in the construction, mining, manufacturing, hotel and restaurant management, electricity, water and gas supply, and health and social work industries is at a broadly similar level, and these industries are better performers in terms of OSH management. Industries such as wholesale and retail trade, transport and storage, financial intermediation, real estate, public administration, education are worse performers in terms of OSH management.
 5. The scope of OSH management increases with increase in proportion of workers aged 50 years and above. However, establishments with balanced age composition (with those aged 50 years and above as a non-negligible proportion but also not as an absolute majority) perform better in terms of OSH management.
 6. The scope of OSH management is the highest in establishments with minority of female workers. Establishments that have exclusively male or exclusively female employees are performing worse in terms of OSH management.
 7. The proportion of foreigners in workforce does not seem to have a marked effect of OSH management, apart from the fact that establishments dominated by foreigners are worse at management of OSH.
 8. There are marked differences between countries in terms of OSH management, with North European countries (Sweden, UK and Ireland) and Spain being the best and Greece, Turkey, Switzerland, Luxembourg, France being the worst.
 9. The perceived presence of OSH issues is conducive to their better management, as are visits paid to establishments by the labour inspectorate.
 10. Perceived pressures from employees, clients, and as a result of legal requirements (but not by labour inspectorate) are associated with better management of OSH.

The first Model explains about 21% of variance in the response variable, adding demographics changes little in the amount of explained variance, while adding country adds a very significant amount bringing the proportion of explained variance to 35%. The full model (Model 4) explains 41% of variance.

Initially we did not introduce the age of establishment into Models 1-4 simply because public institutions were not asked to provide this information in the survey. We however, run additional models on private establishments only. First, we fitted a version of Model 4 to private institutions only to obtain the base for the comparison (hereafter Model 4a). Second, we added age of establishment as a predictor to Model 4 (hereafter Model 4b). Age of establishment proved to be a not significant variable in statistical terms, as Table 6 demonstrates.

Table 6: Results of multivariate analysis: Models 4a-4b (non-public establishments only)

Main factors associated with effective management of OSH – An empirical analysis

Variable name in the dataset	Informative name	Categories labels	Model 4a		Model 4b	
			Coef.	P>t	Coef.	P>t
size_10D2	size of establishment	20-49 emp	0.632	0.000	0.631	0.000
size_10D3		50-99 emp	1.147	0.000	1.142	0.000
size_10D4		100-149 emp	1.392	0.000	1.387	0.000
size_10D5		150-199 emp	1.663	0.000	1.658	0.000
size_10D6		200-249 emp	1.678	0.000	1.671	0.000
size_10D7		250-299 emp	1.713	0.000	1.706	0.000
size_10D8		300-399 emp	1.850	0.000	1.842	0.000
size_10D9		400-499 emp	2.047	0.000	2.039	0.000
size_10D10		500+ emp	2.082	0.000	2.074	0.000
MM100D2		whether part of larger estab	branch	0.403	0.000	0.403
MM100D3	No answer		-0.202	0.591	-0.200	0.596
MM106D2	age of establishment	established in 1990-2005			-0.040	0.184
MM106D3		established after 2005			-0.056	0.387
MM106D4		No answer			0.055	0.748
rev1_1diD1	Industry	Mining	0.156	0.289	0.152	0.303
rev1_1diD2		Manufacturing	-0.053	0.226	-0.058	0.192
rev1_1diD3		Electr Gas and Water suppl	0.366	0.011	0.369	0.010
rev1_1diD5		Wholesale and Retail Trade	-0.221	0.000	-0.223	0.000
rev1_1diD6		Hotels and Restaurants	-0.068	0.394	-0.068	0.392
rev1_1diD7		Transport Storage	-0.335	0.000	-0.335	0.000
rev1_1diD8		Financial Intermediation	-0.280	0.002	-0.283	0.002
rev1_1diD9		Real estate	-0.359	0.000	-0.357	0.000
rev1_1diD10		Public Admin	0.109	0.584	0.103	0.603
rev1_1diD11		Education	-0.173	0.092	-0.175	0.089
rev1_1diD12		Health and Soc Work	0.353	0.000	0.353	0.000
rev1_1diD13		Other community Social	-0.187	0.020	-0.188	0.019
MM400C2D2		Percent of female	1-19%	0.185	0.010	0.184
MM400C2D3	20-39%		0.216	0.004	0.214	0.004
MM400C2D4	40-59%		0.061	0.427	0.060	0.435
MM400C2D5	60-79%		0.011	0.892	0.011	0.895
MM400C2D6	80-99%		-0.031	0.707	-0.031	0.71
MM400C2D7	100%		-0.214	0.146	-0.215	0.144
MM400C2D8	missing %		-0.009	0.966	-0.011	0.96
MM401C2D2	Percent of aged 50+		1-19%	0.211	0.000	0.207
MM401C2D3		20-39%	0.325	0.000	0.317	0.000
MM401C2D4		40-59%	0.292	0.000	0.282	0.000
MM401C2D5		60-79%	0.343	0.000	0.331	0.000
MM401C2D6		80-99%	0.085	0.603	0.073	0.654
MM401C2D7		100%	-0.220	0.672	-0.233	0.654
MM401C2D8		missing %	0.191	0.103	0.182	0.121
MM405C2D2		Percent of foreigners	1-19%	0.014	0.655	0.015
MM405C2D3	20-39%		-0.031	0.532	-0.029	0.570
MM405C2D4	40-59%		0.076	0.253	0.080	0.230
MM405C2D5	60-79%		-0.026	0.773	-0.023	0.802
MM405C2D6	80-99%		-0.018	0.854	-0.011	0.912
MM405C2D7	100%		-0.477	0.009	-0.468	0.010
MM405C2D8	missing %		0.383	0.001	0.386	0.001

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Table 6 -continued Variable name in the dataset	Informative name	Categories labels	Model 4a		Model 4b	
			Coef.	P>t	Coef.	P>t
countryD1	Country	Belgium	-0.658	0.000	-0.664	0.000
countryD2		Denmark	-0.242	0.008	-0.249	0.006
countryD3		Germany	-1.392	0.000	-1.393	0.000
countryD4		Greece	-2.072	0.000	-2.072	0.000
countryD5		Spain	0.227	0.003	0.227	0.003
countryD6		Finland	-0.315	0.000	-0.313	0.000
countryD7		France	-1.770	0.000	-1.774	0.000
countryD8		Ireland	0.319	0.002	0.313	0.002
countryD10		Luxembourg	-1.820	0.000	-1.821	0.000
countryD11		Netherlands	-0.270	0.004	-0.276	0.003
countryD12		Austria	-1.526	0.000	-1.533	0.000
countryD13		Portugal	-0.702	0.000	-0.703	0.000
countryD14		Sweden	0.185	0.053	0.187	0.051
countryD15		United Kingdom	0.330	0.000	0.326	0.000
countryD31		Bulgaria	0.099	0.409	0.118	0.331
countryD32		Cyprus	-1.268	0.000	-1.273	0.000
countryD33		Czech Republic	-1.108	0.000	-1.092	0.000
countryD34		Estonia	-1.110	0.000	-1.093	0.000
countryD35		Hungary	-0.968	0.000	-0.956	0.000
countryD36		Latvia	-1.323	0.000	-1.308	0.000
countryD37		Lithuania	-1.746	0.000	-1.728	0.000
countryD38		Malta	-0.991	0.000	-0.993	0.000
countryD39		Poland	-1.342	0.000	-1.328	0.000
countryD40		Romania	-0.411	0.000	-0.392	0.000
countryD41		Slovak Republic	-0.621	0.000	-0.603	0.000
countryD42	Slovenia	-0.958	0.000	-0.952	0.000	
countryD43	Turkey	-2.044	0.000	-2.036	0.000	
countryD46	Croatia	-0.396	0.001	-0.385	0.002	
countryD51	Switzerland	-2.065	0.000	-2.078	0.000	
countryD52	Norway	-0.066	0.479	-0.069	0.463	
MM200C1	whether OSH risks are major concern	some concern	-0.282	0.000	-0.281	0.000
		no concern	-0.612	0.000	-0.610	0.000
MM170D2	Visits by Labour inspectorate	no visits by LI	-0.556	0.000	-0.555	0.000
MM170D3		No answer	-0.384	0.000	-0.384	0.000
MM171_1BD2	Reason for dealing -legal obligation	No or Minor	-0.309	0.000	-0.309	0
MM171_1BD3		No answer	-0.381	0.077	-0.37941	0.078
MM171_2BD2	Reason for dealing -requests from employes	No or Minor	-0.541	0.000	-0.54074	0.000
MM171_2BD3		No answer	-0.743	0.000	-0.74271	0.000
MM171_3BD2	Reason for dealing -staff ret and absenteesm	No or Minor	-0.338	0.000	-0.33848	0.000
MM171_3BD3		No answer	-0.473	0.000	-0.47374	0.000
MM171_4BD2	Reason for dealing - economic perform	No or Minor	-0.187	0.000	-0.18719	0.000
MM171_4BD3		No answer	-0.031	0.813	-0.03379	0.799
MM171_5BD2	Reason for dealing - clients or reputation	No or Minor	-0.425	0.000	-0.42537	0.000
MM171_5BD3		No answer	-0.359	0.028	-0.36187	0.027
MM171_6BD2	Reason for dealing - pressure from LI	No or Minor	0.043	0.123	0.043265	0.121
MM171_6BD3		No answer	0.063	0.524	0.062699	0.524
_cons			6.798	0.000	6.826	0.000
R2			41.7		41.7	
N			17158		17158	

Note: reference category for age of establishment is 'established before 1990', for reference categories of other predictors see note to the previous table.

All relationships identified in models fitted to all establishments hold good in the models fitted to non-public establishments only.

The table below presents the impact of single predictor variables on change in the amount of variance explained by the model.

Table 7: Quantification of the impact of single predictors (Model 4, all establishments)

Variable	R ² with variable excluded	Full model (Model 4)	Loss of R ² relative to full model
country	0.286	0.414	0.128
size of establishment	0.344	0.414	0.070
reasons for dealing with health and safety	0.372	0.414	0.042
visits by labour inspectorate	0.401	0.414	0.013
whether part of larger establishment	0.408	0.414	0.006
industry	0.409	0.414	0.005
whether OSH risk are major concern	0.410	0.414	0.004
percent of female	0.413	0.414	0.001
percent of foreigners	0.413	0.414	0.001
percent of aged 50+	0.413	0.414	0.001
public or private	0.414	0.414	0.000

Note: N=21,856 (82% of the unweighted sample).

The table shows the proportion of variance explained by a sequence of models from which single predictors were removed in turn, with all other predictors retained. It helps identification of the most influential predictors. The most influential background variables are therefore country, size of the establishment, being part of larger establishment, and industry. Exclusion of country and size of establishment from the model reduces 13% and 7%, respectively, from the amount of explained variance. This is a direct indication of the relative importance of predictors for explaining the scope of management of OSH risks.

Typologies

The aim of this section is to cast the main results of this analysis in a form that is informative for policy makers. In a previous section we identified the significant determinants of OSH management score. Here we ask ourselves: what the policy makers need to know in order to develop interventions aiming to increase the scope of management of OSH risks.

First, the policy makers would need to know the relative strength of different determinants of OSH score. Size, sector, industry and other characteristics of establishment were shown to be significant determinants but are they equally powerful in determining the OSH score? Which of these predictors should be prioritised if increasing the scope of management of risks is a desired goal?

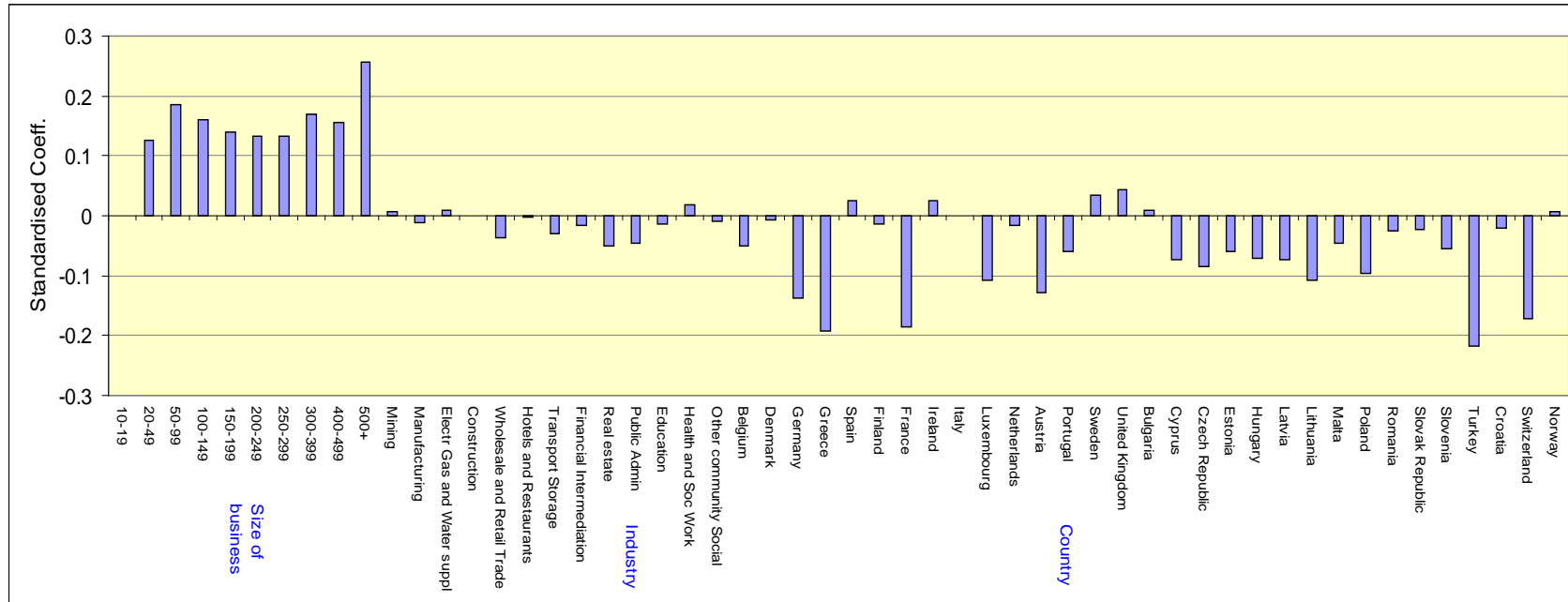
Second, the policy makers would need to know just how large the effect is of manipulating one or more determinants on the OSH score. We know, for example, that belonging to a particular industry increases/decreases the OSH score by a certain amount. To put it differently, other things being equal, what would the OSH score be of the establishments belonging to different types of industries?

To address the first question we present the standardised coefficients of the predictors of OSH score. Previously presented coefficients express a change in OSH score as a result of a one-unit change in value of a particular predictor, other thing being held constant. These coefficients cannot be compared across predictors: from the value of coefficients one cannot form conclusions about the relative strengths of the predictors in determining the OSH score. Standardised coefficients allow us to do just that. A standardised coefficient expresses a change in the OSH score as result of a one standard deviation change in a particular predictor. Inspection of standardised coefficients immediately answers the question of 'what are the strongest determinants of OSH score'.

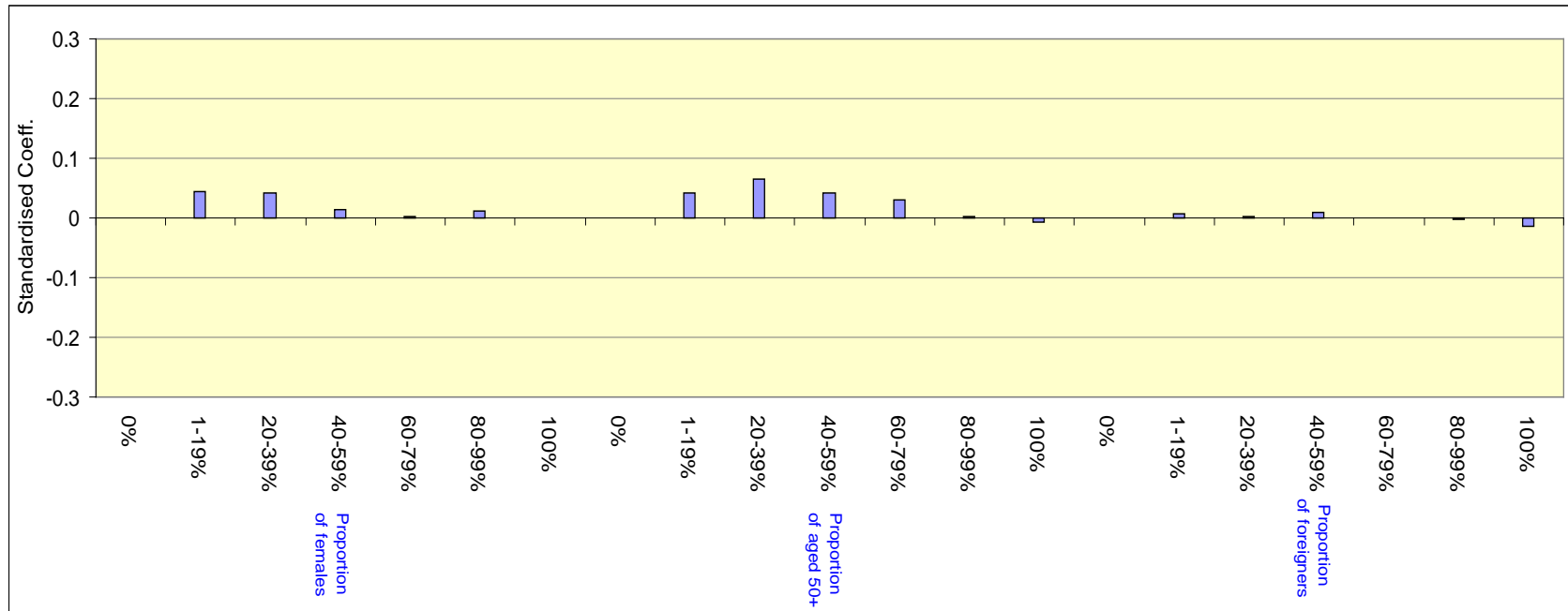
We present the standardised coefficients for all predictors in Model 4 in Figure 4 in three panels. Panel A presents the strongest determinants of OSH score, Panel B presents the determinants of weakest determinants, and Panel C presents determinants of intermediate strength. The matter of principal interest in this figure is the length of the bars indicating the standardised impact of predictors: the taller the bars, the larger the impact.

Figure 4: Standardised coefficients –Final model

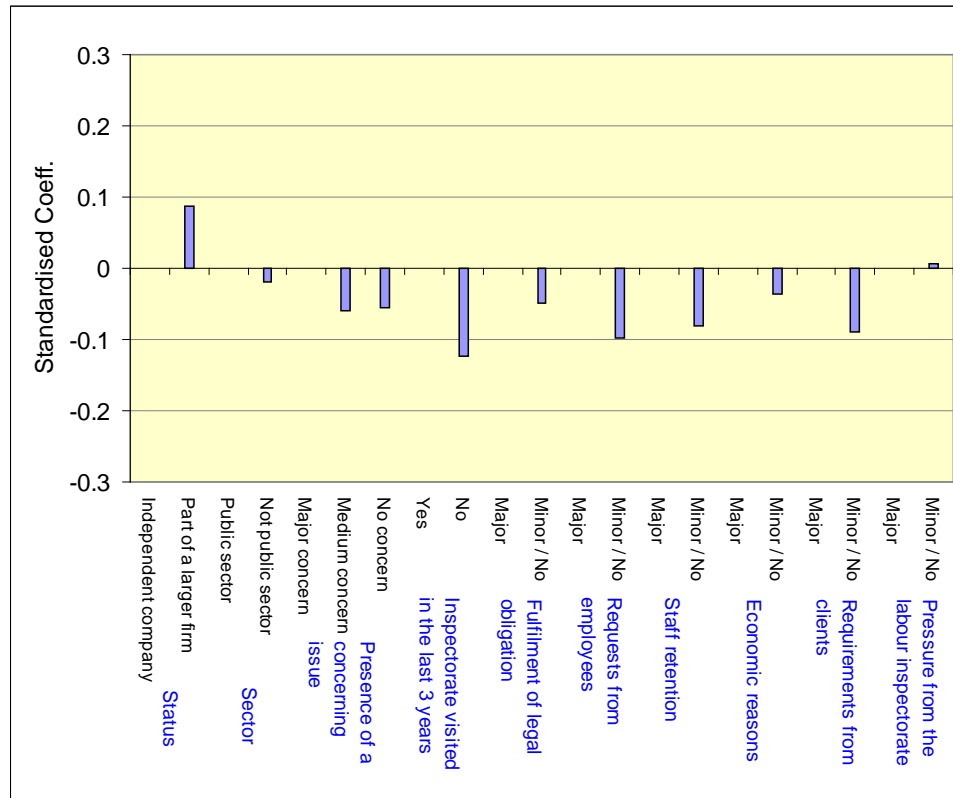
Panel A. 'Strong' predictors



Panel B. 'Weak' predictors



Panel C. 'Intermediate' predictors



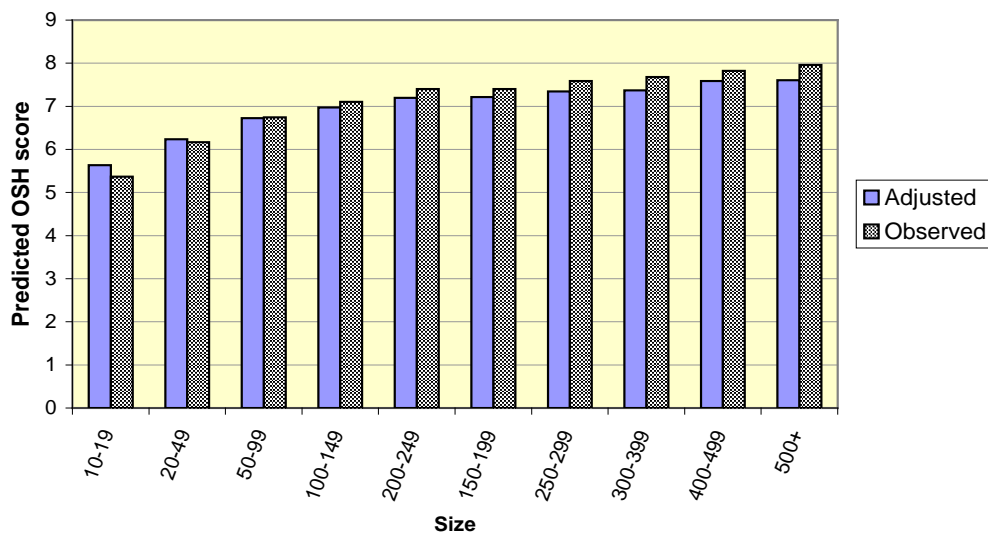
Note: N=21,856 (82% of the unweighted sample).

Size of the establishment, industry and country are among the strongest determinants of OSH score. These findings suggest that policy makers would need to focus their efforts on providing support to small establishments in management of risks, on studying the country-specific infrastructural and legal framework and cultures that may impede or promote OSH management, and on features of particular industries. It is also clear that independent establishments and establishments belonging to the private sector should be prioritised and that internal and economic pressures (clients' and employees' requests, worries about staff retention etc.) are quite influential factors to be taken into account by the policy makers. Establishments' employee demographics, on the other hand, are significantly less influential than other predictors.

To address the second question we present typologies of establishments by three major predictors of OSH score: size of establishment, industry and country (Figure 5). These are effectively adjusted OSH scores for each category of major predictors, calculated with other predictor variables held at their mean values.

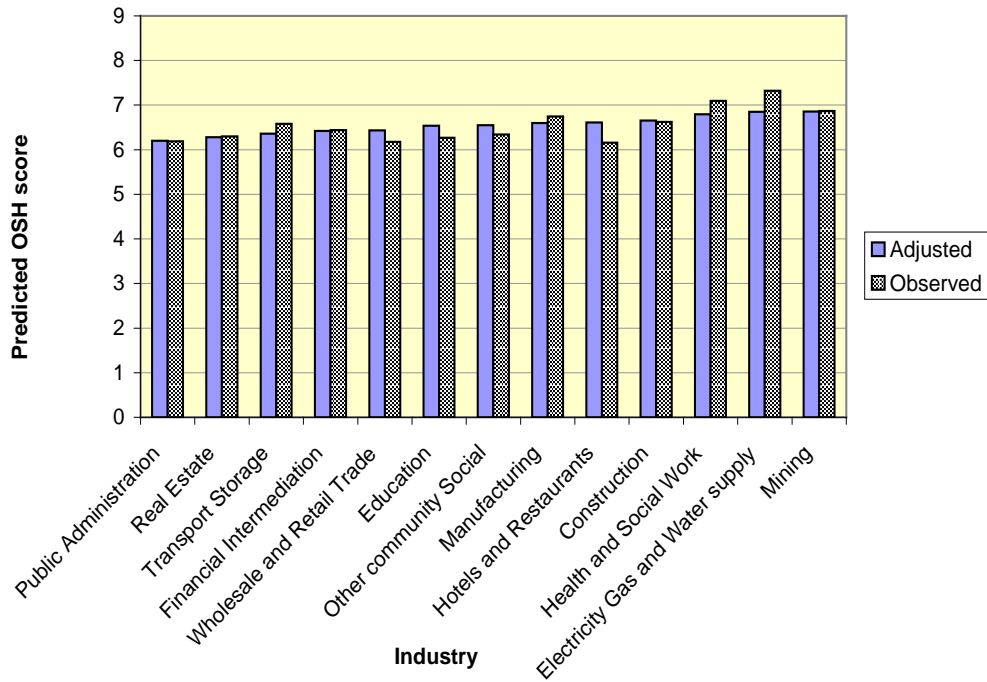
Figure 5: Typologies of establishments: adjusted versus observed OSH scores

Panel A. By size

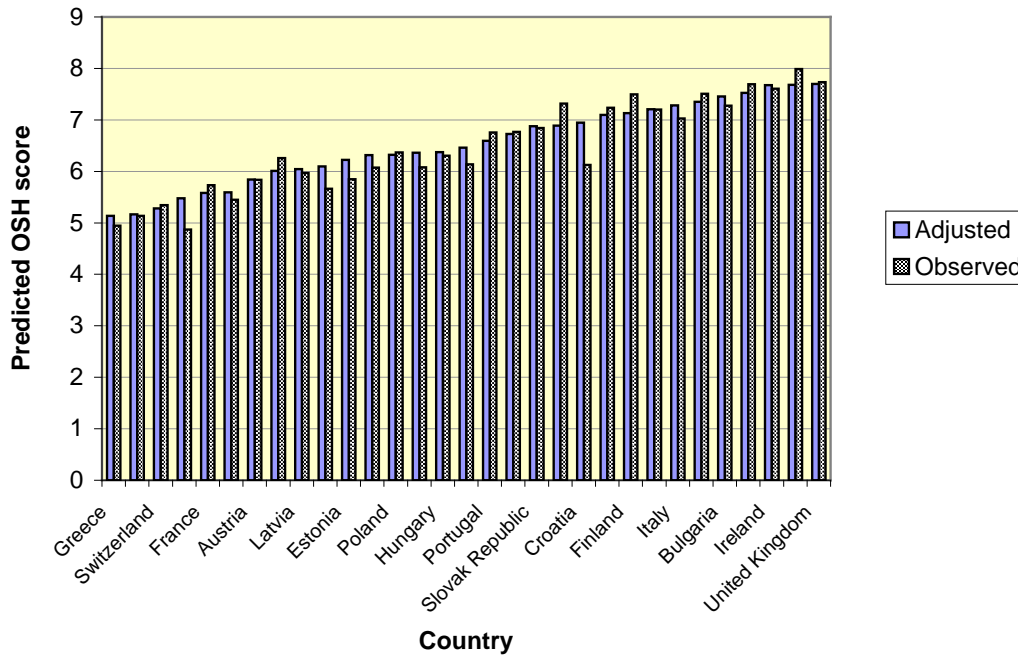


Panel B. by industry

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Panel C. by country



N=21,856 (82% of the unweighted sample).

Note:

It is clear that large size alone can be a major factor behind good OSH management: largest establishments possess OSH score that are close to the maximal possible value (around 8) while smallest establishments possess OSH score of 5. The United Kingdom appears to lead in terms of management of risks with an OSH score of 8 and Greece is situated at the bottom with an OSH score of less than 5. The mining industry presents the highest OSH score of 7. Public administration has the lowest score (6).

Shaded bars in Figure 5 show the OSH scores observed in the dataset, allowing comparison between adjusted and unadjusted (observed) scores. The unadjusted scores are presented mainly to illustrate the degree to which these scores are useful for deriving conclusions about the relationships between size categories, industries and countries, based on the original rather than adjusted data. It shows, for instance that the difference between adjusted and unadjusted scores is insignificant in relation to size categories. Essentially, unadjusted data provides an adequate description of the gradual rise in OSH with size. This is, however, not the case with the comparison between different industries and countries where unadjusted scores provide a different picture to adjusted scores.

Finally, we present predicted score for combinations of industry and size, by country, in Table 8. For this type of presentation, we choose to focus on two selected industries (construction and public administration-among the best and the worst in terms of management of OSH risks, respectively) and on three categories of size. Countries have been selected to represent the best (Sweden, UK, Spain), the worst (France, Greece) and the intermediate (Germany) levels of OSH management and to provide good coverage to principal European economies.

Table 8: Predicted OSH scores by country, industry and size

	Construction (best performer)			Public Administration (worst performer)		
	up to 50 empl.	100-399 empl.	400+ empl.	up to 50 empl.	100-399 empl.	400+ empl.
Sweden	7.2	8.5	8.9	6.8	8.0	8.4
UK	7.2	8.3	8.9	6.8	8.1	8.4
Germany	5.5	6.8	7.2	5.1	6.4	6.7
Spain	7.1	8.3	8.7	6.6	6.0	8.3
France	5.1	6.4	6.8	4.7	5.9	6.3
Greece	4.7	6.0	6.3	4.2	5.5	5.9

Note: N=21,856 (82% of the unweighted sample).

The key conclusions that can be derived from these results are as follows:

1. Although establishment size matters (difference of 1.7 units of OSH score between extreme size categories) it is not a 'destiny': even at small company sizes there is a possibility of having a rather decent coverage of OSH management aspects in certain regulatory contexts: 7-8 (out of 9 possible) in Sweden, UK and Spain in both best performing (construction) and worst performing industries (such as public administration). Additionally, even at largest establishment size, there is a difference of 2-3 units in a number of OSH management aspects implemented by, say, Sweden and Greece;
2. Industry matters, but the differences between best and worst industries are the order of magnitude of half a unit of OSH score. This is much smaller than the impact of size;
3. Country-specific economic, cultural and regulatory context matters the most. In a way, this is the most significant and difficult conclusion, especially from the policy makers' point of view. 'Country context' is a non-specific entity in the context of this study and can include a variety of country characteristics. It is for future research of regulatory environment, economy and culture to elaborate on causal paths making some countries 'good' or 'poor' performers in terms of OSH management;
4. There are especially worrying, from the point of view of policy makers, combinations of 'circumstances': these are pockets of limited presence of OSH management in Greece and France at small establishment sizes, both in best performing and worst performing industries.

Comparison of managerial and employees' perspectives on management of occupational safety and health

It is not altogether clear who, at organisational level, is the appropriate respondent to various questions concerning management of OSH. It is known, on the basis of previous research, that some types of information are known better to one of the sides. For example, managers may have a better view of training in OSH issues offered to employees as they are the principal organizers of it and

bearers of fiscal responsibility. Employees, on the other hand, may be better positioned to answer questions pertaining to presence of tension and conflicts at the workplace.

ESENER and other surveys focusing on industrial relations ask for both managerial and employees' representative's perspective on selected questions. In relation to OSH risks, ESENER included 4 identical questions for managers and employees' representatives: (1) a question on presence of documented policy, management system or action plan on OSH, (2) a question on impact that this policy, system or action plan have in an establishment, (3) a question on presence of regular checks as part of the risk assessment procedure, and (4) a question on degree of involvement of managers and supervisors in management of OSH.

As a first step we conducted analysis of compatibility of answers to these questions. We created crosstabulations of managerial (MM) responses against employees' representatives' responses (ER) to all questions, and conducted chi-square tests to see whether there is a relationship between these two perspectives. The results are shown in the tables below.

Table 9: Comparison of MM and ER perspectives: MM155 versus ER200

Panel A. Absolute figures		ER200			
		Is there a documented policy, established management system or action plan on health and safety in your establishment?			
MM155		1 Yes	2 No	3 NA	Total
Is there a documented policy, established management system or action plan on health and safety in your establishment?	1 Yes	5702	493	194	6389
	2 No	526	200	54	780
	3 NA	49	7	1	57
	Total	6277	700	249	7226
Panel B. Percents		ER200			
		Is there a documented policy, established management system or action plan on health and safety in your establishment?			
MM155		1 Yes	2 No	3 NA	Total
Is there a documented policy, established management system or action plan on health and safety in your establishment?	1 Yes	89.2	7.7	3.0	100.0
	2 No	67.4	25.6	6.9	100.0
	3 NA	86.0	12.3	1.8	100.0
	Total	86.9	9.7	3.4	100.0

Table 10: Comparison of MM and ER perspectives: MM156 vs ER202

Panel A. Absolute figures		ER202				
		In practice, how much of an impact does this policy, management system or action plan have on health and safety in your establishment?				
		Does it have a large impact, some impact or practically no impact?				
MM156		1 Large imp	2 Some imp	3 Practically none	4 NA	Total
In practice, how much of an impact does this policy, management system or action plan have on health and safety in your establishment?	1 Large imp	1144	1186	141	46	2517
	2 Some imp	868	1603	249	55	2775
	3 Practically none	82	188	46	5	321
	4 NA	31	44	11	3	89
Does it have a large impact, some impact or practically no impact?	Total	2125	3021	447	109	5702
Panel B. Percents		ER202				
		In practice, how much of an impact does this policy, management system or action plan have on health and safety in your establishment?				
		Does it have a large impact, some impact or practically no impact?				
MM156		1 Large imp	2 Some imp	3 Practically none	4 NA	Total
In practice, how much of an impact does this policy, management system or action plan have on health and safety in your establishment?	1 Large imp	45.5	47.1	5.6	1.8	100.0
	2 Some imp	31.3	57.8	9.0	2.0	100.0
	3 Practically none	25.5	58.6	14.3	1.6	100.0
	4 NA	34.8	49.4	12.4	3.4	100.0
Does it have a large impact, some impact or practically no impact?	Total	37.3	53.0	7.8	1.9	100.0

Table 11: Comparison of MM and ER perspectives: MM161 vs ER207

Panel A. Absolute figures		ER207			
		Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?			
MM161		1 Yes	2 No	3 NA	Total
Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?	1 Yes	6058	653	88	6799
	2 No	273	114	12	399
	3 NA	23	5	0	28
	Total	6354	772	100	7226
Panel B. Percents		ER207			
		Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?			
MM161		1 Yes	2 No	3 NA	Total
Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?	1 Yes	89.1	9.6	1.3	100.0
	2 No	68.4	28.6	3.0	100.0
	3 NA	82.1	17.9	0.0	100.0
	Total	87.9	10.7	1.4	100.0

Table 12: Comparison of MM and ER perspectives: MM159 vs ER214

Panel A. Absolute figures		ER214					Total
MM159		Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety? Is it very high, quite high, quite low or very low?					
		1 Very high	2 Quite High	3 Quite low	4 Very low	5 NA	
Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety?	1 Very high	440	958	179	35	47	1659
	2 Quite High	650	2669	703	130	108	4260
	3 Quite low	106	562	255	59	27	1009
	4 Very low	16	79	38	9	5	147
Is it very high, quite high, quite low or very low?	5 NA	18	73	21	3	36	151
	Total	1230	4341	1196	236	223	7226

Panel B. Percents		ER214					Total
MM159		Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety? Is it very high, quite high, quite low or very low?					
		1 Very high	2 Quite High	3 Quite low	4 Very low	5 NA	
Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety?	1 Very high	26.5	57.7	10.8	2.1	2.8	100.0
	2 Quite High	15.3	62.7	16.5	3.1	2.5	100.0
	3 Quite low	10.5	55.7	25.3	5.8	2.7	100.0
	4 Very low	10.9	53.7	25.9	6.1	3.4	100.0
Is it very high, quite high, quite low or very low?	5 NA	11.9	48.3	13.9	2.0	23.8	100.0
	Total	17.0	60.1	16.6	3.3	3.1	100.0

Further, 'agreeing' and 'disagreeing' fractions are presented in Table 13.

Table 13: Comparison of MM and ER perspectives

	MM155 vs ER200 Is there a documented policy, established management system or action plan on health and safety in your establishment?	MM156 vs ER202 In practice, how much of an impact does this policy, management system or action plan have on health and safety in your establishment? Does it have a large impact, some impact or practically no impact?	MM161 vs ER207 Are workplaces in your establishment regularly checked for safety and health as part of a risk assessment or similar measure?	MM159 vs ER214 Overall, how would you rate the degree of involvement of the line managers and supervisors in the management of health and safety? Is it very high, quite high, quite low or very low?
MM yes AND ER yes	82%	-	85%	-
MM no AND ER no	3%	-	2%	-
MM yes AND ER no	7%	-	9%	-
MM no and ER yes	8%	-	4%	-
'Agreeing' fraction	85%	51%	87%	49%
'Disagreeing' fraction	15%	49%	13%	51%

The analyses presented in the tables above show that responses to the identical questions are very significantly correlated for some questions (on presence of documented policy and risk assessments), and are less so on other questions (impact that the policy has and degree of involvement of

managers in OSH management). In relation to questions on presence of documented policy and risk assessments, MM and ER answers are identical in 85% of cases. In relation to the questions' impact that the policy has and degree of involvement of managers in OSH management, the answers are identical in 50% of cases. In general, employees tend to provide a somewhat more pessimistic picture of OSH management.

To further assess the difference between the MM and ER perspectives we replaced MM questions with the corresponding ER questions in factor analysis. The results are shown in a table below:

Table 13: Factor loadings with ER variables replacing selected MM variables

Variable (questionnaire)	Abbreviated name	Factor 1	Factor 2	Factor 3
MM150	service_use	0.364	0.028	0.471
MM152	absence_analysis	0.671	0.034	0.117
MM153	supporting_return	0.680	-0.012	-0.056
MM154	monitoring_health	-0.075	0.028	0.549
ER200	OSH_policy	0.233	0.601	0.165
MM158	OSH_discussed	0.500	0.122	0.134
ER214	managers_involvement	-0.038	0.696	-0.076
ER207	risk_assessment	0.013	0.726	0.148
MM173	info_used	0.442	0.059	0.362
MM175	European_week	0.154	0.104	0.392

Note: (1) N=5424; (2) similar results were received after rotation.

The results show that ER responses are weakly correlated with the underlying pattern of MM responses, and that they form their own distinct factor. Thus, ideally, one should measure management of risks with the help of two sets of responses covering MM and ER perspectives. The present content of MM and ER questionnaires does not possess fully identical variables for all elements of management of OSH risks. As a consequence, it is impossible to fully understand whether the nature of associations between major determinants of management of risks and OSH score would be different for MM and ER based responses.

One way to gain some limited impression about differences and similarities is to calculate a new response variable substituting ER questions for MM questions and fit the model with all previously used determinants to this new response variable. We call such new response variable OSH_ER. We subsequently run 2 models on a subsample of 5424 cases³, as follows:

Model 1: with OSH_ER as a response variable and establishment size, sector, status, demographics and country as predictors;

Model 2: with the original OSH score as a response variable and the same set of predictors as in Model 1. We decided to re-run this model on the same subsample as Model 1, rather than to use for comparison results of the models summarised in Table 13.

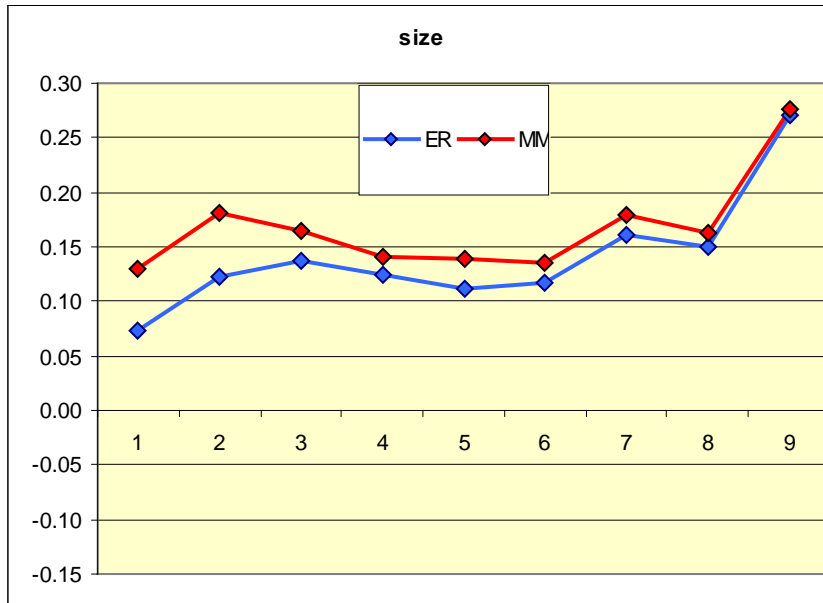
Comparisons of Models 1 and 2 are a key to answering the questions of whether or not adopting MM and ER perspective on management of risks would lead us to different conclusions regarding the nature of the relationships between the mentioned determinants and the measure of management of OSH risks.

In Figure 6 we plot standardised coefficients for 4 major predictors: size of establishment, industry, proportion of females and proportion of migrants in establishment's workforce. Standardised regression coefficients indicate the amount of change in a response variable in standard deviations, and not in original units. Standardisation makes it possible to directly compare the impact of independent variables.

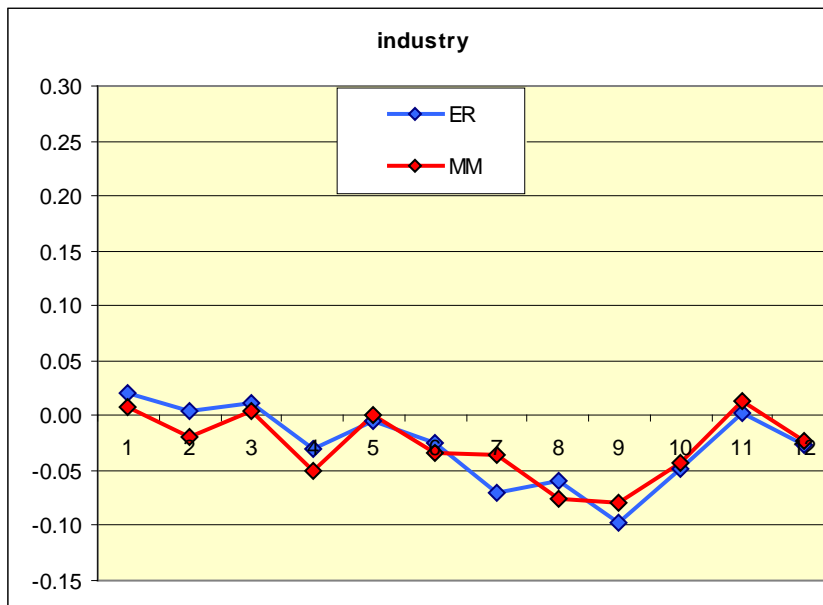
³ The number of cases is identical for all models to allow proper comparison of effects.

Figure 6: Standardised coefficients for the impact of size, industry, proportion of females and migrants on MM and ER –based outcomes

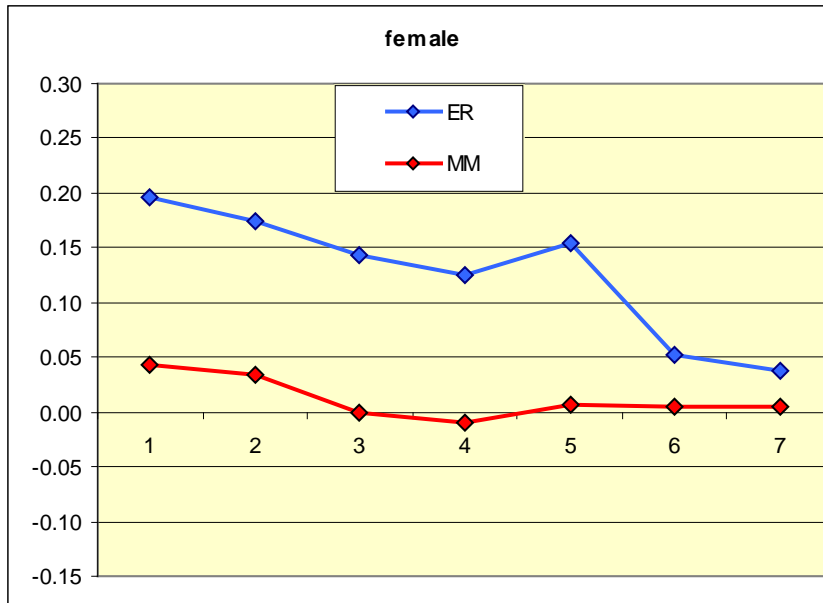
Panel A.



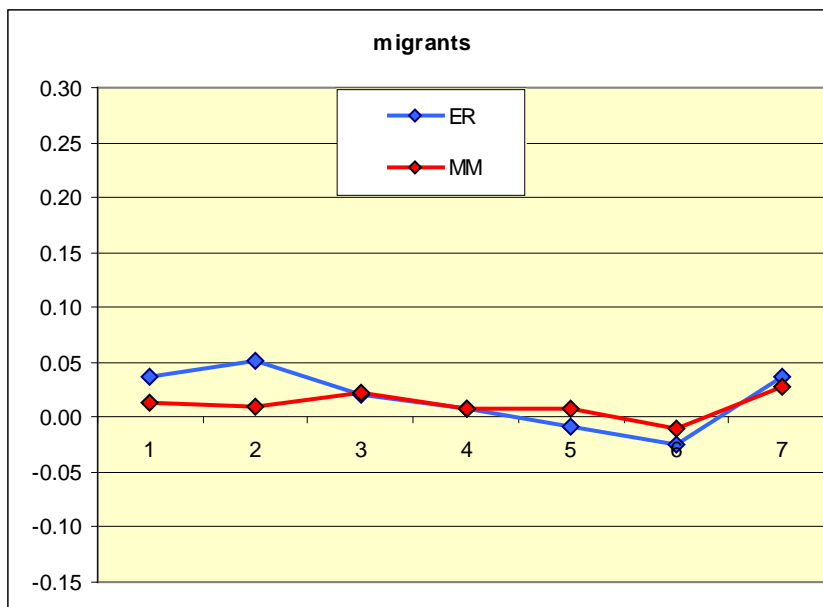
Panel B.



Panel C.



Panel D.



Note: Axes X relate to categories of predictors variables, N=5424.

It appears that size of the establishment has a somewhat greater impact on the MM-based measures relative to ER-based measures. The association between size and management of OSH is well-documented in the literature. This may *suggest* to us that MM-based measures of OSH are somewhat more objective than ER measures. In contrast, proportion of females in establishment has a greater effect on the ER-based measures. This can be interpreted as another finding supporting the hypothesis of greater objectivity of MM-based measures: factual/objective measures are less expected to be affected by establishments' demographic composition. For example, sensitivity of outcome measures to demographic variables is perceived as problematic in the area of research into measures of quality of health care with the resultant stream of research into case-mix adjustment, i.e. the ways to account and control for demographic composition. Note that the coefficients of industry and proportion of migrants do not seem to differ systematically in relation to MM and ER-based measures. At the very least, these results allow the conclusion that MM-based measures *may be*

preferable to ER-based measures, but that further study relying on a fully ER-based OSH score is advisable.

‘Missingness’ in ESENER

Item non-response in ESENER appears as a rather insignificant phenomenon. The majority of variables forming a base for computation of the combined measure of management of OSH risks (OSH score) have missing in the range of 0.6%-4.0%. Variables dealing with use of information on OSH from external sources and support of employees’ return to work following sickness absence have a higher level of missing information: 6%-8%. The extent of missing in predictor variables is also rather modest: up to 3% of all cases.

We investigated the impact of non-response in predictors by assigning a separate code to categories with missing information and using it as an additional category in regression analysis. In most cases, the coefficients of ‘missing’ categories were not statistically significant. When they were statistically significant, no unambiguous interpretation could be applied to this finding. On the basis of these findings there was no reason to suspect that ‘missing’ categories could be informative, and that their presence compromised precision of the estimates of the predictors’ effects on OSH score.

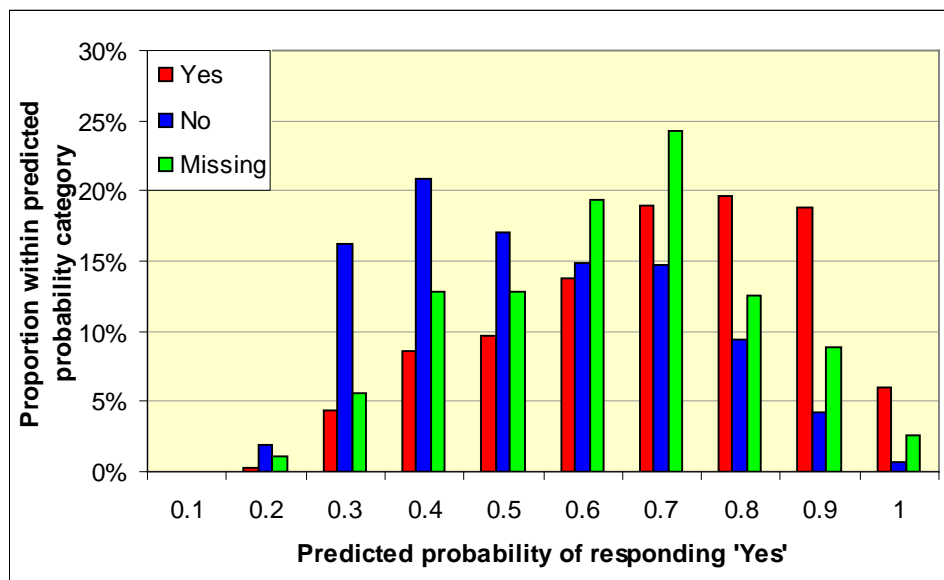
We further investigated the impact of another type of missing information: missing in measures of management of OSH risks. Our main concern with this type of missing information was that those who are missing an OSH measure are not reporting because they are actually worse in management of risks. We run logistic regression on selected binary response variables with a set of predictors used in Model 3 (Table 13). This analysis focused on two measures with greatest proportion of missing: whether information or support from external sources on ways to deal with psychosocial risks was used (MM302, ‘info_used’) and presence of procedures to deal with stress, harassment and violence (MM250-MM252 –based variables, ‘procedures’), both with about 2% missing.

The logistic model was fitted to a dataset that excluded cases for which information on response variable was missing. We then used the model equation to calculate predicted values for each case (establishment) in our dataset, *including* cases with missing information. We compared distributions of predicted values for various categories of response variables. If cases with missing information were underperforming in terms of management of risks their profile of predicted probabilities would resemble the ‘No’ category of the response variables. If, on the other hand, missing cases were in fact a mix of good and poor performers their profile of predicted probabilities would be somewhere in the middle of ‘Yes’ and ‘No’ categories.

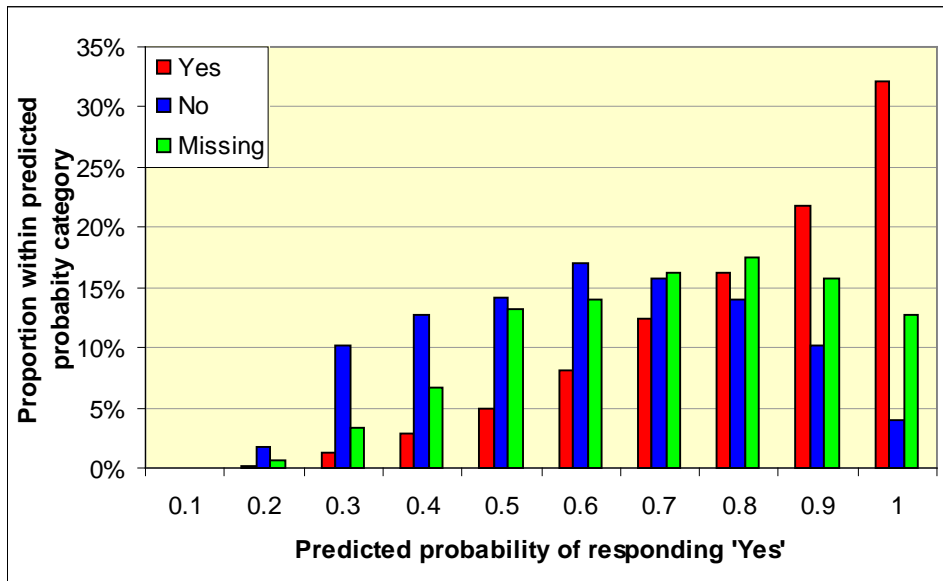
Figure 7 shows the results.

Figure 7: Predicted probabilities for variable ‘procedures’, by response category

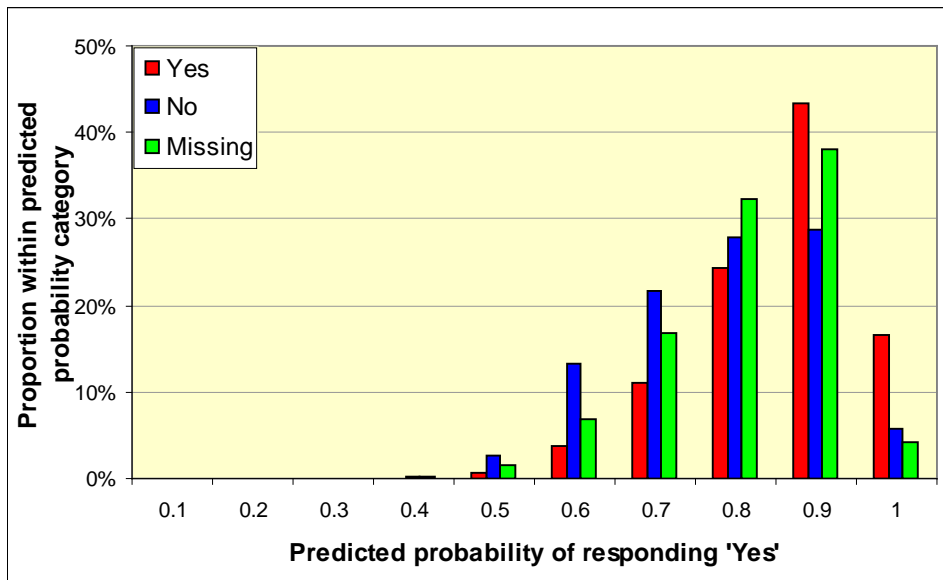
Panel A. Variable ‘absence_analysis’



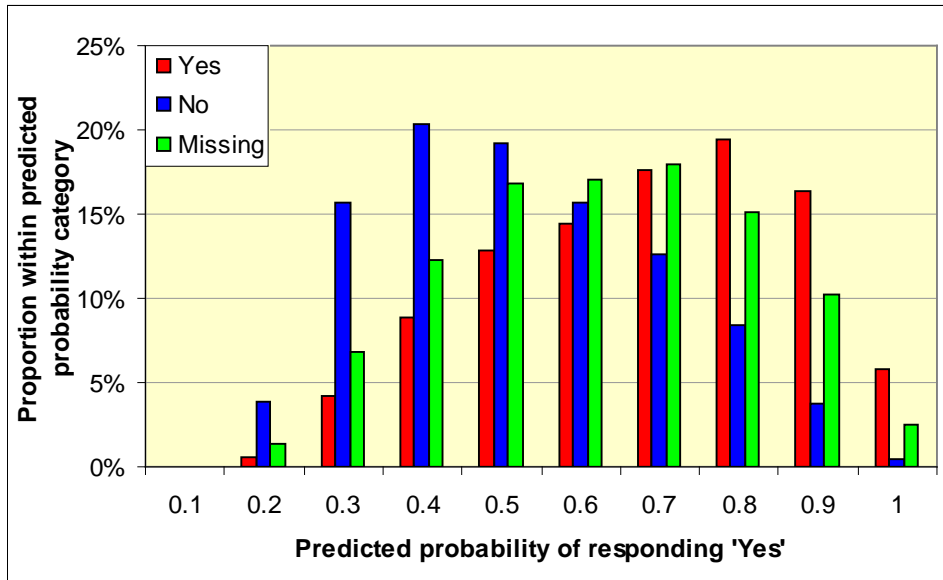
Panel B. Variable ‘supporting_return’



Panel C. Variable ‘managers_involvement’



Panel D. Variable ‘info_used’



Looking at variable on 'info_used', for example, one can see that for 20% of those answering 'No' in reality predicted probability on answering 'Yes' is up to 0.3. Note, incidentally, that among those answering 'No' in reality only a very small minority have predicted probability of answering 'Yes' at the level of 0.9. On the other hand, only 5% of those answering 'Yes' in reality had predicted probability on answering 'Yes' below 0.3 threshold. For those with missing information, 8% had predicted probability on answering 'Yes' below 0.3-a figure situated in a range of 5%-20%.

Thus, the patterns observed in Figure 7 suggest that 'missingness' in measures of OSH risks in this dataset is not a signal of bad performance in terms of management of risks. Predicted probabilities of responding 'Yes' for missing categories are principally in-between 'Yes' and 'No' categories of original variables.

2. Appendix B: Approach to literature review

The review of literature in this report was not comprehensive or exhaustive. As a first step in identifying literature, we used personal networks and contacts with topic experts at RAND Europe, the RAND Corporation, EU-OSHA, and the Work Foundation to identify any key studies or evaluations written on the issue of occupational safety and health, the problem of occupational safety and health, and the effective management of occupational safety and health. As a second step, we used a number of keyword searches using Google, GoogleScholar, and the RAND Library. As this was not a systematic review, we did not capture the exact permutations of keywords used. For instance, searches were based on keywords combinations such as: 'occupational safety and health' and 'effect'; 'management' and 'occupational safety and health'; 'cost' and 'occupational safety and health'; 'occupational safety and health' and 'public health' and different permutations of these keywords. The review typically looked at the first 50-100 hits. As a third step, the reference section of documents was used to identify further documents. Studies were included if they gave information (empirical or at times theoretical) on the problem of psychosocial risks, effective ways of managing psychosocial risks. The decision to include was based on the authors' judgment based on experience of working in this topic area. The report did not devise criteria or a scoring system to guide the inclusion of literature.