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Differences in occupational health and safety efforts between adopters and non-adopters of certified occupational health and safety management systems

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ABSTRACT

Certified occupational health and safety management systems (COHSMSs) continue to grow in popularity and to diffuse to new industries. This study investigated differences in occupational health and safety efforts between adopters and non-adopters of COHSMSs. We used cross-sectional survey data from 4,202 Danish workplaces from all sectors to compare self-reported occupational health and safety efforts in workplaces with a COHSMS and workplaces without a COHSMS. The 'systematic process-related OHS efforts' and 'content-related OHS efforts' were scored on five and seven scales, respectively, for both adopters and non-adopters. The results of linear regression analysis revealed significantly lower score values for non-adopters than for adopters of COHSMSs, which means certified workplaces perform better than non-certified workplaces in both process-related and content-related OHS activities. We conclude that COHSMSs workplaces have a higher overall level of efforts for both process and content OHS activities. The study therefore supports the assumption that COHSMS adopters provide a higher level of OHS management than non-adopters, and that using the company's OHS performance as merely 'window dressing' is not a general feature of adopters. However, the results also indicate that a small group of COHSMS adopters has a considerably lower level of OHS effort than non-adopters, which implies that the certification system does not necessarily secure a high level of OHS management for all adopters. Furthermore, a small group of adopters have high process activities and low content activities, suggesting a decoupling between the systematic OHS processes and the specific preventive activities in the workplace, which could be a sign of window dressing. Further research is needed to establish the possible effects on health and safety outcomes, such as lost-time injuries.

1. Introduction

Certified occupational health and safety management systems (COHSMSs) continue to grow in popularity and to diffuse to new industries (Lafuente and Abad, 2018). Over the last decade, the OHSAS 18001 standard has been adopted globally by organizations as different as Danish municipal workplaces (Jespersen et al., 2016), US metalworks (Pagell et al., 2014), and Iranian consumer goods manufacturing companies (Ghahramani, 2016).

This development is expected to be strengthened by the publication of the ISO 45001 standard – the first ISO-standard on occupational health and safety (OHS) management. But with COHSMSs becoming institutionalized as a standard operating procedure in organizations across the world, how effective these systems really are, has become an important question for authorities, companies, and researchers alike (Heras-Saizarbitoria et al., 2019). The literature is still not conclusive as to whether or not the implementation of COHSMSs improves OHS outcomes in companies. Whereas some studies have shown an overall effect of reducing the number of fines after inspections (Lo et al., 2014), others show no effect on accident outcomes (Heras-Saizarbitoria et al., 2019).

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1.1. Effects of COHSMSs

In their review of OHSMSs Robson et al. (2007) found 13 original studies but only one study was judged to be of high methodological quality and the study concluded that the body of evidence was insufficient to make recommendations either in favour of or against OHSMSs. In the last decade, this lack has been somewhat remedied, although the number of studies is still low compared to studies on the effects of certified management systems in related fields, such as environmental protection or quality management (Heras-Saizarbitoria, 2018). A number of studies show that there are some positive effects from COHSMSs on the health and safety performance of adoptees. Lo et al. (2014) showed in a study of 211 US manufacturers that COHSMS adopters fared better than non-adopters in terms of the relative number of safety violations. Likewise, Abad et al. (2013) could report two positive findings in their study of 149 COHSMS adopters: that accident rates in the companies decreased, and that this rate further decreased with the length of time they held the certificate. A related study (Lafuente and Abad, 2018) showed that a time-dependent 'learning effect' was valid across the various industry groups, but also that the effect on accidents was greater in manufacturing companies than on construction sites or in office settings.

However, there are other studies that find little or no effect of COHSMSs. In their large-scale study of Spanish organizations and companies, Heras-Saizarbitoria et al. (2019) found that COHSMS adopters do not perform better on accident rates than non-adopters. Ghahramani and Summala's (2015) study of Iranian manufacturing companies also shows no effect of COHSMSs.

1.2. Mechanisms of COHSMSs

Even these studies investigated the effects of the adoption of COHSMSs they have not clearly linked the certification process to improved OHS, which leaves the role of the certification process ambiguous in terms of how any effects on health and safety outcomes were brought about.

A realistic review of the scientific literature on the effects of COHSMSs suggests that effects are highly contextual and depend on how systematic OHS practices fit into the overall practice of the adopting companies (Madsen et al., 2020). This is a finding that is mirrored in empirical studies as well (Lafuente and Abad, 2018). The ambiguous evidence for the positive effects of COHSMSs notwithstanding, there is still a lack of knowledge about how the systems work – in particular the relationship between what Øystein Saksvik et al. (2003) call 'processual claims' (such as risk assessments, employee satisfaction surveys, and mandatory top management reviews) and tangible 'content claims' (Øystein Saksvik et al. (2003)). In other words, we still do not know whether the adoption of a management standard for OHS actually leads to more and improved *systematic process-related OHS efforts* that in turn lead to improved *specific content-related OHS efforts*, i.e., implementation of specific preventive OHS measures at the shopfloor.

Taken together, the extant research point to the importance of knowledge on how certified workplaces are actually affected by the certification in relation to their process-related OHS activities and their content-related OHS activities. Also, previous studies have mainly considered the systematic proces-related OHS activities, and to a smaller extent the content-related OHS activities at the workplaces (Hohnen and Hasle, 2011; Jespersen et al., 2016).

The present study seeks to open this black box and bridge these gaps in the literature, by investigating whether COHSMSs lead to changes in both process-related and content-related OHS activities in the workplace. Knowledge about the impact of the mechanisms inherent in COHSM on a workplace's OHS activities is an important link in the understanding of whether and how these mechanisms lead to positive outcomes, such as reducing occupational injuries. Until now, most comparative studies on COHSMSs have studied the difference between adopters and non-adopters regarding various health and safety outcomes. Our contribution to the literature is to investigate whether health and safety practices are on a higher level in organizations that have adopted COHSMSs compared to non-adopters, both in terms of more systematic process-related OHS efforts and the subsequent implementation of tangible preventive measures in the workplace, i.e., content-related OHS efforts.

1.3. The programme theory of COHSMSs

It is reasoned by providers of OHS standards (see e.g. the foreword to the Danish edition of OHSAS18001 (DS, 2010)) that companies by implementing COHSMSs, are ensured compliance with legal requirements across their extended organizations as well as integration of OHS into the operational tasks. In its most basic form, the programme theory behind COHSMSs consists of four steps (Madsen et al., 2020): 1) The process of certification will lead the company, with the help of external auditors, to uncover systems and processes that are not up to standard. 2) This will lead the company to improve these systems and processes, such as strengthened management involvement, active participation of employees, and systematic risk assessment, which in turn will lead to 3) the improvement of the actual preventive control measures, such as noise reduction, fall protection, and safety instructions. 4) The outcome will be improved OHS performance, such as reduction of occupational injuries (see Fig. 1). To ensure that a COHSMS is implemented in practice, compliance with the process is verified by third-party auditors.

However, as we have described in the introduction, most studies of the effect of COHSMSs leap directly from Step 1 to Step 4, rendering the actual mechanisms in Steps 2 and 3 as analytical 'black boxes' (Pawson and Tilley, 1997). Yet, from a previous review (Madsen et al., 2020) we identified that these various mechanisms play an important role for the COHSMSs to successfully improve OHS. This includes the following mechanisms: how well the OHS system is integrated with other business activities ('integration of OHS'); the capability to organize and build up knowledge ('organisation of OHS'); the priority and engagement of the top management and line managers in OHS activities ('prioritisation of OHS'); how the OHS systems is tailored to the organization's needs ('translation and adaptation'); and finally focused priorities to ensure that policies and procedures are translated into practical preventive activities ('attention', in the sense of attention to the practical implementation of OHS efforts).

Although these basic mechanisms in the operation of COHSMSs are generally well understood, there is still a lack of empirical studies on the extent to which these mechanisms to a higher degree are present at workplaces that have adopted a COHSMS compared to non-adopters of COHSMSs. Following Fig. 1, we divide the OSH management efforts into process-related OSH efforts (Step 2) and content-related OHS efforts (Step 3).

1.4. Process-related OHS management

Process-related OHS efforts are by their nature non-specific with regard to particular risks or hazards at work, in much the same way as is quality management (Frick and Wren, 2000). Process-related OHS activities denote efforts to monitor workplaces and organizations, and thereby identify possible hazards for workers' health and safety. Bluff (2003) suggests that these efforts consist of a number of related activities, such as 'integration of OHSM' into other business activities, 'management commitment', 'OHS policy', 'planning and resourcing of OHS management', 'designation of responsibility and mechanisms of accountability', 'procedures and documentation', 'risk management', 'worker participation', 'development of OHS competency', 'reporting', 'investigating and correcting deficiencies', and 'monitoring, auditing and reviewing OHS performance' (Bluff, 2003, p. 7). These related activities are well in accordance with the mechanism identified in the

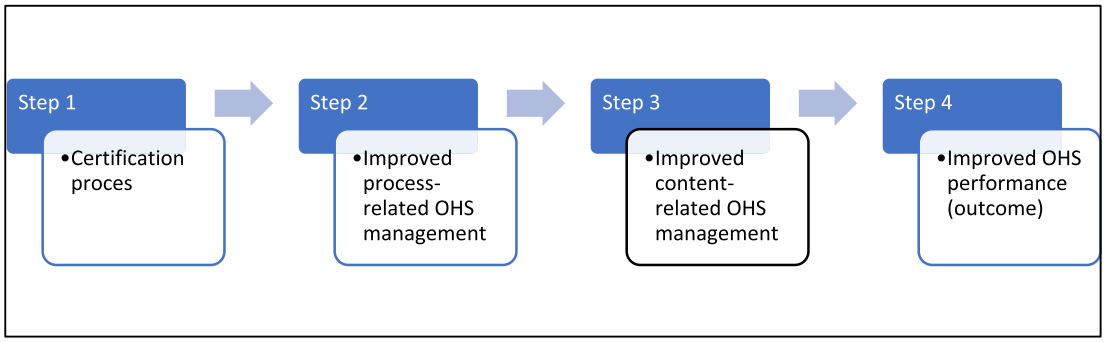

Fig. 1. Programme theory of COHSMSs effects.

realistic evaluation of COHSMSs, as mentioned previously (Madsen et al., 2020).

We might assume that adopters of COHSMSs will outperform non-adopters in implementing process-related OHS management activities, and thereby empirically support a confirmation of the programme theory.

1.5. Content-related OHS management

Content-related OHS management covers the tangible control measures that usually follow a risk assessment (a process activity), which has considered something hazardous in an organization. Such concrete and practical control measures can be as diverse as adjustment of working height and design of workstations to avoid hazardous work postures in manufacturing settings, the replacement of ladders with scaffolding in the construction industry or preventing conflicts and bullying in an office community. Companies across different industries have to deal with very different work environment problems, but the general characteristic of content-related OHS management is that it covers the implementation of tangible control measures, such as changes in work procedures or the establishment of barriers to reduce hazardous exposures. A logical consequence of systematic process-related efforts is that the certified workplaces will show better performance of this step in terms of implementing control measures.

Importantly for the present paper, only two studies have compared adopters and non-adopters of COHSMSs to examine whether adopters have actually implemented OHS efforts to a greater extent in comparison with non-adopters. Ghahramani and Summala (2015) investigated OHS management practices in three adopters and three non-adopters of COHSMSs in power, oil and gas facilities in Iran. They found that adopters were more likely to enforce OHS rules and procedures than non-adopters, and the level of safety training was also higher among adopters. Furthermore, the study showed a significant positive difference for most of the 44 key performance indicators included. A study of safety management practices and safety behaviour in eight chemical manufacturing plants in India's Kerala province by Vinodkumar and Bhasi (2011) showed a significant difference between certified and non-certified companies in terms of safety management activities. The certified companies performed better on training, management commitment, communication, rules and procedures, promotion policies and workers involvement in safety related matters.

However, both studies have rather small sample sizes, evaluate key performance indicators based on single item (question) without scale validations, and were limited to larger enterprises in the chemical industry with a risk of major accidents. In the present study, we seek to open the black box concerning the difference in OHS activities between COHSMS adopters and non-adopters across the key sectors of society.

2. Material and methods

The overall design compares non-adopters of COHSMSs with adopters of COHSMSs to see whether the latter performs better in terms of process-related OHS efforts and content-related OHS efforts. We used a national questionnaire 'Work Environment Activities in Danish Workplaces' (WEADW) to evaluate OHS efforts at workplace level (Thorsen et al., 2017). The questionnaire was administered to both adopters and non-adopters of COHSMSs.

To identify adopters of COHSMSs we obtained a register including all workplaces registered with a COHSMS by 9 April 2018 from the Danish Working Environment Authority (WEA). This list included the Central Business Register numbers for both the main company and for its local workplace(s), allowing us to obtain information on company name, size, and addresses at workplace level from the Central Business Register in Denmark. We consider this list to be rather complete, as workplaces with a COHSMS was exempted from a visit from the Labour Inspectorate and furthermore, workplaces were listed with a 'Smiley' on the homepage of the WEA, indicating good OHS performance.

The register of COHSMS adopters also provides information on the status of the certificate for each workplace (the company's local units) in a company. A third-party certification body checks the status of the implementation of a COHSMS during the audit process, as set out in the legislation and/or in the terms and conditions applicable to obtaining a certificate. Workplaces are excluded from the study if they have not passed this audit process or if they for other reasons do not have an active certificate in the study period.

The questionnaire was sent to all workplaces in Denmark that were registered with a COHSMS (N = 2596) conforming to Danish law. However, only those workplaces that answered 'Yes' to a question about whether the company had an OHS committee (n = 630) were included in the analyses (Table 1). By Danish law all companies with 35 or more employees are required to have an OHS committee. The questionnaires were send to one employee representative and one employer representative at each workplace. If we received two answers from a workplace, i.e., both an employer and employee questionnaire, we took the average value unless the question was a 'yes'/'no' question, in which case a 'yes' overruled a 'no'.

The comparison group of non-adopters consists of a stratified sample of workplaces in 108 strata to ensure comparability (N = 8100), as there are far more small than large workplaces in Denmark, and the distribution by size differs greatly in the various sectors. In each stratum, the workplaces were randomly selected from the Central Business Register by size (workplaces with 1–9 employees, 10–34 employees, 35 or more employees) and industry group (36 different groups). The distribution of workplaces within industry groups and within workplace size groups is relatively similar, for adopters and non-adopters of COHSMS, respectively (Table 1).

The average response rate for all workplace sizes is 46% and the average response rate for workplaces with 35 or more employees is 65%, where the latter represent the workplace sizes included in the present study. To establish a comparison group of non-adopters of COHSMSs we excluded adopters of COHSMSs from the stratified random sample and kept the remaining (about 90%) workplaces, which have not adopted

Table 1
The number of worksites included for each industry group and for each size group of workplaces and the percentage distribution, for adopters and non-adopters of COHSMS, respectively.

COHSMS status	**Adopters** N = 630		**Non-adopters** N = 1917	
Industrial main groups:	**N**	**%**	**N**	**%**
Construction	46	7%	111	6%
Trade	18	3%	91	5%
Manufacturing industry	150	24%	499	26%
Office and communication	56	9%	154	8%
Agriculture and food	26	4%	156	8%
Public service	37	6%	191	10%
Private service	32	5%	147	8%
Transport	58	9%	93	5%
Social and health	167	27%	301	16%
Teaching and research	40	6%	174	9%
		100%		100%
Workplace size groups:	**N**	**%**	**N**	**%**
employees 1–9	11	2%	113	6%
employees 10–34	205	33%	653	34%
employees 35–99	215	34%	792	41%
employees 100–249	126	20%	258	13%
employees 250–499	42	7%	60	3%
employees 500 or more	31	5%	41	2%
	630	100%	1917	100%

COHSMSs (non-adopters), as the comparison group (N = 7543). Also in this sample we only included those that answered 'Yes' to a question about whether the company had an OHS committee (n = 1917) (Fig. 2).

The responses for the stratified sample were collected between late 2017 and mid-2018, and the responses from the COHSMSs group were collected mid-2018.

2.1. Development of scales to measure workplace OHS efforts

We developed 12 scales for the OHS efforts related to process-related OHS efforts and content-related OHS efforts by use of exploratory factor analysis (EFA) of the data from the stratified WEADW 2017 survey.

First, we identified 84 questionnaire items related to workplace OHS efforts from the WEADW questionnaire on the basis of the OHS management literature (Bluff, 2003; Frick et al., 2000; Saksvik and Quinlan, 2003). Then we divided these items into process-related and content-related questionnaire items, and within each of these two groups of questions we established scales based on their loadings on relevant factors by use of the EFA. These factors (indicators) are well in accordance with the five important mechanisms for successfully improving the OHS, that was identified in a previous study (Madsen et al., 2020): Prioritization of OHS ('*Commitment*'); Integration of OHS with management activities ('*integrative aspect*'); Organisation of OHS ('*organisational learning*'); Work Place Assessment ('*Translation and adaptation*'); The seven indicators for content-related OHS efforts, i.e., actual preventive activities ('*attention*').

This led to the construction of 12 scales, five process-related and seven content-related scales. They were Likert scale questions scored as 1, 2, 3, etc. from lowest to highest answer category, apart from questions about work place assessment, where only yes/no response categories were available. 'Not relevant' and 'do not know' were scored respectively as 'missing' and as 'no'. We tested the internal consistency of the scales using Cronbach's alpha, which was 0.7 or higher for ten of the 12 scales, indicating high internal consistency. The remaining two scales (Organization of OHS and Efforts to prevent accidents) showed a Cronbach's alpha above 0.6, indicating moderate, but still acceptable, internal consistency.

2.2. Scoring of OHS efforts scales

In order to evaluate the level of OHS efforts in adopters and non-adopters of COHSMSs, we scored questions on a Likert scale from lowest to highest answer category where the scores ranged from 0 to 100 points. 'Do not know' was scored as 'no', that is the lowest category, and 'not relevant' was set as 'missing'. The exceptions were the questions in the OHS efforts scales, '4. Work Place Assessment (WPA) for psychosocial and physical risks' and '5. WPA for chemical risks', which were scored as 'Yes'=100, 'No'=0, 'Do not know'=0, and the questions in the OHS efforts scales '10. Efforts to reduce threats and emotional demands' and '11. Efforts to reduce physical risks', where the answer category, 'The workplace does not have any workers this is relevant for', was scored as a 'No'=0.

We scored the 12 scales as the average score of the respective questions in the scale if half of the questions in the scale were answered. Furthermore, we prepared two overall scales, aggregating scales 1–5 into one scale for process-related OHS efforts, and scales 6–12 into one scale for content-related OHS efforts. The overall scales were calculated if answers to at least half of the sub-scales were present.

2.3. Covariates

We adjusted for the following covariates: industry group (10 groups) and the size of the workplace as number of full-time employees. Both industry group and number of employees were taken from national registers (Statistics Denmark). We also controlled for whether it was an employee or an employer representative, or both, who answered the questionnaire for the workplaces.

2.4. Statistical analyses

All analyses were performed using SAS 9.4. We performed exploratory factor analysis using both unweighted least squares as the extraction method and principal component analysis with oblique rotation of the factors to construct the scales for the present study using 'proc factor' from SAS (Joliffe and Morgan, 1992; Osborne and Banjanovic, 2016). We provide descriptive statistics of the mean value of the OHS efforts scales for COHSMS adopters and non-adopters respectively. We divided the two 'overall' scales (process-related OHS efforts, content-related OHS efforts) along their 40th percentile from the non-adopters' dataset to make a cross-table.

By visual inspection, we examined the distribution of all OHS scales. The 12 individual sub-scales had small or large deviations from a normal distribution, the two overall scales, 'process-related OHS' efforts and 'Content-related OHS' efforts, were normally distributed. We therefore used a non-parametric (Mann-Whitney-Wilcoxon) test to examine if each OHS sub-scale was different between COHSMS adopters and non-adopters. We used a parametric student's *t*-test, with unequal variances for the overall scales. We used unequal, since the variance of COHSMS adopters were smaller than non-adopters. We divided the data up on 10 different industrial sectors (10 different analyses for each scale). Last, we examined if the COHSMS adopters compared to non-adopters had higher scores on process-related OHS efforts and content-related OHS efforts adjusted for industrial sector and number of employees by using general linear regression with the GLM procedure in SAS 9.4. Industrial sector was included as a categorical variable and number of employees as an interval variable.

3. Results

Adopters of COHSMSs have significantly higher scores on 10 of the 12 scales (Table 2). There is a tendency for adopters to perform particular well on process-related efforts, which could be expected as this is the basic requirement in a COHSMS. With controls for size and sector differences, the scale values for processual OHS efforts are overall

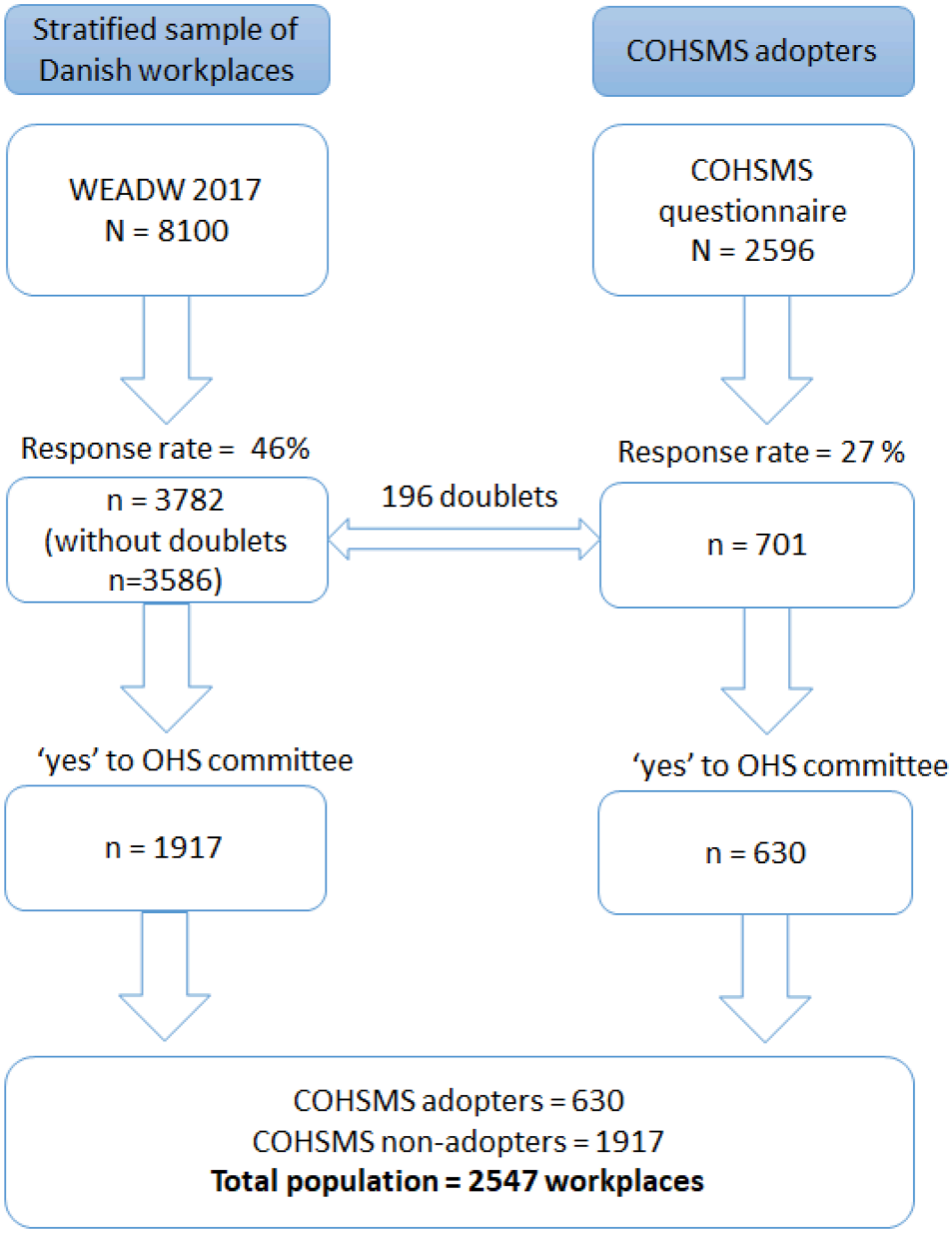

Fig. 2. Study populations and data collection.

significantly higher among adopters than non-adopters for the combined scales and for three out of five of the specific scales. In particular, the integration of work environment activities with other management activities is clearly greater in adopters than in non-adopters, indicating that the certification process helps the workplaces to integrate the OHS efforts into the management system.

However, the differences between adopters and non-adopters were not significant for the two scales for WPA. It can also be an artefact, as this questions was not a Likert scale but only a yes/no answer category, and therefore difficult to discriminate various levels of performance.

The mean difference between adopters and non-adopters is found across almost all main sectors in society for both process-related OHS efforts and content-related OHS efforts (Table 3). The difference is significant with the exception of Trade on both the combined scales and Construction and Public Service for the content-related OHS efforts.

The linear regression analysis shows that with controls for workplace size and sector differences, the scale values for both process-related OHS efforts and for the specific preventive OHS efforts are overall significantly higher among adopters of COHSMSs compared to non-adopters (Table 4).

Certification with third-party verification is expected to ensure that all adopters maintain a high level of both systematic and preventive effort. The scatter plots in Fig. 3 confirm that most adopters have a high level on both scales, whereas non-adopters are distributed more widely on both scales. However, a smaller group of adopters are low on either both general scales or low on one of the two general scales, and thus have a performance lower than the 40th percentile of non– adopters.

Both Table 4 and the scatter plots in Fig. 3 show that adopters do better than the average non-adopter. In Table 5, we use the 40th percentile of the non-adopters to show how adopters and non-adopters are distributed on low/high for both process-related OHS efforts and content-related OHS efforts. The table shows most adopters have a high performance on both process-related and content-related OHS efforts, and a small fraction have a low performance on both scales, indicating that they might be examples of adopters that adopted COHSMSs for ceremonial reasons. A group of approximately 25 pct. (9.52% + 14,76%) of the workplaces scored low on one of the two scales, but interestingly with a relatively higher scores for process-related OHS

Table 2
Comparison of mean score values for adopters and non-adopters.

Scale		Adopters Mean value	SD	Non-Adopters Mean value	SD	Difference Adopters-Non adopters	P-value
	Process-related OHS efforts						
1.	Prioritization of OHS activities	83.1	18,4	75.7	19,4	7.3	<0.0001
2.	Integration of OHS in management and operations	86.8	19,3	60.1	32,5	26.7	<0.0001
3.	Organization of OHS	93.3	17,8	82.3	28	11	<0.0001
4.	WPA for psycho-social and physical risks	73.4	26,8	72.8	28	0.6	0.4372
5.	WPA for chemical risks	23.8	32,4	24.5	31,5	−0.7	0.1444
	Process-related OHS efforts (overall scale)	72.1	14,3	63.1	17	9	<0.0001
	Content-related OHS efforts						
6.	Safety guidance and instruction	83.5	17,9	74.3	22,1	9.2	<0.0001
7.	Efforts to prevent accidents	80.7	18,5	71.9	22,2	8.8	<0.0001
8.	Psycho-social prevention efforts	61.8	12,4	58.4	13,8	3.4	<0.0001
9.	Efforts to reduce conflicts and bullying	65.3	32,8	58.5	33,7	6.8	<0.0001
10.	Efforts to reduce threats and emotional demands	43.3	38,5	34.6	36,7	8.7	<0.0001
11.	Efforts to reduce physical risks	55.3	32,3	45.3	32,8	10	<0.0001
12.	Efforts to reduce chemical risks	50.3	32,3	44.3	32,3	6	0.0027
	Content-related OHS efforts (overall scale)	63.9	14,8	56.1	16,2	7.8	<0.0001

Note: The standard deviation (SD), the mean difference, and significance of difference (P-value). P-value is calculated by the non-parametric Mann-Whitney-Wilcoxon test (several sub-scales are not normally distributed).

Table 3
Comparison of mean score values for adopters and non-adopters distributed across main sectors.

Sector	Adopters Mean value	SD	Non-adopters Mean value	SD	Difference Adopters-Non adopters	P value
Process-related OHS efforts						
Construction	77.3	11,7	66.1	18,8	11.2	<0.0001
Trade	68.9	7,8	62.8	17,2	6.1	0.0212
Manufacturing industry	76.1	15,1	63.9	17,4	12.1	<0.0001
Office and communication	72.3	12,3	55.2	16,2	17.1	<0.0001
Agriculture and food	75.9	13,7	67	17,9	8.9	0.0055
Public service	71.1	16,6	64	16,2	7.1	0.0210
Private service	76	16,6	62.8	18,6	13.2	0.0002
Transport	68.2	13,1	58.8	14,8	9.4	<0.0001
Social and health	68.2	13,4	63.8	15,3	4.4	0.0015
Teaching and research	70.4	15,2	62.6	15,6	7.8	0.0050
Content-related OHS efforts						
Construction	60.2	15,8	56.1	17,3	4.1	0.1530
Trade	62.7	11,4	56.6	15,6	6.1	0.0615
Manufacturing industry	64	12,9	55.9	15,2	8.1	<0.0001
Office and communication	61.4	15,6	45.2	16,1	16.3	<0.0001
Agriculture and food	62.7	10,3	55.6	14,7	7.1	0.0042
Public service	60.1	17,1	57.8	14,9	2.3	0.4476
Private service	67.1	15,6	57.1	17,3	10	0.0022
Transport	66.4	14,7	55.2	16,6	11.3	<0.0001
Social and health	65.8	15,7	62.2	15,8	3.7	0.0163
Teaching and research	61.7	15,6	53.5	15,4	8.2	0.0038

The standard deviation (SD), the mean difference, and significance of difference (P-value). P-value is calculated by the parametric student's *t*-test (unequal variances).

Table 4
Linear regression of the association between score values and adopters/non-adopters adjusted for sector and number of employees at the workplace.

Scale	Estimate	95% CI	P value
Process-related OHS efforts (overall scale)	9.3	[7.82–10.78]	<0.0001
Content-related OHS efforts (overall scale)	7.34	[5.92–8.77]	<0.0001

The p-value is calculated based on a t-distribution.

efforts but conversely lower scores for content-related OHS efforts. There is thus a group of adopters, who do well on the process-related OHS efforts, but who do not follow up with content-related OHS efforts to the same extent.

4. Discussion

The results support the program theory for yielding positive effects of COHSMSs as the regression analyses show that workplaces that have adopted COHSMSs, overall perform better compared to non-adopters of COHSMSs, in terms of both process-related and content-related OHS efforts. Furthermore, for ten of the twelve subscales included in the analyses, adopters of COHSMSs perform better (had higher scores) compared to non-adopters. When comparing the mean scores for both process-related and content-related OHS efforts, the results show that the adopters performs better than non-adopters in most industrial sectors.

The five key mechanisms that enables COHSMSs to function efficiently described in the OHS literature (Madsen et al., 2020) are supported by our findings. In particular the indicator 'integration of OHS in management and operations' (the 'integrative aspect' mechanism)

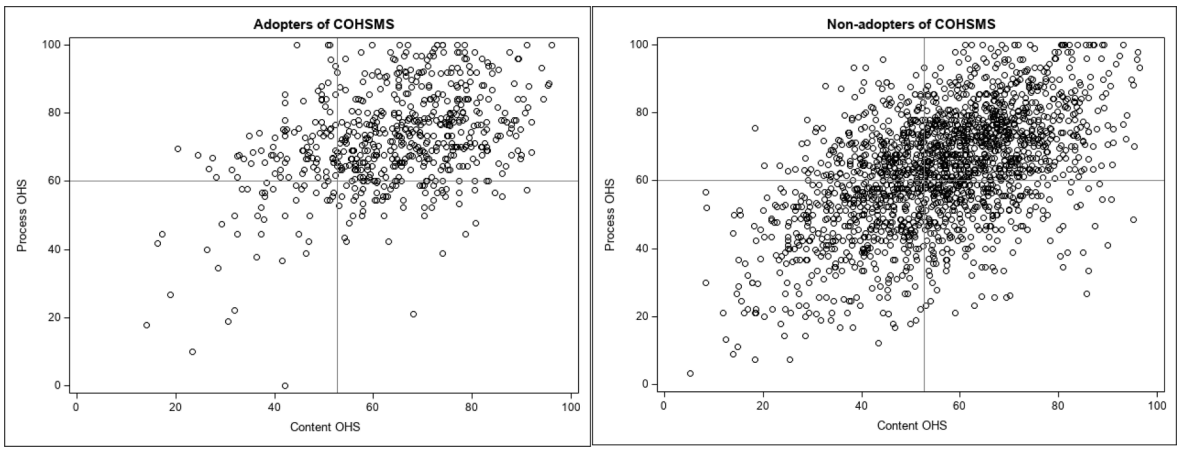

Fig. 3. Scatter plots of adopters and non-adopters distributed on the two general scales. Cross-hairs indicate the 40th percentile among non-adopters of COHSMSs of respectively the systematic OHS process-scale and specific preventive OHS effort-scale.

Table 5
The cut-points for the division in high and low for the two scales are set as the 40th percentile based on the scales' distribution among Non-adopters.

		Adopters		Non-adopters	
		Content-related OHS efforts			
	%	Low	High	Low	High
Process-related OHS efforts	Low	6.51	9.52	24.67	15.28
	High	14.76	69.21	15.28	44.76

shows significantly higher scores for adopters compared to non-adopters. This indicates that adopters integrate OHS efforts with other business activities to a much greater extent than non-adopters. Adopters also score higher on 'prioritisation of OHS activities' ('commitment' mechanism) and 'organisation of OHS' ('organisational learning' mechanism) compared to non-adopters.

For the two WPA indicators (related to the 'translation and adaptation mechanism') representing risk assessment of 'psychosocial and physical risks' and of 'chemical risks', respectively, the differences are small and non-significant. We assume that the latter reflects that WPA is a basic legal requirement in Denmark, which is relatively easy and unambiguous to enforce for the authorities, and thus contributes to a high degree of compliance for most of the larger companies, regardless of certification status. It can also be related to an artefact, as we only use yes/no for these scales.

In terms of content-related work environment efforts, we include seven indicators that focus on the extent to which prioritised policies and procedures are translated into practical prevention activities ('attention mechanism'). For all of the content-related OHS efforts, the COHSMS adopters have a significantly higher score, and thus indicate that adopters to a higher degree translate policies and procedures into practical preventive OHS efforts. This mechanism works through the resources of audits and management reviews, which direct stakeholders to focus on particular OHS elements, pertinent to the risk assessment activities (WPA indicators).

It has been highlighted in the scientific literature that psychosocial risk factors are not very well captured by certification systems, such as OHSAS18001, and that the psychosocial risks factors might be unfamiliar to the auditors and thus are more difficult for auditors to assess compared to other risk factors, such as accidental risks (Hohnen and Hasle, 2011; Jespersen et al., 2016). According to this, there could be a risk that certification systems contribute to workplaces downgrading their focus on specific important risk factors, such as the psychosocial risk factors. However, our results do not indicate that adopters have less focus on the psychosocial risk factors, but on the contrary, our results show that adopters give higher priority to psychosocial prevention efforts, as well as more specific efforts aimed at reducing conflicts and bullying in the workplace and efforts to reduce threats and emotional demands at work.

Our data is cross-sectional, and we are therefore unable to draw firm conclusions about the causality of adopting COHSMSs and a subsequent increase in the performance of OHS activities. Nevertheless, the results confirm the expectation that certification would correlate with higher performance on both systematic process-related and content-related OHS efforts. Our study therefore helps explain the causal mechanisms behind earlier results (Lafuente and Abad, 2018; Lo et al., 2014), which show that certification leads to better OHS outcomes. In other words, the certified companies are better at systematically monitoring risks and having updated policies in place when it comes to, for instance, machinery and other workplace equipment, and in turn translate this into content-related OSH efforts.

It is to be expected even for adopters of COHSMSs that the performance on both systematic and preventive efforts will have a normal distribution, but certification with third-party verification ought to ensure that the really bad performers are either corrected or have their certificates suspended. It is therefore surprising that our results indicate that there exists a small group of companies that perform as badly as the poorest performers among the non-adopters. This finding suggests that the audit verification system is not able to identify and remedy all bad performers.

We cannot provide a firm explanation for this outcome but the literature points towards so-called 'window dressing' (Blewett and O'Keeffe, 2011; Brunsson et al., 2012; Rocha and Granerud, 2011) and 'bureaucratization' as risks in the application of COHSMSs. Window dressing implies that companies adopt programmes to appear legitimate in the eyes of customers, regulators, and competitors (Heras-Saizarbitoria et al., 2013). It has furthermore been argued that such adoption of COHSMSs purely for legitimacy reasons leads to a decoupling of COHSMSs from the central decisions and strategies in the adopting companies (Hasle et al., 2021), resulting in very small, if any at all, effects on the actual OHS practices in the companies.

Notwithstanding the methodological limitations of cross-sectional studies, the results from this study can refute the window dressing assumptions to some extent as the large majority of adopters perform considerable better than non-adopters. If window dressing was the dominant factor, there would not be significant differences between certified and non-certified companies on preventive OHS efforts. Our study therefore does not support the findings of Heras-Saizarbitoria et al. (2019), which indicated that the search for legitimacy is a dominant feature among certified companies. On the contrary, our study suggests that adopters of COHSMSs seem to have a higher level of both process-

related and content-related OHS efforts compared to non-adopters, and that adopting OHSMS is an indicator of a high level of OHS activities, and thereby provide a useful tool for companies to improve their OHS activities.

However, while the large majority of certified companies perform better than the non-adopters, our results do show that a small fraction performs poorly. While it is not possible from the data to assess to what extent certification requirements are fulfilled, it seems likely that the 6.5% of adopters (the same percentage is 25 % for non-adopters) performing at a low level for both systematic and preventive efforts will have problems with certification compliance. Furthermore, 15% perform at a high level on systematic processes, but at a low level on content-related OHS efforts. These results support a tendency to decoupling in practice where companies either generally have a low level of OHS management or make up 'paper work' that does not support tangible preventive efforts. While we cannot draw any conclusions about motives from our data, the results do suggest a decoupling between the certificate and practice in this small group of companies, and an element of window dressing to look legitimate is a likely explanation for a least some of this behaviour.

Another part of the explanation for the low performance in some workplaces on content-related OHS efforts may relate to the criticism of certification for being bureaucratic and superfluous when it comes to tangible control of risks in the companies. Some sources criticize a general tendency towards bureaucratization in OHS-management (Dekker, 2014), claiming that systematization creates 'number games' and shifts focus to known and expected patterns in health and safety, which prevents bureaucratized organizations from reacting to unexpected incidents or to multi-factor issues that do not fit the dominant understanding of OHS (Madsen and Hasle, 2017; Nielsen, 2000). This echoes a widespread view on certifications and systems pointing out that only visible and 'auditable' incidents and factors are identified and prevented (Power, 1997). This perspective has inspired studies that describe how complex risks such as psychosocial factors affecting well-being were not being detected and prevented adequately by certified management systems (Hohnen et al., 2014; Hohnen and Hasle, 2011).

Bureaucratization does generally not seem to be a problem as the great majority of adopters perform better on both process and content-related OHS efforts. Yet, the results show that for a small group of workplaces there might be a decoupling between the systematic processes and the practical preventive efforts. While this will not be considered a problem in a majority of companies with fairly well-functioning organizations, the problem can arise if the adopting company does not possess the capabilities to run a systematic organization to begin with and/or focuses more on signals to external stakeholders than the internal outcomes of the management system.

4.1. Implications for practice

Our study has three major implications for practitioners. First of all, while the majority of certified workplaces actually do quite well both in terms of content and process OHS activities, we can see that there is still room for improvement. It is important that OHS-professionals and managers in certified companies make sure they follow up on the risk assessments and ensure that the actual preventive activities identified through the risk assessment, are implemented. The results of the study suggest that there are some certified workplaces where this is not the case. Secondly, certification bodies and their auditors need to be aware that there are some certified workplaces who have a very low OHS performance, and that it is the responsibility of the auditors to identify and remedy this problem. Thirdly, the tendency to include COHSMSs in national legislation implies that law makers and regulatory agents should pay attention to poorly performing certified companies and develop tools and processes to find the 'bad apples'.

4.2. Implications for future research

This study also indicates four distinct future avenues of research, which can further enhance our understanding of the effects of COHSMSs on OHS performance and management.

Further research is needed on the causality in the relationship between certification and improved OHS management activities. It is important for future research to apply longitudinal data from certified companies to establish whether they improve their OHS activities over time or whether workplaces that adopt COHSMSs simply have a higher performance when first certified. A related factor is whether certification can provide continuous improvements or the effect of a COHSMS wanes after fixing 'low-hanging fruits' in terms of OHS issues. Only research that has access to historical or prospective follow-up data on OHS activities from a large group of companies will be able to answer these questions.

Furthermore, it is important to establish whether the stronger management performance of certified companies also means that actual OHS outcomes improve in certified companies. Have the risks of accidents, fatal accidents, and lost workdays due to occupational health problems actually been reduced in these companies over time since certification?

An avenue for future studies would also be to gain a deeper understanding of the reasons some companies are more successful than others in implementing COHSMSs. Are there any patterns in the mechanisms applied that make some companies successful with COHSMSs while others fall into the decoupling trap? This would be a question of interest to practitioners and regulators alike, as certification plays an increasing role in supplier selection, tenders, and regulatory schemes across Europe. This avenue of research should also study the integration with other management systems in particular ISO 9001 and ISO 14001. A new line of research is increasingly pointing towards the advantages for application of integrated systems (Wilkinson & Dale, 1999; Kauppila et al., 2015).

Finally, earlier literature suggested that OHS management would have a positive impact on economic performance (Pagell et al., 2014), so research is needed to confirm this relationship, also with regard to productivity, quality, and the environment. It would be particularly interesting to illuminate the mechanisms behind such positive impacts.

5. Limitations

One limitation of this study was that we used data from an existing national workplace-survey, 'Work Environment Activities in Danish Workplaces' that was not specifically developed to investigate differences between adopters and non-adopters of COHSMSs. Also, the questions in the survey were not designed to capture all elements of systematic OHS management, even though it could capture workplace responses on the most important OHS efforts, which we used to establish scales for the analyses. On certain dimensions only a limited number of questions covered the scale, which can give more uncertain measures of a scale.

Another limitation is that the OHS efforts are self-reported which can introduce some bias in the responses, as workplaces want to indicate that OHS is under control. However, we have used answers from both employer and employee representatives to evaluate OHS at each workplace. We assume that this has alleviated the bias of self-reporting.

Even we excluded workplaces with COHSMSs from the comparison group, some workplaces might use OHSMS without being certified and also using certification systems that are not approved by Danish authorities, but still might work well. However, this would bias our results towards the null, which means that we would see a smaller differences between adopters and non-adopters. For the two scales for WPA (workplace assessment) we only had the answer category yes or no to distinguish between adopters and non-adopters, making it more difficult to discriminate between various levels of adoptions. This will also bias our results towards the null and might be a plausible explanation for not

having a significant difference between adopters and non-adopters for these two scales.

Finally, we have no information on the quality of the implementation of the content-related OHS efforts, and neither the process-related OHS efforts. For this reason, it can be uncertain to what extent that OHS efforts translate into tangible outcomes, such as occupational injuries.

6. Conclusion

This paper contributes to several important aspects of the discussion on the effects of COHSMSs. First of all, the results clearly indicate that COHSMS adopters have a better performance on both process-related OHS effort and content-related OHS efforts, and it is a performance which is found across industrial sectors and workplace sizes. The study thereby is supportive of earlier findings of a positive effect on OHS efforts.

While the superior performance with regard to process-related OHS efforts is to be expected given that COHSMSs are designed to improve these processes, it is even more important that our results show that adopters of COHSMSs also outperform non-adopters in terms of content-related OHS efforts. Furthermore, our results show that COHSMS adopters give higher priority to psychosocial prevention efforts, as well as more specific efforts such as those aimed at reducing threats and emotional demands at work. This is interesting as previous studies have suggested that complex OHS issues, such as psychosocial OHS risks, are deprioritized or simplified by COHSMSs.

Also, we found no support for the frequent criticism that COHSMSs mainly increases paperwork and bureaucracy in safety without improving the quality of the tangible control of OHS risks. While our study seems to refute window dressing and bureaucratization as a general tendency, we did, however, find a small percentage of certified companies where certification generally show low performance for all dimensions of OHS efforts or little or no apparent effect on the level of content-related OHS efforts. There is a small minority of adopters, whose performance is so poor in general that it should have been identified by third-party audits.

With this conclusion, further research is needed to fully capture the effect of COHSMSs and also to find out how the risk of window dressing and bureaucratization can be avoided to a larger extent. For instance, analyses of historical data would be necessary to finally prove a causal link between certification and the quality of activities. And more case studies will be needed to investigate the mechanisms that lead to successful and unsuccessful adopters, respectively.

Credit authorship contribution statement

Christian U. Madsen: Conceptualization, Methodology, Writing - Original draft preparation. **Sannie V. Thorsen:** Data curation, Formal analysis, Writing - Review & Editing. **Peter Hasle:** Conceptualization, Methodology, Writing - Review & Editing, Funding acquisition. **Line L. Laursen:** Data curation, Formal analysis, Comments and Writing - Review & Editing. **Johnny Dyreborg:** Conceptualization, Methodology, Writing- Review & Editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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