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LABOUR INSPECTION AND ITS IMPACT ON ENTERPRISES' COMPLIANCE WITH SAFETY REGULATIONS

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ABSTRACT

A recurring conclusion in accident investigations and analyses, across a range of different industries, is that non-compliance with safety regulations is a significant contributory factor to accidents. Such non-compliance can take place both at the individual level and the organisational level. In recent years, safety researchers have mostly focused on individual non-compliance, its contextual origins, and the relevant measures that can be taken to improve safety compliance among frontline workers. However, few studies have paid attention to organizational compliance or non-compliance with safety regulations and the measures that can be taken to improve compliance at the organizational level. In Norway it is first and foremost the Norwegian Labour Inspection Authority which is responsible for ensuring that enterprises comply with the national safety regulations, such as the Working Environment Act and its accompanying regulations. This is done primarily by on-site inspections of the enterprises. On basis of two field experiments (N=291), which compare inspected versus previously uninspected enterprises, the present paper examines the impact that such control activity has on the enterprises' compliance with national safety regulations. The results of the comparative analyses show that enterprises which have been subject to inspections by the labour inspection authorities exhibit a significantly higher level of compliance with safety regulations compared to enterprises which not have been subject to inspections. These findings are of great importance considering the fact that non-compliance is a common triggering factor of accidents at work. The implications of the findings are discussed here.

1. INTRODUCTION

Accident investigations and analyses across a range of different industries regularly identify non-compliance with safety regulations as a significant contributory factor (Hopkins, 2011). This is not only the case in investigations of occupational accidents with a relatively limited extent of loss, but is also a recurring finding in investigations of major accidents and catastrophes (Hudson et al., 1998). One of the best known examples of this is the Chernobyl catastrophe in 1986, where five of the seven human actions that led directly to the accident were deviations from written procedures (Reason, 1987), and the Piper Alpha disaster two years later where platform managers' safety practices were found to be contributory to the disaster and significantly diverging from written procedures (Wright, 1994). Another well-known example is the BP Texas City refinery explosion in 2005, where an important finding, among others, was that a casual attitude to compliance with safety procedures contributed to the explosion at the refinery (Hopkins, 2009).

As regards occupational and organizational safety, non-compliant acts can be defined as 'deviations from safe operating procedures, standards or rules' (Reason, 1997: 72). Such deviations can take place both at the individual level, in relation to company internal safety procedures, and at the organisational level, in relation to

the national occupational health and safety regulations. In recent years, safety researchers have paid most attention to individual non-compliance among frontline workers, and a considerable amount of research has been conducted with the aim of identifying the antecedents of such unsafe acts and suggesting measures which can be taken in order to improve individual safety compliance (e.g. Antonsen et al., 2008; Clarke, 2006; Dahl and Olsen, 2013; Griffin and Neal, 2000; Kapp, 2012; Kongsvik et al., 2012; Lawton, 1998; Lu and Yang, 2011; Martínez-Córcoles et al., 2011; Mearns et al., 2010; Pedersen and Kines, 2011; Torp and Grøgaard, 2009; Zohar, 2002). A recurring finding in these studies is that non-compliant behaviour not is a random phenomenon (Wagenaar, 1998) that evolves in a vacuum, but is triggered to a large degree by different inadequate organizational conditions, often created by management itself (Alper and Karsh, 2009).

In spite of the substantial amount of research that has been conducted with the aim of identifying the origins of non-compliance at the individual level and effective measures which can be taken to improve individual safety compliance, few studies have paid attention to the organizational level. Thus, few studies have examined why some organizations follow national safety regulations while others do not and few studies have aimed at identifying effective compliance-enhancing measures at the organizational level.

There are, however, some exceptions. For example, Saksvik et al.'s (2003) study of Norwegian companies and Baldock et al.'s (2006) study of British small enterprises, found that poor compliance with safety regulations at the organisational level is a consequence of a limited access to health and safety resources. Hence, factors such as enterprise size, public sector, management training and experience and membership of trade or business associations were found to be positively associated with rule compliance at the organizational level in these studies.

As regards effective compliance-enhancing measures, Baldock et al. (2006) found that enterprises inspected by regulatory authorities (labour inspections) were far more likely to comply with safety regulations, compared to enterprises which not had experienced such inspections. In fact, in their study, inspections on the part of regulatory officials were found to be the variable with the most positive influence on organizational safety compliance. In addition, the study revealed that enterprises which had been controlled by the regulatory authorities' labour inspectorates were more likely to use external assistance in order to improve compliance with health and safety regulations. Hence, the positive impact of labour inspections was found to be indirect as well as direct. On the basis of these findings, Baldock et al. (2006: 844) therefore concluded that an appropriate strategy with regard to enhanced compliance at the enterprise level "would be to provide the resources needed to increase substantially the number of inspections undertaken".

Baldock et al.'s findings in relation to the impact of labour inspections are important because they indicate that public resources spent on control and enforcement within this area actually serve one of its intended key-purposes, namely to improve enterprises' compliance with health and safety requirements. This finding is also supported by some other studies which have looked at a broader set of regulatory instruments (Andersen et al., 2009; Wright et al., 2000).

A limitation of these studies, however (including Baldock et al.'s (2006) own study), is that compliance is measured by the use of self-reported data. This can result in an unintended positive bias. Another limitation is that the cross-sectional design of these studies makes it difficult to establish a sequential cause and effect relationship between the measures imposed by the labour inspectorates and improved compliance. The internal validity of these studies, related to their interpretations of cause and effect, can therefore be discussed. In order to further examine the impact of regulatory authorities' control activity on enterprises' compliance with safety regulations it is therefore necessary for additional investigations which make use of research methods which not are vulnerable to the biases associated with self-reported data. This is what the present study aims to do.

The methodological limitations related to interpretations of causality that are associated with the studies described above are characteristic of social research in general, and there is no widely acknowledged solution to the causality problem in the social sciences (Vedung, 1997). The experimental research design is, however, often pointed out as the research method that is most suitable for producing systematic and robust evidence when examining the effects of different public actions or services in general (Clarke and Dawson, 1999), and has been recommended as an appropriate research methodology for examining the effects of safety interventions (Robson et al., 2001) and labour inspections in particular (Hillage et al., 2001). In order to further examine the effect that labour inspections have on enterprises' compliance with safety regulations, the present study was therefore designed as a field experiment, where compliance was measured by more objective criteria than self-reports and where the researchers fully controlled the independent variable (i.e. labour inspections).

To date, 130 countries have ratified the international Labour Inspection Convention (ILO, 2013). This implies that the majority of countries across the world have implemented a system of labour inspection, under the

control of a central authority, which aims to secure the enforcement of legal provisions relating to health and safety at work. The purpose of the present paper is not to address the multitude of different labour inspection systems, but to focus on one of them; the Norwegian Labour Inspection Authority (NLIA). The control activity which is examined here is on-site inspections of enterprises related to workplace safety (not health or employment conditions), carried out by the NLIA, and the objective of this paper is to examine whether labour inspections carried out by the NLIA have an impact on enterprises' compliance with safety regulations.

The methodological design of the current study allow for a comparative analysis of the level of compliance between inspected versus previously uninspected enterprises. The applied method and specific research hypotheses will be described in detail in section three of this paper, after a section that gives a brief description of the case of NLIA. Section four of the paper presents the empirical results of the study and is followed by a discussion and a conclusion in sections five and six, respectively.

2. BRIEF CASE DESCRIPTION

In general, the overall mission of most labour inspectorates, regardless of country, is to ensure safe and healthy work environments and secure employment conditions, by making sure that the enterprises comply with existing legislation. Within the Norwegian context it is intended to achieve this mission via the application of different instruments, such as inspections, verifications, guidance, information, campaigns and through collaboration with other public authorities like the police, the tax authorities and the environmental authorities. The main instrument, however, is the one that is the focus of this study, namely inspections of enterprises which aim to control and enforce compliance with the national working environment regulations.

The NLIA performs approximately 15.000 workplace inspections per year, and at this activity level the inspectorate covers roughly 7% of all land-based enterprises annually. Some guidance and information is usually offered by the inspectors during an inspection, but when dealing with enterprises that do not comply with the requirements of the Working Environment Act and its accompanying regulations, the NLIA has four different coercive measures available: formal orders, coercive fines (which can be imposed if formal orders are not followed), shutdown of operations and reports to the police. Formal orders, which are written orders to correct eventual violations within a limited time period, represent the most widely applied coercive measure. In 2011 formal orders were given in approximately 60% of all inspections (NLIA, 2012).

The inspections are divided among different priority areas such as work-related musculoskeletal disorders, work-related psychological disorders, social dumping, young workers, chemical hazards and technical safety. In this study, which deals with safety rather than health-related issues or employment conditions, it is important to underline that the effect of inspections was evaluated by addressing the two priority areas that are most clearly related to safety, namely *chemical hazards* and *technical safety*. Hence, priority areas related exclusively to health and employment conditions (such as wages, contracts and working hours) were excluded from this study.[1]

In 2011 roughly 20% of all inspections were performed within the priority area of technical safety, and 17% within the priority area of chemical hazards (NLIA, 2012). Within both of these priority areas the NLIA's focus is on control of some paramount statutory demands, such as appointment of safety representatives, establishment of safety objectives, risk identification, risk analysis and plans of action, but also on some specific statutory demands, such as proper access to personal protective equipment, safe storage of hazardous substances and the technical condition of production facilities. The legal basis for these demands is the *Working Environment Act* and its accompanying regulations such as the *Internal Control Regulations* and the *Regulations concerning Safety Representatives*.

3. METHOD

3.1. The experimental research design

As already described, the present paper is based on a study that applied an experimental research design. Basically, an experiment is a form of research methodology which examines the effect that an independent variable has on a dependent variable, by means of comparing two groups; an experimental group and a control group. Under ideal experimental conditions, assignment to the two groups should be random to assure that they are equal, except that the members of the experimental group are exposed to the independent variable, and the

[1] Separate studies (within other priority areas) related to the impact that labour inspections performed by the NLIA has on enterprises' compliance with health regulations and employment conditions has also been conducted, but is not reported in this paper.

members of the control group are not. Further, both groups should be pre-tested. The independent variable is usually dichotomous (i.e. present or absent, e.g. treatment or no treatment) and is typically under the control of the experimenter. In this model, the experimenter measures observations of changes in the dependent variable when the independent variable is present compared to observations of when it is absent (Clarke and Dawson, 1999).

The upside of the experimental research design is that it provides a high level of causal inference and internal validity. That is, it enables relatively firm conclusions to be drawn with regard to the effect of the independent variable (Babbie, 2010). Within the social sciences, including safety science, true experimental conditions are often difficult to achieve unless the experimental situation is moved to a laboratory or another artificial context. Such a context is, however, normally not desirable because it is necessary for the external validity to study the subjects in their naturally occurring environments (Clarke and Dawson, 1999). Thus, when experimental designs are applied in safety research the pure experimental design is usually replaced with different types of quasi-experimental designs, where some of the characteristics of the true experimental design are altered (Shannon et al., 1999).

In the present study, two experiments were conducted; one for the priority area of chemical hazards and one for the priority area of technical safety. A particular type of quasi-experimental design was employed for both experiments; the so called *post-test-only control group design* (Campbell and Stanley, 1963), also referred to as *after-only measures and a control group* (Robson et al., 2001). This implies that there were no pre-tests of the experimental groups and the control groups. Instead the experimental groups and the control groups were compared simply by assuring equality between the two groups through the use of matching pairs. Also, the context of the two experiments was natural. Such experiments are usually referred to as field experiments, and are frequently used within all types of evaluation research (Clarke and Dawson, 1999).

3.2. Experimental groups and control groups

The assignment of enterprises to the experimental groups in the present study was done primarily by means of randomization. This implied the existence of two lists of all enterprises that had been subject to inspections which either focused on (1) chemical hazards or (2) technical safety during the previous calendar year was created (at least 6 months and maximum 18 months before inclusion in the study), and then enterprises were selected at random from these lists. In total 100 enterprises were selected randomly from the list of enterprises that had been subject to inspections which focused on chemical hazards.

The list of enterprises that had been subject to inspections which focused on technical safety was subdivided into two different lists. These lists mirrored two different types of inspections within this priority area: accident inspections and preventive inspections. The first list consisted of enterprises which had been subject to an inspection due to an accident (accident inspections). The second list of enterprises consisted of enterprises that had been subject to preventive inspections. In total 40 enterprises from the first list were selected randomly. The 40 enterprises from the second list, however, were selected by matching. This implies that each enterprise from this second list was matched with another enterprise selected from the first list (matched pairs). The enterprises were matched on the following variables: branch of industry, geographical localization and number of employees.

In order to assure that the three experimental groups were comparable to the control groups, the assignment of enterprises to the control groups was done by using matching pairs. Firstly, a complete list of enterprises that had never previously been subject to inspections by the NLIA was created. Then, enterprises were selected from this list so that they matched those in the experimental groups. In total, 100 enterprises were selected to match those from the experimental chemical hazard group, and 40 enterprises were selected to match those selected from the two (40+40) experimental technical safety groups. Branch of industry, geographical localization and number of employees were used as criteria for matching. This ensured that the matched pairs were within the same branch of industry, that they were located within the same province and that they had approximately the same number of employees.

3.3. Measures, hypotheses and statistical procedures

In order to compare the level of compliance with safety regulations between the experimental groups and the control groups, follow-up inspections were conducted. These inspections were performed by regular inspectors from the NLIA. Due to practical reasons, however, some of the enterprises and some of the inspectors were not available for follow-up inspections. The net sample was therefore reduced accordingly, see table 1.

Table 1
Gross sample, net sample and net sample rate

	Chemical hazards		Technical safety		
	Exp. group	Contr. group	Exp. group 1[a]	Exp. group 2[b]	Contr. group
Gross sample	100	100	40	40	40
Net sample	96	96	33	33	33
Net sample rate (%)	96.0%	96.0%	82.5%	82.5%	82.5%

[a] Preventive inspections, [b]accident inspections

During the follow-up inspections, the inspectors applied a check list to measure the level of compliance with safety regulations within the enterprises. The check list consisted of eight variables and was developed by the researchers, prior to the inspections, in collaboration with chief inspectors and experts from the NLIA within the given priority area. Unlike for example Levine et al.'s (2012) study of labour inspection effects in the U.S., safety performance data such as occupational injury records was not applied. This was a conscious choice based on the aim (*compliance* and not *safety performance*) of the study, and because objective and comparable safety performance data are notoriously hard to obtain (e.g. Brown et al., 2000, Choudhry et al., 2007).

To assure reliability, validity and to avoid potential positive bias, all the inspectors were given written instructions with regard to how the inspections should be performed and with regard to how the check list should be applied. All eight variables were dichotomous, and were either assigned a 'yes' (value 1), indicating compliance, or a 'no' (value 0), indicating non-compliance. All the variables typically represented compliance with a specific relevant statutory demand, see table 2. Thus, if an enterprise was assigned a 'no' on a given variable, this would also trigger a formal order. Hence, the potential for systematic errors, positive bias and reduced validity were reduced by the fact that a 'yes' or a 'no' would trigger a real juridical consequence.

Table 2
Dichotomous variables included in the check-lists

Chemical hazards (CH)	CH1: Can the enterprise ensure that a written risk assessment of chemical hazards, which take all relevant risk factors into account, has been conducted?
	CH2: Can the enterprise ensure that measures have been implemented to reduce the potential risks of identified chemical hazards and/or has the enterprise prepared a relevant and scheduled plan of action?
	CH3: Can the employer ensure that he/she has undergone training in health, environment and safety work?
	CH4: Can the enterprise ensure that safety representatives have been elected (or have the parties agreed in writing upon a different arrangement/not to have a safety representative, which is allowed for enterprises with less than ten employees)?
	CH5: Can the enterprise present an up to date record of substances and products?
	CH6: Can the enterprise ensure that written procedures regarding use, storage and maintenance of personal protective equipment are available?
	CH7: Can the enterprise ensure that the employees have received information regarding risks revealed by a risk assessment?
	CH8: Can the enterprise ensure that that it has prepared periodic plans and reports regarding the work that the occupational health service carries out? [a]
Technical safety (TS)	TS1: Can the enterprise ensure that hazards are identified and that risks are assessed against this background?
	TS2: Can the enterprise ensure that measures have been implemented to reduce the risks of identified hazards and/or has the enterprise prepared a relevant and scheduled plan of action?
	TS3: Can the employer ensure that he/she has undergone training in health, environment and safety work?
	TS4: Can the enterprise ensure that safety representatives have been elected (or have the parties agreed in writing upon a different arrangement/not to have a safety representative, which is allowed for enterprises with less than ten employees)?
	TS5: Can the enterprise ensure that it registers all personal injuries/illnesses which occur as a result of work performed in the enterprise?
	TS6: Can the enterprise ensure that the employees have received information regarding risks revealed by a risk assessment?
	TS7: Can the enterprise ensure that it has prepared periodic plans and reports regarding the work that the

occupational health service carries out? [a]

TS8: Can the enterprise ensure that it has implemented routines to uncover, rectify and prevent non-compliance with national safety regulations?

[a] Enterprises which not are obliged to provide occupational health services were given the value 1 on this variable.

On basis of the check lists, all enterprises were assigned an index-score of between 0 and 8 following an inspection, by summing up the score on each individual variable (no missing values were registered). This index-score was treated as a measure of compliance with safety regulations on the enterprise level (dependent variable), and was used to test the following two hypotheses:

Hypothesis 1: Enterprises that have been subject to labour inspections which focus on chemical hazards will display a higher level of compliance with safety regulations relevant to this priority area, compared to enterprises that have never been subject to labour inspections.

Hypothesis 2: Enterprises that have been subject to labour inspections which focus on technical safety will display a higher level of compliance with safety regulations relevant to this priority area, compared to enterprises that have never been subject to labour inspections.

In order to test hypothesis 1, a one-tailed independent samples t-test was performed (Field, 2005). A one-tailed test, not a two-tailed, was considered appropriate owing to the fact that the hypothesis was directional. The t-test tested whether the mean index-scores in the experimental group were significantly higher from those in the control group. The alpha level was set to .05. This implies that if the t-test yields probability values below .05 this indicates that the hypothesis is supported by the data, whereas the existence of probability values greater than .05 indicates that the hypothesis is not supported by the data. The effect size was estimated by Pearson's r (Field, 2005).In order to test hypothesis 2, a t-test was not appropriate since the data consisted of three groups (two experimental groups and one control group). For this reason, a one-way ANOVA was conducted (Field, 2005).[2] The advantage of the ANOVA is that it can test whether or not the means of three or more groups are all equal. The ANOVA, however, does not provide information on which means are significantly different from each other. To test this, a Least Significant Difference (LSD) post-hoc test was applied (Ott and Longnecker, 2010), and, in line with hypothesis 2, it was expected that the two experimental groups would have a mean index-score greater than the control group, but that they would not differ significantly from each other. As for the t-test, the alpha level was set to .05 for both the ANOVA and the LSD-test.[3]

4. RESULTS

4.1. Internal consistency and reliability

Prior to the test of the two hypotheses the internal consistency and reliability of the applied indexes were evaluated by Cronbach's alpha coefficient of reliability (Cronbach, 1951). According to Nunnally (1978) alpha scores (α) greater than .70 are indications of adequate internal consistency and reliability. The alpha scores (see table 3) for the two indexes vary from .78 to .82. Hence the internal consistency and reliability were considered adequate.

Table 3
Descriptive statistics for indexes

Index	Variables	Mean	SD	N	α
Chemical hazards	8	5.78	2.20	192	.78
Technical safety	8	5.63	2.44	99	.82

4.2. Test of hypothesis 1

After having confirmed that the index had adequate internal consistency and reliability, the one-tailed t-test was conducted to test hypothesis 1. The results of the test, including a comparison between the experimental group and the control group for each individual variable in the index are presented in table 4.

[2] Hypothesis 2 is directional. However, the ANOVA is a non-specific test which means that it just tells us whether there is a difference or not. Thus it is not possible to run a one-tailed ANOVA (Field, 2005).

[3] All statistical tests, including randomization, were conducted with SPSS 18.0.

As shown in table 4, the experimental group scored higher on all of the eight individual variables in the index. The greatest difference between the two groups was to be found in variable CH1, where 84% of the enterprises within the experimental group were given the value 1 (=yes) compared to only 42% of those within the control group. This implies that whereas 84% of enterprises which had been subject to a labour inspection that focused on chemical hazards could document that a written risk assessment of chemical hazards has been conducted, this could only be documented by 42% of the enterprises which had not been subject to a labour inspection. The smallest difference between the two groups is to be found in variable CH4, which concerns the election of safety representatives, where 89% of the enterprises within the experimental group were given the value 1 (=yes) compared to 82% within the control group.

The t-test of hypothesis 1, which concerns the overall safety compliance index, demonstrated that enterprises which have been subject to a labour inspection (M=6.70, SD=1.61) display a significantly higher level of compliance with safety regulations relevant to the priority area of chemical hazards, compared to enterprises that had never been subject to labour inspections (M=4.85, SD=2.32), t(190)=6.40, p<.001. Thus, the data gave support to hypothesis 1. This implies that labour inspections performed by the NLIA have a positive effect on enterprises' compliance with safety regulations relevant to the priority area of chemical hazards. The calculated effect size was r=.42, p<.001, and the difference between the experimental group and the control group on the safety compliance index represents a 38.1% difference.

Table 4

Scores on variables and index in the experimental group (N=96) and the control group (N=96), including t-test of mean index difference (hypothesis 1)

	Exp. group		Contr. group		Difference
Variables/index	Mean	SD	Mean	SD	Mean difference
CH1	.84	.37	.42	.50	.42
CH2	.76	.43	.42	.50	.34
CH3	.89	.32	.78	.42	.11
CH4	.89	.32	.82	.38	.07
CH5	.86	.34	.78	.42	.08
CH6	.83	.38	.66	.48	.17
CH7	.76	.43	.48	.50	.28
CH8	.86	.34	.50	.50	.36
Index (chemical hazards)	6.70	1.61	4.85	2.32	1.85[a]

[a] T-test: df=190, t=6.40, p<.001 (effect size: r=.42, p<.001)

4.3. Test of hypothesis 2

The results of the ANOVA, including a comparison between the two experimental groups and the control group for each individual variable in the index are presented in table 5. As shown in the table, the two experimental groups scored higher than the control group on all of the eight individual variables in the index. The greatest difference between the two experimental groups and the control group was to be found in variable TS7, where 82% and 67% (mean for both groups =75%) of the enterprises within the experimental group 1 and 2 were given the value 1 (=yes) respectively, compared to only 33% within the control group. This implies that whereas 75% of enterprises which had been subject to a labour inspection which focuses on technical safety could document that they had prepared periodic plans and reports regarding the work that the occupational health service carries out, and this could only be documented among the 33% of enterprises which had not been subject to a labour inspection. The smallest difference between the two experimental groups and the control group was to be found in the variables TS2 and TS8, which concern implementation of risk-reducing measures and routines to uncover, rectify and prevent non-compliance with national safety regulations.

As regards the test of hypothesis 2, which concerns the overall safety compliance index, the ANOVA demonstrated that there was a statistically significant difference between the groups, F(2, 96)=4.47, p=.041. The LSD post-hoc test revealed that enterprises which had been subject to a preventive inspection (M=6.10, SD=2.18) scored significantly higher on the safety compliance than did enterprises which not had been subject to an inspection (M=4.76, SD=2.70), p=.025. This difference in the safety compliance index represented a percentual difference of 28.2%. Also, the LSD-test revealed that enterprises which had been subject to an accident inspection (M=6.03, SD=2.23) scored significantly higher on the safety compliance index than enterprises which not had been subject to an inspection, p=.033. This difference in the safety compliance index represents a percentual difference of 26.7%. In addition, the LSD post-hoc test (not reported in table 5) revealed that there was, as expected, no statistically significant difference between the two experiment groups, p=.918. In sum, the results

from the ANOVA and the LSD supported hypothesis 2. This implies that labour inspections performed by the NLIA have a positive effect on enterprises' compliance with safety regulations relevant to the priority area of technical safety.

Table 5
Scores on variables and index in experimental group 1 (N=33), experimental group 2 (N=33) and the control group (N=33), including ANOVA-test of mean index difference and LSD-tests (hypothesis 2)

	Exp. group 1[a]		Exp. group 2[b]		Contr. group		Difference	
Variables/index	Mean	SD	Mean	SD	Mean	SD	Mean diff gr. 1	Mean diff gr. 2
TS1	.76	.44	.73	.45	.67	.48	.09	.06
TS2	.70	.47	.64	.49	.61	.50	.09	.03
TS3	.76	.44	.82	.39	.70	.47	.06	.12
TS4	.88	.33	.85	.36	.55	.51	.33	.30
TS5	.73	.45	.76	.44	.61	.50	.12	.15
TS6	.79	.42	.85	.36	.67	.48	.12	.18
TS7	.82	.39	.67	.48	.33	.48	.49	.34
TS8	.67	.48	.73	.45	.64	.49	.03	.09
Index (techn. saf.)[c]	6.10	2.18	6.03	2.23	4.76	2.70	1.34[d]	1.27[e]

[a] Preventive inspections, [b]accident inspections
[c] ANOVA: df=2, 96, F=3.29, p=.041, [d] LSD-test: p=.025, [e] LSD-test: p=.033

5. SUMMARY AND DISCUSSION

To ensure that enterprises comply with national health and safety regulations, most countries across the world have implemented a system of labour inspection (ILO, 2013). However, few studies have attempted to examine the effect that labour inspections actually have on enterprises' compliance with safety regulations. Some exceptions exist, but the methodological design of these studies (self-reports/cross-sectional) has some limitations in regard to interpretations of causality (e.g. Baldock et al., 2006). Thus, by applying an experimental research design and focusing on two priority areas (chemical hazards and technical safety) within the Norwegian Labour Inspection Authority (NLIA), the objective of the present study was to examine whether labour inspections carried out by the NLIA have an impact on enterprises' compliance with national safety regulations.

By comparing inspected versus previously uninspected enterprises, via follow-up inspections conducted by inspectors from the NLIA, the results of the empirical analyses demonstrated that enterprises which had previously been subject to inspections by the NLIA exhibit a significantly higher level of compliance with safety regulations compared to enterprises which not have been subject to inspections. Within the priority area of chemical hazards, the experimental group (previously inspected enterprises) scored 38.1% higher than the control group (previously uninspected enterprises) on the safety compliance index. The t-test confirmed that the mean score within the experimental group was significantly higher than the mean score of the control group, thus supporting hypothesis 1. Within the priority area of technical safety, the two experimental groups (preventive inspections and accident inspections) on average scored 26.7% higher than the control group on the safety compliance index. The ANOVA and the LSD post-hoc test confirmed that the mean score within both experimental groups was significantly higher than the mean score of the control group, but that there was no significant difference between the two experimental groups, thus supporting hypothesis 2.

Owing to the fact that comparability between the experimental groups and the control groups was assured (at least on three variables) through matching pairs, it would be reasonable to conclude that the variation between the two groups' level of compliance was caused by variation in the independent variable; labour inspection. These findings are consistent with previous studies of the impact that labour inspections have on enterprises' compliance with safety regulations (Andersen et al., 2009; Baldock et al., 2006), but the methodological design of the present study provides higher internal validity with regard to inferences about the causal relationship.

The findings have important theoretical implications. As already described, safety researchers have traditionally been concerned with identifying the origins of non-compliance among frontline workers and to suggest effective measures which can be taken to improve individual safety compliance. Simultaneously, few studies have paid attention to compliance at the enterprise level and even fewer have examined the impact that labour inspections have on enterprises' propensity to act in accordance with prevailing safety regulations. The findings of the present study should therefore fill a research gap within safety research and add new knowledge to our understanding of the impact of labour inspections.

In a broader sense, the findings should also shed light on another under-researched topic within safety research, namely the causal relationship between company external factors and safety critical internal factors. As Kongsvik et al. (2012) previously have highlighted, there is a need to include external factors in order to more fully understand the state of safety within organizations. The findings of this study are an example of this, and they clearly illustrate a classical point made by Rasmussen (1997); that the socio-technical system which actually is involved in the creation of organizational safety extends far beyond a company's internal conditions and, moreover, that it is the result of the interplay between actors operating on different societal levels.

In addition to these theoretical implications, the findings of the present study also have some important practical implications. As described in the introduction, non-compliance with safety rules and procedures is a common triggering factor of accidents at work. Hence, it needs to be dealt with. The findings of the present study indicate that labour inspections have a positive effect with regard to this. This is important. Because, as has been stressed by for example Levine et al. (2012), occupational health and safety regulators are surrounded by controversies, with some observers claiming that workplace inspections have no effect on workplace safety and others arguing that inspections improve workplace safety. The findings of the present study, including Levine et al.'s own study which focused on injury rates and inspections conducted by OSHA[4], clearly support the latter group of observers. The findings should thus be a well-founded argument for the necessity of labour inspections in a period where (1) deregulation has been debated for a long time (Walters et al., 2011), (2) where a reduction in the frequency of labour inspections is a fact in many countries (e.g. Larsson, 1997; Tombs and Whyte, 2010; 2012), and (3) where economic recession has led to funding cuts which in turn have forced regulatory authorities across several countries to limit their activities (Johnson, 2012).

However, the findings of the present study should be interpreted with some methodological limitations in mind. Firstly, the study deals only with short-term effects. All enterprises in the experimental groups that were included in the study had been subject to an inspection in the previous calendar year (at least 6 months and maximum 18 months before inclusion in the study). Thus, the findings do not offer information on long-term effects. It would therefore be useful for future research to replicate the present study over a longer time span.

Secondly, the study was performed within the Norwegian context. Hence, the validity of the findings is, strictly speaking, restricted to inspections conducted by the NLIA. The conclusions that can be drawn from the study are thus not automatically generalizable to other regulatory regimes. The methodology which is developed in this study, however, should be applicable, with some adjustments to national variations, when assessing the effect of labour inspections within other regulatory regimes.

Thirdly, the findings do not illuminate the causal mechanism between labour inspections and improved compliance. Thus, the study indicates that labour inspections performed by the NLIA have a positive impact on enterprises' compliance with safety regulations, but it says less about why. It would be tempting to interpret the findings as a result of enforcement actions, and to conclude that compliance at the enterprise level can be improved by more enforcement and more use of coercive measures. However, as Wright and Marsden (2005) and Wright et al. (2005) have previously noted, non-compliance at the enterprise level is not only associated with deliberate attempts to ignore regulations, but more with a lack of knowledge and understanding of the regulations. If this is true, it is likely that the positive impact that labour inspections were found to have in the present study was caused more by guidance and information given during inspection than by formal orders or other coercive measures. The present study, however, does not provide sufficient information for robust conclusions to be drawn on this subject. It would therefore be valuable if future research could test and compare the impact of enforcement-only inspections versus guidance-only inspections.

6. CONCLUSION

The present study has demonstrated that enterprises which have been subject to inspections by the Norwegian Labour Inspection Authorities exhibit a significantly higher level of compliance with safety regulations compared to enterprises which not have been subject to such inspections. The methodological basis of the study was two field experiments which applied a post-test-only control group design that compared inspected versus previously uninspected enterprises. Comparability between the two groups of enterprises was assured through matching pairs. It is thus highly likely that the variation between the two groups' level of compliance was caused by the fact that the one group of enterprises previously had been subject to inspection while the other had not. These findings are important considering the fact that non-compliance is a common triggering factor of accidents at work. The findings should also contribute with significant knowledge of the impact of labour

[4] OSHA: U.S. Occupational Safety and Health Administration

inspections and about the causal relationship between company external factors and safety critical internal factors. Also, the findings should be important in a time where deregulation, economic recession, funding cuts, and a reduction in the frequency of labour inspections are affecting many countries.

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