Formal and Informal Safety Management
The Importance of Ethnographic Research for Safety Surveys

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Abstract

Safety surveys normally focus on the influence of formal safety management (bureaucracy) on safety performances, while neglecting the impact of informal coping strategies (craftsmanship) that are the main topic of ethnographic safety studies. Based on a survey in a Dutch energy company (N=265) we show this negligence is problematic. First, the effect of formal safety management on self-reported incidents and accidents depends on informal coping strategies. It is shown that informal coping strategies facilitate formal safety management. Second, informal coping strategies influence safety performances independent of formal safety management. The perceived utilisation of tacit knowledge improves safety records (i.e. self-reported incidents and accidents) because it reduces unsafe behaviour, while perceived presence of professional discretion worsens it because it enhances unsafe behaviour. Our efforts show it is possible to incorporate findings of ethnographic safety studies fruitfully in safety surveys.

> '"I will have no man in my boat", said Starbuck, "who is not afraid of a whale". By this, he seemed to mean, not only that the most reliable and useful courage was that which arises from the fair estimation of the encountered peril, but that an utterly fearless man is a far more dangerous comrade than a coward'
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> (Herman Melville, *Moby Dick* 1992 [1851]: 116).

Introduction

Two main research traditions can be identified in research regarding the causes and prevention of work related incidents and accidents: socio-psychological survey research and ethnographic studies.

Safety surveys normally focus on the importance of *formal* safety management for safety performances. Safety management is conceived of as a *bureaucratic* system of regulations that are enforced and trained. Often, the perceived presence of an elaborate safety policy is designated an important indicator of a healthy safety climate (see for example Cooper & Philips, 2004: 497; Mearns & Flin, 1999: 5). Researches probe into the positive effects of the perceived presence of bureaucratic safety management on self-reported incidents and accidents. Most studies indeed find positive direct or indirect effects of one ore more dimensions of perceived bureaucratic safety management on self-reported unsafe behaviour, incidents and accidents (Varonen & Mattila, 2000; Mearns, Whitaker, & Flin, 2001; Cooper & Philips, 2004).

Ethnographic safety studies, on the other hand, deal with processes not embedded in formal organisational structures that influence the exposure of individual employees to risks in specific sectors or occupations. This means their focus is on the informal organisation: 'the actual personal interrelations existing among the members of the organization which are not represented by, or are inadequately represented by, the formal organization' (Roethlisberger en Dickson, 1950 [1939]: 566).

Survey research on the importance of safety climate dominates. It is less time consuming than conducting ethnographic studies and sooner heralds the promise of revealing causes of accidents that can be tackled by concrete policy instruments.[1] In this research tradition the search for advance is clearly present. Researchers often refer to similar previous surveys, use validated measurement instruments, replicate studies, and try to solve well known problems (for latter point, see Guldenmund 2000: 247 and Glendon & Litherland 2001: 162). However, the separation with the ethnographic research tradition is almost complete. If any reference is made at all, it is merely to point out such research exists (Hopkins, 2006: 878-890). We do not know of any research systematically incorporating the insights of ethnographic studies into a safety survey.

This blind spot means there are no safety surveys probing the extent to which the effects of formal, bureaucratic safety management on safety performances depend on the informal handlings of safety. This is remarkable because several organisation studies have demonstrated that the informal organisation can have great impact on the realisation of formal organisational goals. Barnard (1962 [1938]) has shown that the informal organisation can complement the formal one in important respects. It can provide crucial communication channels and cohesion among individuals and groups and protect the integrity of individual organisation members. On the other hand, the informal organisation can also hamper the realisation of formal goals. Parties whose interests are underrepresented in formal policy can frustrate or sabotage it by applying informal tactics (see for example, Gouldner, 1954; Watson, 1987: chapter 7; Morrill, Zald, & Below, 2003). First, these studies show the impact of the formal organisation on the realisation of organisational goals cannot be understood well without considering the informal organisation. Next, they make clear the effects of formal policy depend on its legitimisation. The less formal policy is legitimised, the more it is undermined by the informal organisation.

1. This appeals to the business commissioners who often subsidise this kind of research.

Therefore, our first goal was to find out to what extent the effects of formal safety management depend on informal coping strategies with safety. In other words, we wanted to find out whether an eventual positive influence of formal safety management on safety performances is enabled or hampered by informal coping strategies. Our next goal was to find out to what extent the effects of both formal and informal safety management depend on their legitimacy. Finally, we tried to establish to what extent the informal coping strategies have an influence on safety performances apart from formal safety management. Before we answer these research questions, we describe the main characteristics of informal coping strategies occurring in ethnographic safety studies.

Ethnographic Safety Studies: Craftsmanship

Can specific coping strategies with safety be derived from ethnographic safety studies, and if so, what do they look like? This has proven to be the case. Three dimensions can be distinguished: 'discretion', 'tacit knowledge', and 'personal responsibility'.

Discretion

Several studies show employees de-emphasise the value of rules and procedures. They feel regulation does not foresee all risky situations and when it does, it does not necessarily mean regulation provides the best answer to handling risks.

Brun (1995) showed that linemen sometimes refrain from using mandatory safety goggles claiming they reduced visual contact with the electrified components. They also did not use protective devices aimed to shelter them from accidental contact with electricity because installing and removing them created added risks. By refraining from using protective equipment, workers regained control over their working environment: 'When we install protective equipment and do our work, we apply our own logic and knowledge… We have no control at all over the protective equipment, all we can do is hope it still works… But when it comes to my own powers, I know I'm still good for a while longer!' (Brun, 1995: 819). Such practices were condemned by management, which accused employees of being reckless and incompetent.

Schepens (2005) draws similar conclusions in relation to lumberjacks of whom one in five had an accident every year. While the lumberjacks' association condemned deviating from safety regulations, the lumberjacks themselves stressed they did because the rules were

counterproductive. For example, safety regulations dictated the use of face shields. According to the lumberjacks, these shields limited their sight, making it unable for them to see what was happening in the trees. Moreover, the noise shield in the helmets limited the hearing ability so they did not notice branches braking off. Lumberjacks perceived the real danger was the diminishing of audiovisual contact with the environment instead of not wearing the mandatory personal protection devices.

As these examples show, employees often disagree with those who do not have to work with the rules themselves (see also Mascini, 2005). Managers, branch organisations and monitoring governmental organisations condemn this behaviour of the users. However, if non-users refuse to acknowledge the impracticality of rules it can have severe consequences, as shown by Baccus' study (1986) into the regulation of maintenance and repair of so-called 'Multipiece Truck Wheels'. As the Ministry of Transport insisted, their work instructions were valid, tens of people were killed and hundreds injured during these work activities because in practice, it was impossible for the mechanics to follow these rules. The instructions were based on the assumption that garages were well equipped and spacious, while in fact mechanics had to deal with lack of space and protective equipment and with a lot of work that had to be done outside the garages. It took a lot of external pressure on the Ministry of Transport before it decided to ban this type of truck wheels altogether.

In short, a reoccurring theme in ethnographic studies is employees' emphasis on the importance of what Freidson calls (1999: 23) *discretionary specialization*. Discretionary specialization involves work of which '[…] the tasks and their outcome are believed to be so indeterminate […] as to require attention to the variation to be found in individual cases. And while those whose occupation it is to perform such tasks will almost certainly engage in some routines that can be quite mechanical, it is believed that they must be prepared to be sensitive to the necessity of altering routine for individual circumstances that require discretionary judgement and action'.

Tacit knowledge

The relativising of the value of procedures by those for whom they are intended, is closely related to the limited usefulness they attribute to formal training. This is explicitly brought forward by previously mentioned research by Schepens on lumberjacks, by Brooks (2005) on fishermen and by Gherardi & Nicolini (2002) on builders. These manual workers are convinced novices do not learn the trade by formal training, but by acquiring experience. They argue formal training teaches novices mainly techniques without context, based on ideal cir-

cumstances and applicable to every situation (Gherardi & Nicolini 2002: 202). However, according to lumberjacks, for example, each tree is unique. In order to prevent accidents it is necessary to acknowledge the fact that all knowledge is relative when commencing a new task (Schepens, 2005: 7). This means they conceive professionalism not as a fixed status, but as something to be proven constantly.

Gherardi & Nicolini (2002) also stress that during the training of novices on a construction site a lot more value is placed on the development of so-called 'sensory maps' than on safety training and education. By seeing, talking, listening, feeling and doing, novices learn to recognise dangers and how to deal with them. Therefore, learning to work safely is not so much a matter of acquiring cognitive knowledge, but rather a matter of gaining experience and involving all senses during this process. By developing 'sensory maps' novices gradually master the 'tacit skills', that constitute the 'community of practices' on an construction site (Gherardi & Nicolini, 2002: 196). During this learning process, the novice gradually transforms from an unknowing outsider to an expert co-worker through 'legitimate peripheral participation'. 'Developing a sense of safety [thus] relies on ineffable and not communicable subtleties mainly derived from the repeated exposure to clues and sensory experiences provided by the unfolding activity, as well as from the linguistic productions that take place during the activity. Active participation as a legitimated member within the unfolding activity is therefore a necessary precondition for appropriating a culture of practice and for learning to take place (Gherardi & Nicolini, 2002: 217).

The notion that novices' training can only commence in practise is closely related to a master apprentice relationship. This entails an experienced master pointing novices at risks and demonstrating them how to deal with them. Brooks (2005: 808) describes such a relationship in his study on fishermen, namely between skipper and deckhand: 'Unsafe practices are corrected swiftly and, in the case of a new deckhand, none to gently'. Other studies also show novices are warned about mistakes and dangers harshly. For example, Gouldner (1954: 119) found that older, experienced miners: 'enjoyed scaring "snowbirds" (as newcomers to the mine were called) […]'. Lumberjacks verbally abuse novices in combination with hitting them on their helmets, to make them aware of the risk surrounding their work environment (Schepens, 2005: 5). Masters also use accidents to make novices aware of their mistakes. They feel accidents are an effective means by which the consequences of not following advices can be illustrated, precisely because the victims find the consequences to their cost (Schepens, 2005: 6).

These stringent tactics are not only aimed at correcting or warning novices, but also at testing fellow workers' stress tolerance. Brun (1995: 821) showed linemen deliberately took risks in order 'to check on each other from time to time'. Haas (1977: 162) called this 'binging'. He showed how high steel ironworkers tested their co-workers' trustworthiness by constantly baiting and belittling them, a treatment especially reserved for novices. Those who could not take binging were viewed as untrustworthy and consequently were made to quit. Gouldner (1954: 134) showed the harsh treatment of co-workers who could not handle binging was especially effective because of the dangerous circumstances in which they worked: 'Ostracism and isolation were a much more disturbing experience to the deviant in the darkened mine than to a worker in the well lighted surface factory'.

We can conclude that learning to work safely is closely related to what Polanyi called *tacit knowledge*. 'This type of knowledge is unverbalized, perhaps even unverbalizable, but in any case not part of a formal corpus of codified technique. First, the acquisition of tacit knowledge is based on experience rather than formal theory. Such skills are learned not in classrooms, but rather during the course of working […]. It is neither formal in character nor systematically articulated (Polanyi 1967)' (Freidson 1999: 25/6). Secondly, the master apprentice relationship plays an important role regarding tacit knowledge: 'Recruits to crafts […] learn their craft as they work on the job with a full-fledged member of the trade who serves as teacher and supervisor. The craft is learned as a practical, vocational enterprise in which the working knowledge and tacit skills required are learned as work is being performed' (Freidson 1999: 89). Thirdly, 'binging' ensures novices store this tacit knowledge into their system and those who cannot deal with it face ostracism.

Personal responsibility

Closely related to the socialisation of novices and the process of learning to recognise and deal with dangers is the attribution of responsibility for accidents. Several studies show employees tend to place responsibility for accidents on those who had them ('blaming the victim') (Schepens, 2005). For instance, this proved to be an important reason why employees of a steel factory never actually sued their employers for damages on account of work related injuries (Fischer, 1993). Employees tend to cover up incidents and accidents fearing they might damage their status as a professional. Employees, as it happens, assume accidents cannot happen when employees are vigilant. They attribute accidents to moments of distraction and amateurism: 'An accident thus becomes an individual shortcoming, something of which to be ashamed. It is an index of weakness' (Gherardi & Nicolini, 2002: 204). There are cir-

cumstances, though, were those involved realise they are exposed to uncontrollable forces. Mines can collapse suddenly, sawed off trees can get caught in other trees and move unpredictably, and sudden changes in the weather at open see can cause mayhem.

Employees use at least two strategies to cope with such uncontrollable circumstances. First, they attribute human characteristics to nature. Miners talk about a 'talking roof'; 'As we say it, "The roof is talking to you!"' (Gouldner, 1954: 118). Lumberjacks compare woods to humans: 'Un bout de bois, c'est comme un être humain, il n'y en a pas un qui se ressemble, de caractère, de forme, de corpulence. Un bout de bois..., c'est pareil, ils ont tous leur petite malice. Il y en a qui sont très gentils, il y en a qui sont malins, il y en a qui sont très malins' (Schepens, 2005: 12) and a retired fisherman said 'The sea can be mean' (Brooks, 2005: 806). Although those involved use these *animistic* views to indicate nature decides over life and death, that does not mean they feel at the mercy of nature. On the contrary, a skilled observer knows the characteristics of the natural environment and how to handle them. The professional skipper knows he always has to pay respect to the sea (Brooks, 2005: 806), the experienced lumberjack feels a malicious tree branch will strike during the smallest lapse of concentration and an able mine worker hears the roof talking when little stones suddenly begin to fall (Gouldner, 1954: 118). This means the sea, the mine and the woods judge whether you are an expert or an amateur; who has an accident was unable to interpret the signals by the natural environment and thus proves to be an amateur. Therefore, employees do not attribute accidents to coincidence or bad luck, but to personal mistakes (Schepens, 2005: 13).

This feeling of personal responsibility also expresses itself in performing *magic rituals* in order to expel uncontrollable forces. 'Some fishermen would never begin a season on a Thursday, others keep pictures of religious deities in the wheel-house, some believe it is bad luck to change the name of a boat' (Brooks, 2005: 806). Gouldner found miners endowed the so-called 'prop man' with magic properties**.** His purpose was to support the mineshafts**.** 'The miners wove a network of folklore about their prop man's personal prowess'. […] 'The miners expected that the prop man should be powerfully built and obviously muscular, for in a sense, they conceived of him as an Atlas who held up the roof'. […] 'The prop, of course, did not only safeguard the miner's safety, but also served the important psychological function of enhancing the miner's feeling of control over his situation and his sense of security' (Gouldner, 1954: 120-123). The effectiveness of magic rituals is ascribed, with hindsight, to the quality with which they were performed (Malinowski, 1925 [1948]: 86). Therefore, an accident does not necessarily prove the rituals at fault, but can also signify they were not carried out properly. This means magic also implies personal responsibility.

We can conclude that ethnographic safety studies indeed show an approach towards safety that fundamentally differs from formal, bureaucratic safety management, which is featured so prominently in safety surveys. Not the importance of mechanically following rules and procedures is considered essential, but the possibility to apply general rules to one's discretion on concrete situations. Safety training and education are considered of lesser importance than acquiring practical experiences. Teaching novices on-the-job is not only accompanied by the development of 'sensory maps' for dangers, but also by the acquirement of their identity as full-fledged employees. During this process of socialisation, experienced workers try to prevent novices from making mistakes by enabling them to experience dangers first hand instead of by imposing formal sanctions. Safety is conceived as a personal responsibility instead of an organisational one due to the pivotal role bestowed upon craftsmanship.

In short, in ethnographic studies craftsmanship plays a central role instead of bureaucratic safety management. This craftsmanship consists of manual labour that cannot be fully standardised. The craftsman, then, also needs discretion to deliver a customised product. The knowledge and skills needed to deliver customised products is transferred to novices by enabling them to experience what can go wrong during the execution of tasks. The craftsman's notion that he plays a pivotal role in the execution of tasks is accompanied by a deep sense of responsibility for the product he delivers.

Data and measurement

This section deals with the answer to the question whether we succeeded measuring craftsmanship in survey research. We also address the collection of the data and the measurement of the other concepts.

Data

Data were collected with a survey conducted in a Dutch energy company. Respondents consisted of gas, heat, and electricity maintenance personnel and their managers. The surveys were mailed to the respondents accompanied with a letter clarifying the goal of the survey. All questions were multiple choice. The research population consisted of 856 persons. The response rate was 31 percent (N=265).

Measurement

Our dependent variable self-reported *involvement in incidents and accidents* was measured by asking respondents how often they got involved in each of the following mishaps at work in the last two years: 1) near accidents, 2) accidents not resulting in absenteeism, 3) accidents resulting in absenteeism. The response categories ranged from: 1) never to 4) more than twice. These three items together constituted a reliable scale (Cronbach's $\alpha = 0.67$).

The intermediate variable *unsafe behaviour* was measured with eight items covering the whole execution of a task, ranging from its preparation, execution, and checking to the sanctioning of deviations.[2] The eight items produced a reliable scale (Cronbach's $\alpha = 0.74$).

The first of three independent variables: *perceived presence of bureaucratic safety management* was measured with nine items,[3] covering the following three dimensions: 1) rules and regulations, 2) training and education, 3) sanctioning and supervision. The scales reliability of these nine items was good (Cronbach's $\alpha = 0.81$).

The measurement of the second independent variable *craftsmanship* merits a close look because it is a new concept for safety surveys. We measured seventeen items covering the three dimensions discussed in the theoretical section: 1) discretion in handling safety matters, 2) tacit knowledge in handling safety matters, 3) personal responsibility with respect to incidents and accidents.

Table 1 shows the unrotated Principal Component Analysis yielded five factors with an Eigenvalue exceeding one. The scree plot (not depicted) showed a distinct break between the steep slope of the first three largest factors and the trailing of the last two. The latent factors underlying these first three factors refer to, respectively: 1) discretion, 2) personal responsibility and 3) tacit knowledge. This means that our measurement of craftsmanship consists of three separate factors instead of a single one. However, these three dimensions correspond perfectly with the concept of craftsmanship discussed in the theoretical section.

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2. Respondents were asked 'How much does your company actually use the following safety instruments?' The answer categories consisted of a scale ranging from: 1) never to 5) very often. With the loading on the first factor in brackets, the eight items were: 1) Being unprepared while fixing a malfunction (0.62), 2) Deviating from safety procedures (0.77), 3) Performing a task individually, which should have been executed by two or more workers (0.75), 4) Working without mandatory personal protection clothing (0.69), 5) Working in a manner which endangers you or a colleague (0.67), 6) Leaving a workplace in such a manner, that it causes danger for others (0.49), 8) How often have you received a note in your employee personnel file or were you given a negative assessment (0.36).

3. All the answer categories consist of a scale ranging from (1) very less to (5) very much. 1) Safety procedures (0.61), 2) Adapting procedures on account of changing circumstances or new legislation (0.68), 3) Testing employees' knowledge pertaining to safety procedures (0.69), 4) Demonstrating safety procedures on-the-job (0.51), 5) Brushing up employees' knowledge by means of safety training and safety courses (0.64), 6) Issuing safety instructions to new employees before they start working (0.71), 7) Safety inspections (0.53), 8) Discussing working safely during assessments (0.61), 9) Discussing safety during work meetings (0.67), 10) Providing feedback on incident reports (0.51).

Table 1. Perceived presence of craftsmanship (N=236; factor loadings below 0.30 are left out).

	Unrotated PCA					*Varimax rotated analysis of first 3 PC*		
	1	2	3	4	5	1	2	3
Tacit knowledge								
Using experienced workers to train novices on-the-job	0.60				-0.53	0.67		
Keeping an extra eye on novices	0.59		-0.33	0.52		0.76		
Making novices aware of danger by testing them during specific activities	0.63		-0.44	0.40		0.77		
Involving employees in the development of new safety procedures	0.66		-0.37			0.70		
Involving employees in the purchase of new safety protection equipment	0.70			-0.31		0.63		
Involving employees in the introduction of new equipment and techniques	0.65			-0.52		0.74		
Duplicating risky situations so employees can experience what can go wrong	0.77					0.56		
Utilizing situations where employees found risks to their cost, to make them work more consciously	0.63				-0.37	0.49		
Stringently correcting employees who work unsafe	0.50			0.31	-0.43	0.47		
Discretion								
Adapting safety procedures when employees say they are hindered by them during work	0.61		0.30		0.37	0.44		0.50
Allowing employees to use their discretion, even when this means violating rules and procedures			0.67					0.68
Allowing employees to use their discretion in situations that have not been foreseen by rules	0.37		0.61	0.37				0.70
Trusting that workers themselves know best how to carry out a task	0.39		0.64					0.74
Personal responsibility								
During each task I am aware that something can go wrong		0.84					0.85	
The slightest laps in concentration can lead to an accident		0.82					0.85	
I am always aware that even the slightest mistake can result in an accident		0.82					0.86	
When an incident occurs, I automatically wonder whether I could have prevented it		0.41					0.46	
Eigenvalue	4.5	2.4	1.8	1.3	1.1	4,1	2.3	2.2
Explained variance (%)	27	14	11	7	6	25	14	14
Cronbach's α						0.84	0.77	0.67

Next, table 1 shows the results of the varimax rotated Principal Component Analysis based on the first three factors only. It shows that just the item 'Adapting safety procedures when employees say they are hindered by them during work' loads stronger than 0.30 on two factors: 0.44 on the tacit knowledge factor and 0.50 on the discretion factor. Therefore, it was possible to use each item for the measurement of one craftsmanship dimension only. Because of our relatively small sample, we wanted to minimize the total amount of cases that had to be excluded from our analyses because of missing values. For this reason we did not save factor scores of each scale, but computed the average score on a minimum of valid answers to the items belonging to each of the three scales. We allowed missing values on two items belonging to the tacit knowledge factor and one missing value on the items belonging to the personal responsibility and discretion scales. The measurement of each factor yielded a reliable scale (Cronbach's α perceived utilisation of tacit knowledge in handling safety matters = 0.84; Cronbach's α perceived personal responsibility for incidents and accidents = 0.67; Cronbach's α perceived utilisation of discretion in handling safety matters = 0.76).

For our last research question, we had to make a distinction between employees who legitimise a particular safety management technique and those who do not.

Therefore, we did not only ask respondents for the perceived presence of *bureaucratic safety management* and of the utilisation of *tacit knowledge* and *discretion* in handling safety matters, but also whether they legitimised each of the safety management techniques.[4] Each analysis produced a reliable scale (Cronbach's α desirability of bureaucratic safety management = 0.86; Cronbach's α desirability of tacit knowledge= 0.83; Cronbach's α desirability of discretion= 0.75). Further, we recoded these three variables to dichotomous variables of equal size into the categories: 1) legitimate safety management technique, 2) illegitimate safety management technique. Because it was senseless to measure the legitimisation of the attribution of personal responsibility – either you do or you do not – we did not.

Results

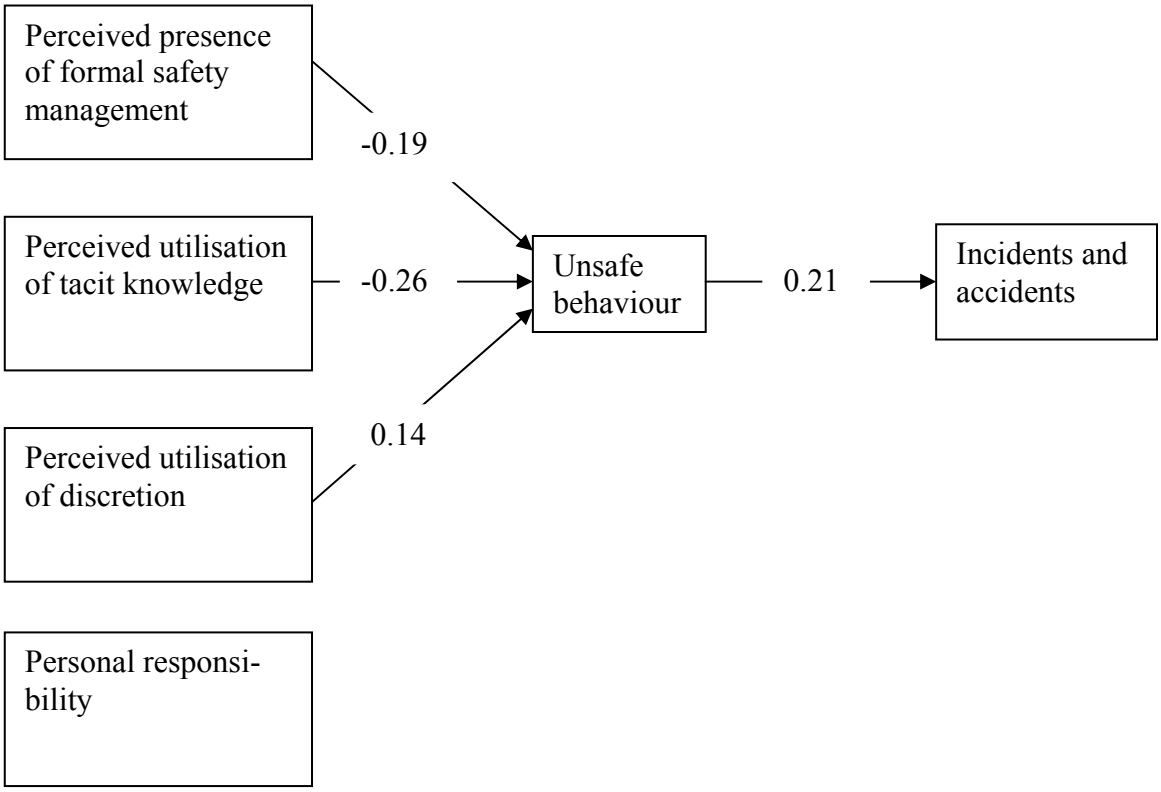
In this section, we discuss the results of the quantitative analyses. We will successively assert to what extent the effects of formal safety management on safety performances depend

4. All the answer categories consist of a scale ranging from: 1) very undesirable to 5) very desirable.

on informal coping strategies, whether informal coping strategies influence safety performances apart from formal safety management and to what extent the effects of both formal and informal safety management depend on their legitimacy.

Figure 1 shows that employees report themselves more often as former victims of incidents and accidents as they account for more unsafe behaviour ($ß = 0.21$; $p < 0.05$). Moreover, they report less unsafe behaviour as they perceive more bureaucratic safety management. This means the perceived presence of bureaucratic safety management improves safety performances. The perceived presence of safety rules and their enforcement and of safety education and training withholds employees from unsafe behaviour.

Figure 1. Self-reported incidents and accidents and unsafe behaviour explained (N=216; R^2 unsafe behaviour = 16%, R^2 self-reported incidents and accidents = 9%; all paths shown are significant ($p < 0.05$))



Furthermore, the results show the effect of formal policy on safety performances depends on informal coping strategies. When controlled for the three dimensions of craftsmanship, the

correlation of –0.32 (not depicted in figure 1) between perceived presence of bureaucratic safety management and self-reported incidents and accidents decreases to a beta of –0.19. This means 41 percent of the effect of the perceived presence of formal safety management on safety performances must really be ascribed to informal coping strategies (0.32 - 0.19 / 0,32 = 41 percent). Put in other words, the three dimensions of craftsmanship facilitate the effectiveness of formal safety management.

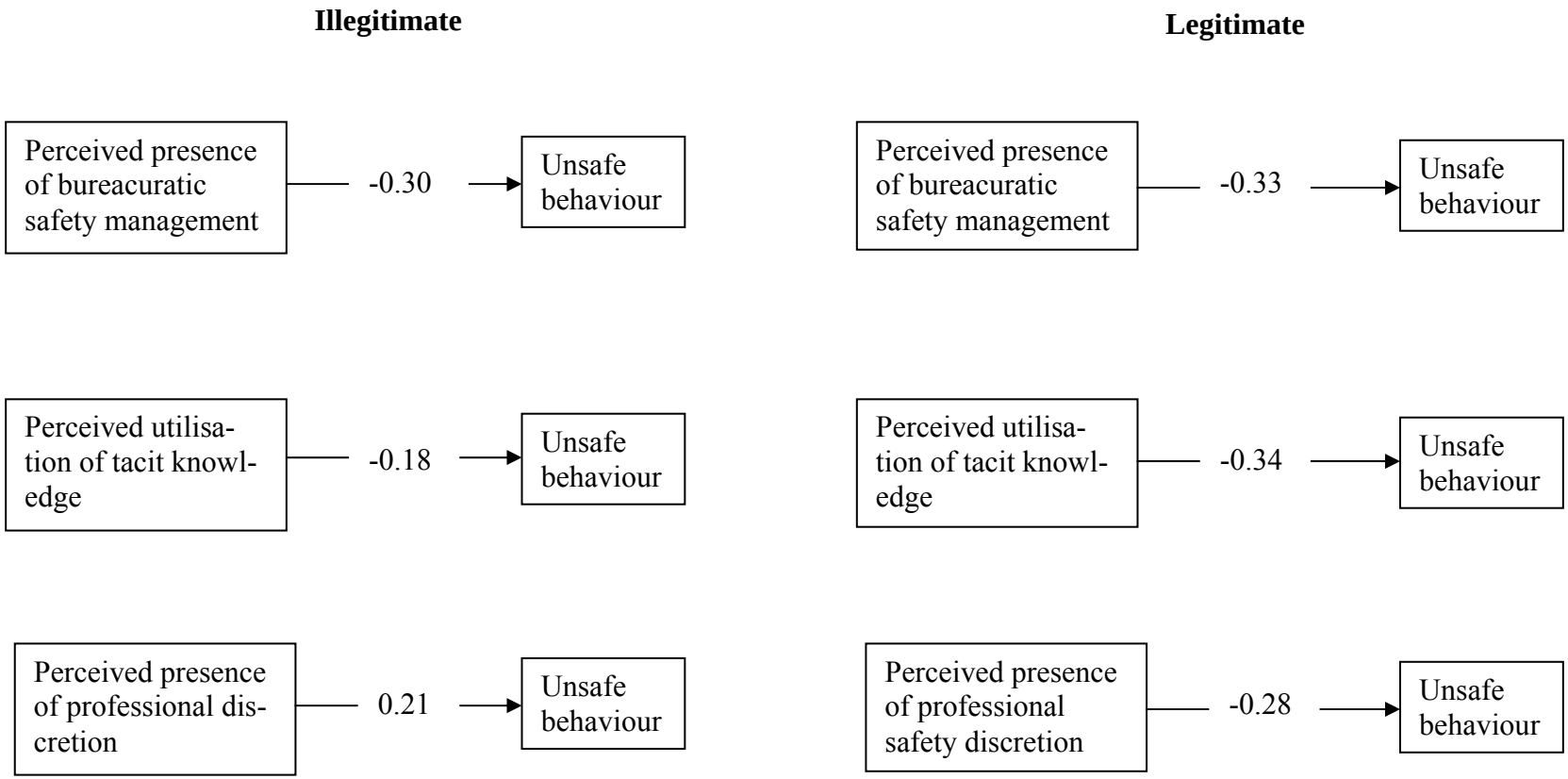
The results also show informal coping strategies have an influence on safety performances apart from formal safety management. Employees report less unsafe behaviour as they perceive more utilisation of tacit knowledge in handling risks (ß = -0.26; $p < 0.05$). On the other hand, the perception of discretion in handling risks results in more unsafe behaviour (ß = 0.14; $p < 0.05$). Perceived personal responsible for accidents turned out not to affect safety performances. In retrospect, this is logic. Perceived personal responsibility is an attitude that conveys responsibility for accidents *after* they occur. It makes sense, therefore, that this does not affect acts *preceding* accidents. Because the attribution of personal responsibility for accidents did not affect safety performances, we excluded it from our next analysis.

None of the perceived safety management types has a direct effect on safety achievements; all effects are indirectly caused by their effects on unsafe behaviour. In total 9 percent of the total variance in self-reported incidents and accidents can be explained by the different types of safety management.

Figure 2 shows the influence of formal safety management on safety performances does not depend on its legitimacy. The influence of the perceived presence of formal safety management on safety performances did not differ significantly between those who do not legitimise it and those who do (ß = -0.30 versus ß = -0.33). However, the influence of informal coping strategies do depend on their legitimisation. The perceived utilisation of tacit knowledge in handling risks reduces unsafe behaviour to the greatest extent for those who believe in doing so (ß = -0.18 versus ß = -0.34), while the importance of legitimacy is most obvious with respect to the perceived utilisation of discretion in handling risks; employees who regard it suitable report less unsafe behaviour as they perceive more discretion, while the inverse is true for those who believe discretion is unsuited for handling risks (ß = 0.21 versus ß = -0.28). In short, the perceived utilisation of tacit knowledge prevents unsafe behaviour most among those who legitimise it, while the effect of the perceived utilisation of discretion is positive for those who legitimise it and negative for those who do not.

We suspect the different impact of legitimisation on the effects of both formal and informal safety management results from recent developments within the company under study. In recent years, the safety policy of this company has been bureaucratised largely. The company has invested mostly in safety regulations, personal protective devices, safety courses and trainings, and inspections and enforcement. This process seems to have eroded the normality of craftsmanship. Newcomers get responsibilities based on their credentials instead of practical experiences enabled by expert colleagues. Safety inspections have been disconnected from the execution of daily tasks and the emphasis has shifted from personal responsibility for safety to organisational responsibility. In other words, the bureaucratisation of safety policy seems to have forced the importance of craftsmanship into the background. Therefore, it is understandable it still works for those who still believe in it, while it does hardly any more for those who have lost faith in it. Since the bureaucratisation of formal policy has lead to it becoming the standard, it makes sense its effectiveness does not depend on its legitimisation.

Figure 2. Unsafe behaviour explained respectively for those who do not legitimise a particular safety management technique and for those who do (N bureaucratic illegitimate = 125, N bureaucratic legitimate = 121; N tacit knowledge illegitimate = 107, N tacit knowledge legitimate = 141; N discretion illegitimate = 117, N discretion legitimate = 135)



Conclusion and discussion

First, we have established the effect of formal, bureaucratic safety management on safety performances (i.e. self-reported incidents and accidents) depends on informal coping strategies. Part of the attribution of the perceived presence of formal safety management must really be ascribed to informal coping strategies. This means, in other words, that informal coping strategies facilitate the effectiveness of formal safety management. Moreover, we have demonstrated that informal coping strategies also have an effect on safety performances independent of formal safety management. The perceived utilisation of tacit knowledge *improves* safety performances because they reduce unsafe behaviour, while perceived presence of professional discretion *worsens* it because it enhances unsafe behaviour. Therefore, we can conclude the focus of safety surveys on the effects of formal safety management on safety performances is problematic. For it means that both the direct and indirect effects of informal coping strategies on safety performances remain unnoticed.

We have also established that the influence of formal safety management on safety performances does not depend on its legitimacy while the influence of informal coping strategies do. The perceived utilisation of tacit knowledge prevents unsafe behaviour most among those who legitimise it, while the effect of the perceived utilisation of discretion is positive for those who legitimise it and negative for those who do not. We suspect the different impact of legitimisation on the both types of safety management results from recent developments within the company of our research. In recent years, the safety policy of this company has been bureaucratised largely. The company has invested mostly in safety regulations, personal protective devices, safety courses and trainings, and inspections and enforcement. This process seems to have eroded the normality of craftsmanship that underlies informal coping strategies with safety. Therefore, it is understandable it still works for those who still find it suitable, while it does hardly any more for those who have lost faith in it. Whether this is indeed the reason legitimacy has a greater impact on the effects of informal coping strategies than on that of formal safety management and whether these developments might also occur in other companies, we think deserves more systematic research.

A second question our research raises, is how it can be understood that the ethnographic research tradition has consequently been ignored by safety surveys. We can think of at least two possible reasons. First, it can be an unintended consequence of the quest for accumulation of knowledge. In this type of research, validated measurement instruments

and replication research are frequently used, and answers to known research problems are often sought. This falling back on previous research contains the risk of not only replicating valuable research insights but also blind spots. This means the quest for scientific validity by safety climate researchers would unintentionally cloud scientific vision. Secondly, the measurability of both approaches towards safety could play a role. It is easier to measure the presence of formal policy than of informal coping strategies with safety. However, we have shown these coping strategies that are the focus of ethnographic studies cannot be ignored without cost, because they affect safety performances. Thus, there are good reasons to tear down the boundaries between both research traditions.

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