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AN INTERVENTION IN MANAGEMENT TEAMS TO IMPROVE WORKERS' SAFETY CLIMATE. A MIXED-METHODS STUDY OF INTERVENTION PROCESS AND EFFECTS

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ABSTRACT

A safety climate intervention aiming at increasing management safety activity was performed in the management teams of two Swedish dairy producing plants, using a switching replication study design. If the intervention was successful, a second aim was to investigate if such an increase in management safety activity had a lagged effect on organizational safety climate among the production staff. The intervention methodology was based on a functional model of group decision-making and process consultation, with eight meetings with the management teams during one year in each plant. Effects on organizational safety climate were studied through a questionnaire to all production staff in an interrupted time series design with six to seven pre- and post-intervention measurement points, at six month intervals. The analyses were done using multilevel modeling of longitudinal questionnaire data. Intervention processes were evaluated using participative observations and interviews. Results indicated that workers' safety climate may be positively influenced by an increase in management safety activity that need not be large-scale or dramatic. However, the intervention process analyses revealed a number of contextual and process conditions affecting the implementation and thereby the outcome, and that need to be considered in the design and implementation of future organizational safety climate interventions.

Keywords

Occupational safety, safety leadership, safety climate, safety intervention, process evaluation, multilevel analysis

1 INTRODUCTION

Developing effective intervention methods to decrease the number of occupational accidents in working life is important and urgent. A substantial amount of previous research has convincingly shown that a good safety climate is an antecedent of occupational safety (Beus, Payne, Bergman, & Arthur, 2010; Christian, Bradley, Wallace, & Burke, 2009; Kuenzi & Schminke, 2009; Larsson-Tholén, Pousette, & Törner, 2013). Improving safety climate is therefore a potentially strong route to improve occupational safety and reduce suffering, as well as high societal costs related to the often high rates of occupational accidents. This potential calls for research on whether safety climate may be improved through active intervention.

Safety climate is defined as organization members' shared perceptions of policies, procedures, and practice in relation to safety in the organization (Neal & Griffin, 2002; Zohar, 2000). Organizational safety climate theory suggests that a change in safety climate is dependent on a collective reconceptualization among the employees of the degree to which safety is valued within the organization (Zohar, 2008), based on perceptual cues of a change in policy, procedures and practice (Schneider, 1975). Such perceptual cues would largely be dependent on changes in managerial behaviour, since such behaviour signals to the employees what is valued by the organization, and what is not. In accordance with this, workers' shared perceptions of management commitment to safety have been identified as the most robust climate predictor of occupational injuries (Beus et al., 2010). The primary source of such perceptual cues would then be top managers, and the effects would be expected to trickle-down, through lower management levels, to workers (DeJoy, 2005). These perceptual cues would be stronger and have a greater effect on workers' safety climate if the new managerial behaviour is consistent over time and between different managers. Increased management safety activity and safety communication could be expected to be important perceptual cues of management safety commitment and thus be associated with subsequent improvements in workers' safety climate. Despite its potential for improving safety, very little research has been performed on whether safety climate may be improved through active intervention toward organizational management. In some of few such studies, interventions to increase supervisors' safety communication with workers have been found to be associated with positive effects on safety climate (Kines et al., 2010; Zohar, 2002; Zohar & Polache, 2013). These interventions specified what supervisors should do in order to signal safety priority down the line, and implied the premise that managers were in fact ready and willing to communicate safety priority as specified by the researchers. Due to the fact that safety in reality may not always be of highest priority (e.g. due to production pressure, or slow budget processes), or be entangled in union-employer conflicts, local managers may be reluctant to become more safety active. Such reluctance may be driven by a motive to avoid cognitive dissonance (Kenworthy, Miller, Collins, Read, & Earlywine, 2011) due to a misfit between espoused values and actual practice, or to avoid topics of conflict. This situation motivates another intervention strategy that leaves the choice open to participating managers about what is feasible and credible management safety activity in their local context. This implies a participative strategy (Haines, Wilson, Vink, & Koningsveld, 2002), where managers are free to decide and try any activity that they, based on their knowledge of local conditions, regard as feasible and relevant and based on a just and rational problem solving process. Another reason for focusing on managers' safety related problem solving is that this capacity must be developed in order for any activity to result. Safety is a complex issue, and safety leadership may be socially demanding. Research (Fruhen, et al, 2014) has indicated that problem-solving skills are important for safety leadership, and that social competence in terms of being able to understand workers´ perspecives on safety, and to communicate safety effectively, are important for safety leadership. Problem solving as well as managing social situations related to safety may be enhanced by teamwork (Wheelan, 2005), and this speaks in favor of a group-based intervention strategy. A group-based strategy also enables managers to align and coordinate their behaviors and activities with each other. This could increase both the number and strength of workers' perceptual climate cues, and thus increase the impact on the safety climate. It could also help to make changes in managers' behavior more durable.

The present study aimed at testing if an intervention into high-level management groups, based on participative principles, structured according to the functional model of group problem solving and supported by process consultants, could increase management safety activity, and if then an effect could be detected on production staff safety climate. Positive results would strengthen organizational climate theory, suggesting that the primary source of workers´ safety climate is managers' safety related behavior. It would also provide knowledge on effective organizational level approaches to improve occupational safety. However, if an intervention is evaluated solely through its end-outcome, and these results are inconclusive, the underlying theory may wrongly be dismissed. The end-outcomes of interventions in working life may be affected by a number of factors in the implementation process or in the organizational context (Nielsen, 2013; Nielsen, Taris, & Cox, 2010; Nytrö, Saksvik, Mikkelsen, Bohle, & Quinlan, 2000). It has therefore been emphasized, that occupational health interventions should be studied not only from an end-outcome perspective, but also from a process perspective (Nielsen, Randall, Holten, & Gonzalez, 2010). Such an approach makes it possible to a) explain and validate conclusions drawn from statistical tests of end-outcomes; and b) in case of inconclusive end-outcomes, to understand and distinguish between theory failure and program failure (Kristensen, 2005). Theory failure refers to falsification of the hypothesized mechanism of change, while program failure means that the hypothesized mechanism may be valid but has not been possible to test through failure to implement the theoretically determined necessary preconditions. Studying not only intervention effects but also the intervention process could therefore contribute to theoretical development, but also and not least to practical application of research results through the improvement of intervention practice. Few previous empirical studies have been presented where the study of the effects of a management team intervention on production staff safety climate has been combined with a process study indicating contextual factors of importance for intervention success. A reason for this shortage may be that such studies require a longitudinal, mixed-methods design, and as such are highly resource demanding. The present study aimed at contributing knowledge in this scarcely researched area by investigating not only the effects but also the process of an intervention for improving safety climate in Swedish food industry, through a mixed-methods longitudinal design. The specific aims were the following:

Aim 1: To test if an intervention in management groups in food industry, with an intervention strategy featuring group-based action planning, could lead to increased management safety activity.

Aim 2: To test if increased management activity to promote safety was associated with a change in production workers' and team supervisors' (production staff) safety climate;

Aim 3: To identify contextual and within-intervention factors that may have influenced intervention effects.

2 METHOD

The study involved two industrial cases. A mixed methods evaluation approach was used (Bryman, 2006) comprising a quantitative quasi-experimental study of intervention effects on production staff safety climate, and process interviews and participative observations.

2.1 The intervention

Participants and time structure. The intervention was implemented in the management groups (MGs) at two Swedish dairy production plants that were regional branches of a multi-national company in the food industry. These plants and MGs will here be referred to as cases A and B. The MGs represented the highest organizational level at each plant but were subordinate to corporate management. Both groups included a plant manager, a production manager, a technical manager, a quality manager, and a controller. Group A also included two production line managers. The researchers initiated the recruitment, with support from the corporate safety coordinator. At meetings with each MG six months before the start of the intervention, the researchers explained the intervention methodology and the ideas behind it. Subsequently, each MG member was asked about his/her inclination to participate in the intervention, and all were in favour of participation. Each plant manager then took the final decision to participate. The interventions were performed sequentially in the two MGs. The intervention period in each case was approximately one year, and in each case nine three-hour meetings were planned, one per month except during Christmas and New Year season, and during the summer holiday period. All planned meetings were held, except one in group B (MG prioritized acute economy tasks).

The intervention strategy. The intervention meetings were designed to identify safety problem areas, and design, decide on and evaluate MG actions aiming to enhance management safety activity and safety communication, according to a model based on the functional model of group problem solving (Wittenbaum et al., 2004). Similar models also appear in learning theory (Kolb, Boyatzis, & Mainemelis, 2000; Wood, 2003) and working life intervention literature (Cummings & Worley, 1997; Hagberg et al., 1995; Nielsen, Randall, et al., 2010). This provided a circular, stepwise model on how to proceed in participative action planning. It comprised the stages 1) selection of theme or problem to be focused during the meeting; 2) inventory of perspectives on, and analysis of, the chosen theme or problem; 3) search for possible activities to reduce or eliminate the problem; 4) action decision and planning; 5) activity between meetings; and 6) evaluation and reflection at the next meeting. This model will subsequently be referred to as "the learning circle". The first intervention meeting was used to further inform the MG about the intervention design and its theoretical basis. The functional model of group problem solving to structure the action planning process was presented and explained, verbally and visually. This was subsequently repeated whenever needed or requested during the intervention period. At the first meeting, the MG and consultants also agreed upon definitions of their respective roles in the intervention process. It was clarified that in order to help the MGs overcome process obstacles (Nytrö et al., 2000; Wittenbaum et al., 2004), the work along the learning circle would be supported by process consultants (Schein, 1987), i.e. two members of the research team (an organizational psychologist, and a safety researcher with experience from process consultancy, hereafter called "the consultants"). The process consultation focused task structure (Schein, 1987).

Whenever the MG spontaneously worked according to the learning circle, the consultants refrained from interfering.

2.2 The intervention process study: data collection and analysis

Observations. The consultants acted as participating observers at intervention meetings and independently took notes on the themes discussed, the activities decided by the MG, the follow-up of activities that had or should have been implemented, and how the work along the learning circle proceeded. After each meeting, the content of this material was discussed and inductively analysed by the consultants in collaboration. The purpose was to identify themes discussed during intervention meetings, the kinds of activities that were implemented and followed-up, and phenomena that were observed at the meetings that may explain the MGs ability to proceed effectively according to the learning circle.

Interviews with management group members. After the intervention period all participating MG members were interviewed (1-1,5 h) individually by a researcher (not one of the intervention consultants). The method for collecting and analysing interview data was inspired by phenomenography (Bowden, 2000; Marton, 1986; Marton & Säljö, 1976). In line with the qualitative approach, open questions were used that covered perceived safety leadership effects, the intervention process structure, and its management by the consultants. Questions were also asked about obstructing and facilitating factors. The interviews were recorded and transcribed. The analysis was inductive and performed in 7 steps: 1) Preliminary coding of transcripts; 2) preliminary categorization of content. Step 1 and 2 were first performed by each author independently, then 3) the categorizations were critical discussed and revised by the authors in an iterative process until consensus was reached. 4) The first author wrote a summarizing account of each category. 5) These accounts were critically discussed and revised by all authors until consensus was reached. 6) Accounts were condensed further by the first author and presented at validation seminars with the MGs. No modifications were suggested at these seminars. For this article, the accounts were further condensed.

2.3 The quasi-experimental outcome study

Design. The interventions were performed sequentially in the two cases, in a switching replication design with repeated pre-measurements of production staff safety climate (Shadish, Cook, & Campbell, 2002). Through an interrupted time series design, with repeated pre- and post-intervention measurements, each case functioned as a comparison group for the other case (Figure 1). This enabled us to identify secular corporate or branch trends affecting safety climate but not induced by the intervention, in order to minimize the risk of over- or under-estimating intervention effects. The lot decided which case was to be first to participate in the intervention.

Safety climate was measured through repeated questionnaire measurements among all production staff and their team supervisors. Intervention effect was defined as: a) a positive change in the trend (growth rate) of the safety climate, between the pre-intervention and the intervention periods, and b) no such change in the trend in the other case during the same period.

To establish a safety climate baseline for each case, two pre-measurements were performed before the start of the interventions. Repeated measurements were then performed at six-month intervals including two follow-up measurements after the end of the last intervention. The measurements were made at approximately the same time in plant A and B, and each data collection was completed within 2-4 weeks. In all, seven measurements were performed for case A and six for case B. The overall design and times for questionnaire data acquisition are presented in Figure 1.

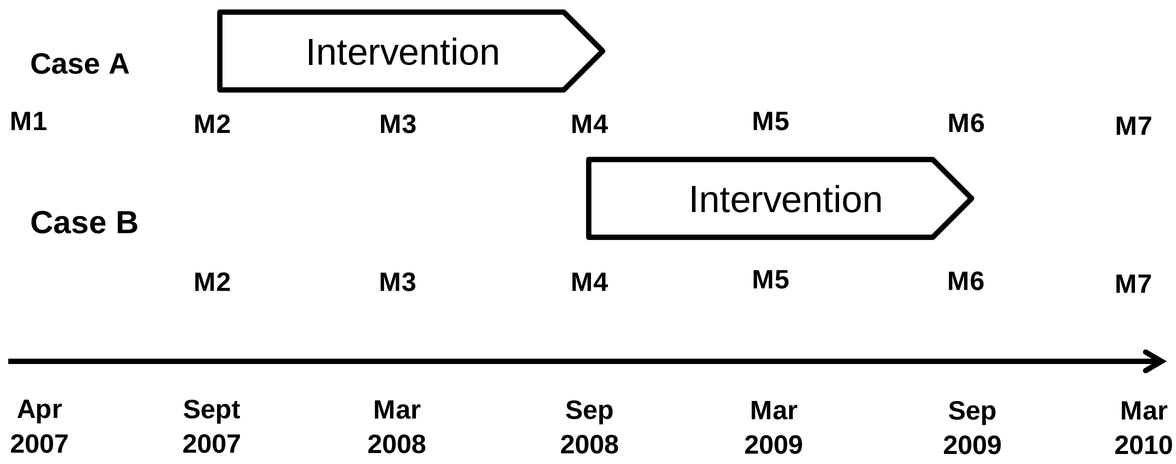

Figure 1. The switching replication design of the quasi-experimental study, and times for the questionnaire measurements at Case A (M1-M7) and Case B (M2-M7). Arrows indicate the intervention periods.

Data collection and participants. Data collection mainly took place at the production facilities during working hours, with a member of the research team present. Employees not present that day got their questionnaire from their supervisor or by mail to their home address. All respondents gave their informed consent to participate. The target group for the questionnaire was 332 - 362 individuals in case A, and 161-172 individuals in case B. The answers from each individual responding more than once were matched throughout the entire period of data collection. Table 1 shows the target group, number of returned questionnaires and response rates for the two cases.

Table 1. Target group, number of returned questionnaires and response rate.

	M* 1	M 2	M 3	M 4	M 5	M 6	M 7
Case A							
Target group	362	332	362	340	336	333	252
Returned valid questionnaires	238	195	187	106	111	54	66
Response rate	66%	59%	52%	31%	33%	16%	26%
Case B							
Target group		169	172	163	161	164	138
Returned valid questionnaires		116	101	111	102	88	80
Response rate		69%	59%	68%	63%	54%	58%

*: M= Measurement

During the seven waves of data collection ("measurements"), a total of 1549 questionnaires were returned by 494 unique individuals, 331 from case A and 163 from case B. This means that most employees answered the questionnaire on at least one occasion. 410 individuals participated at two measurements or more, thus providing information about change.

In case A (at measurement 2) 6.2% had a supervisory position, 9.7% were females, and 27% were temporarily employed. Mean age was 40.4 years (SD= 13.4), and mean tenure was 15.5 years (SD= 12.2). In case B (at measurement 2) 3.4% had a supervisory position, 30.2% were females, and 12.9% were temporarily employed. Mean age was 37.5 years (SD= 12.2), and mean tenure was 14.1 years (SD= 12.2).

Safety climate measures. Management safety priority, and management safety activity and commitment, were the two safety climate dimensions that were the main targets of the intervention and the trajectories of measures of these will be presented. Management safety priority was taken from a questionnaire by Cheyne and co-workers (Cheyne, Cox, Oliver, & Tomas, 1998), further developed and tested in the Swedish construction industry (Pousette, Törner, & Larsson, 2002). It was measured by four items (sample item: “Management accepts that employees here take risks when the work schedule is tight”, reverse coded; Cronbach’s alpha 87 at = 0. second measurement). Management safety activity and commitment was based on a scale from the Nordic Safety Climate Questionnaire (NOSACQ) (Kines et al., 2011) and measured by nine items (sample item: “Management ensures that safety problems discovered during inspections are corrected immediately”; □ = 0.88 at second measurement). For each item there were five fixed response alternatives ranging from “completely disagree” (1) to “completely agree” (5).

2.4 Statistical analysis.

Questionnaire data were analysed by means of linear growth curve modelling. This method specifies change as a linear trend characterized by the level (intercept) and the slope of the trajectory. Both level and slope are allowed to vary across individuals. Thus, there are four parameters describing the data; intercept mean and variance, and slope mean and variance. Since there were three discrete periods during the project time: the pre-intervention, intervention and post-intervention periods, the models were set up as sequential piecewise growth curve models, specifying slope parameters for these three periods. In this way it is possible to make comparisons of growth rate between the periods (Duncan, Duncan, & Strycker, 2006). For estimation, the multilevel modelling software MLwiN ver. 2.22 (Rabash, Steele, Browne, & Goldstein, 2009) was used. Measurements (time) were level one nested within individuals at level two. The estimation procedure has the advantage of not requiring balanced data to obtain efficient parameter estimates, i.e., it does not require the same number of lower level units (measurements) within each higher-level unit (individual) (Rabash et al., 2009). This feature was particularly important in this study where about half of the cells in the data matrix were empty, since the response rate varied. Predictor variables were entered sequentially. First, a random intercept model was specified that decomposed the variation into within-individual and between-individual variances. We then added the three piecewise slope predictors as fixed parameters. Following the design described in Figure 1, the pre-intervention slope variable for successive measurements was coded [0 1 1 1 1 1 1] for case A and [0 1 2 2 2 2] for case B. The intervention slope variable was coded [0 0 1 2 2 2 2] for case A and [0 0 0 1 2 2] for case B, and the post-intervention slope variable was coded [0 0 0 0 1 2 3] for case A and [0 0 0 0 0 1] for case B. As a third step, all three slope variables were added as random variables. The models were set up for each climate dimension and separately for case A and case B. Parameter estimates from these models were used to calculate predicted values, presented in Figures 2-3. In order to evaluate the intervention effect, the change in growth rate between the pre-intervention and intervention phases was calculated as the difference between the slope coefficients for successive phases. Standard errors and p-values for these difference scores were obtained by specification of change-in-slope models, where the slope variables where re-parameterised as follows: the overall slope variable for successive measurements was coded [0 1 2 3 4 5 6] for case A and [0 1 2 3 4 5] for case B. The change in slope variable between pre-intervention and intervention phases was coded, [0 0 1 2 3 4 5] for case A and [0 0 0 1 2 3] for case B, and the change in slope variable between intervention and post-intervention phases was coded [0 0 0 0 1 2 3] for case A and [0 0 0 0 0 1] for case B. The probabilities for estimated parameters being equal to zero were calculated using the Wald test (Hox, 2010). Parameter estimates where $p<0.10$ are reported in the results section and further discussed.

3 RESULTS

3.1 The process study

Observations

Discussion themes during intervention meetings. Talk about difficulties to make the production system completely safe, and a less than optimal safety climate at all levels in the organization, tended to occupy much time at all meetings in both MGs. These problems were well known, complicated and recognized as difficult and/or expensive to manage. No activity resulted from these discussions.

Group A managed to stick to certain themes related to safety communication and to policies, procedures, and practice in relation to safety, and pursue them through all stages of the learning circle and during the major part of the intervention period. The most consistent theme in group B was to question the ideas and methods of the project and to challenge the consultants. No action planning resulted from this, indicating that failure to establish a working alliance between group and consultants had a negative influence on intervention effect.

Action planning and implementation. In both MGs actions were planned and implemented, but MG A produced more activity than MG B, and the activity in A was of a more proactive character. MG A consistently followed themes related to management safety commitment and safety communication, meaning that the MG made itself visible in a safety context to subordinates, or made decisions that led to changes in organizational routines and practice: 1) The incident/accident reporting routines were revised, updated and communicated down the line. 2) A one-day seminar was arranged with all supervisors and union safety representatives, at which the importance of reporting, managing and following-up risks was emphasized. 3) The MG made safety rounds at all departments to inform themselves about local risks and safety needs. 4) Safety was made a mandatory issue on daily production meetings. 5) A system for visualising safety information and scores was implemented in the production facilities. 6) New safety introduction routines for new employees were implemented.

Thematic consistency (management commitment to policies, procedures, and practice in relation to safety) during the intervention process thus made likely a positive influence on shop-floor safety climate. In MG B, clarification of a legal issue facilitated implementation of new safety routines decided independently of this project. This activity implied little MG visibility as safety leaders. This low degree of MG B safety activity did not prompt any expectations concerning shop-floor climate effect.

Interviews with MG members

Positive effect-influencing conditions. Members of MG A expressed an impression that the project had contributed to developing the MG as a team. MG A members´ also expressed appreciation of the process consultants´ efforts to structure and guide the group´s work along the learning circle. Otherwise, virtually no positive effect-influencing factors were mentioned in the interviews.

Many effect-attenuating conditions were mentioned. These referred to conditions that existed independently of the present intervention, as well as conditions related to the intervention process.

Effect-attenuating conditions that were independent of the intervention.

Different types of conditions were identified that contributed to resistance towards more active safety leadership, and caused difficulties when it came to identifying targets for more active safety leadership:

Structural background conditions:

1) Priority of short-term economic outcomes and rewards: Short-term economic results, not safety, were, in practice, requested by corporate management, and therefore prioritized by the MGs. There was also a perception that the production workers would resist more active safety leadership, because piece wage systems and short-term convenience tended to reward risk-taking.

2) Lack of economic resources to solve identified safety problems. Strictly limited budget for passive prevention and slow corporate budget processes, created long delay between identification of safety problems and investments to fix them.

3) Less than satisfactory systems and routines for monitoring safety in the plant. This was seen as a cause for uncertainty about safety in the MG:s, and caused difficulties when it came to identifying targets for more active safety leadership.

4) External threats: Corporate signals that plant B may be considered for closedown, competed for attention with the present project.

Factors related to social aspects of safety leadership:

1) Risk-taking and non-compliance with safety routines was to some extent accepted practice in production. More active safety leadership would have to confront such behavioural patterns and corresponding norms, which was seen as a very difficult task, since, at the same time, the economic structures rewarded risk taking.

2) Safety leadership implies visibility and accountability: Safety could be an issue for hard negotiation, rather than collaboration, between managers and unions. Also, workers were critical against MG members for failing to take action against identified risks. Becoming more active and visible as safety leaders would imply the risk of being confronted by frustrated workers, without having control over the resources necessary to eliminate identified risks.

Attributes of the MG.s themselves: 1) Safety was not regarded a suitable issue for management groups: Neither of the groups were accustomed to regarding safety as a strategic issue deserving focused attention by the MG, nor something to manage proactively. Safety was normally an issue for lower operational levels in the organization. This caused resistance towards the central idea of the intervention – to make the managers more active as safety leaders. It also contributed to:

2) Insufficient safety competence: Management of safety was seen as requiring specialist knowledge, e.g. technical and legal. Such knowledge was perceived as lacking in the MGs, as well as among support staff. Swedish managers are legally obliged to be well-informed about safety conditions, so more active safety leadership implied that this lack of knowledge would be openly exposed. The insufficient safety competence also caused difficulties when it came to identifying targets for more active safety leadership.

3) Risk acceptance: Members in MG B said that a "reasonable" level of safety was considered acceptable and that they were not motivated to improve it beyond that. Safety in case B was largely managed reactively.

4) Poor ability to function as a problem-solving group: The MGs did not normally work with group-based problem-solving and action planning. Rather, the MG tended to be a forum for individual reporting to the plant manager, and task allocation. In group A, poor discipline, and defensiveness were mentioned as general characteristics of the group. This involved sloppy implementation of decisions, coming to meetings unprepared, and a general difficulty in maintaining focus during meetings.

Within-project conditions that attenuated project effects on safety leadership. MG members told about several sources of dissatisfaction with the way work in the project groups had proceeded. Most of these appeared in both cases and concerned the difficulties the groups had to work according to the learning circle model, and to understand and accept their own and the consultants´ roles in the project.

1) Failure to communicate and/or understand the respective roles and obligations of the MG members and the consultants. In MG B, members did not understand the method and their role in it. Participation in the project was associated with a weak sense of personal responsibility and an attitude of waiting for the consultants to take initiative and lead. This MG expressed confusion and frustration. The collaboration between MGs and consultants worked better in Case A.

2) Dependence on and ambivalence towards the consultants: Informants from both MGs stated that the consultants ought to have been more challenging, demanding, driving, critically evaluative, confronting, directing, and teaching. (Note that this was not their agreed role, see Method). In MG A, however, the consultants were also seen as having been helpful in contributing to structure, reflection and analytical work (which was their role).

3) Planning failure: During the project, MG members had realized that the project demanded more time and engagement from themselves than they had expected and were prepared to invest. Insufficient information, as well as weak directions from plant managers and/or the researchers, were put forth as causes of these problems.

4) Difficulties in selecting safety issues to approach: Participants of both groups stated that too much time had been devoted to operative issues, such as incident reporting. However, in case A this had led to concrete activities with relevance for safety leadership. Still, members in MG A had observed uncertainty and resistance when action alternatives were considered, that would have made the MG itself visible to subordinates as safety leaders. In MG B, some members considered talk about operative issues to be unsuitable at the MG-level, and this caused frustration and tension between MG members.

5) Low ability to design, implement and follow-up activities: Both groups had a tendency to get stuck in the early stages of the learning-circle. Action planning was impeded by difficulties in identifying and agreeing upon safety issues to work with. When issues were identified, they mostly concerned complicated problems that the groups had tried and failed to solve before. Therefore, the process got stuck and decisions on and allocation of responsibility for activities tended to become diffuse. Group A succeeded in implementing and following-up activities focused on risk communication, while in group B almost no work according to the intentions of the project was accomplished.

6) Low activity between project meetings, due to unclear safety priority: Diffuse allocation of responsibilities among MG members, unclear project aims, unclear safety priority, and insufficient guidance and initiative from the plant manager were attributed as causes for low inter-meeting activity, and was reported in both groups.

7) Negative emotions and fantasies evoked by the project: Participants told about worry, shame, confusion, and resignation. These emotional reactions acted against openness in the work process, and impeded action-

planning, follow-through of discussion themes, and follow-up of decisions. The emotions were triggered by the perceived lack of structure in the MG project work, or the awareness that one did not contribute according to the agreement. From MG A, members told about an ethical dilemma caused by the tension between concern for economy and concern for people´s health and safety. From MG B, members told about feelings of meaninglessness and ridicule, and about a perception that the consultants/researchers had a hidden agenda, namely to study the dynamics in the MG, and that action planning for safety leadership was just an excuse for this. From such a point of view, serious attempts to tackle safety issues in the project group seemed less meaningful to the MG.

3.2 The quasi-experiment

There were substantial differences between the two cases in both safety climate dimensions (Figure 2-3). Case B showed higher initial ratings of both Management Safety priority, and Management safety activity and commitment. Tables 2 and 3 present estimates for trajectories of the three phases of the project, for the safety climate dimensions, while Figures 2 and 3 visualise these estimated trajectories.

Management Safety priority. In case A, the slope mean during the pre-intervention phase was very close to zero, indicating a stable state in this climate variable. During the intervention phase, the trajectory turned to be increasing (positive slope, p=.07), but changed (change in slope p=.07), to slightly decreasing (negative slope p=.16) during the post intervention phase. In case B, the slope mean was close to zero during all three phases, indicating a stable safety climate (Figure 2). These results indicated a moderate positive effect of the intervention in case A, which declined after the intervention. No effect was seen in case B.

Management safety activity and commitment. In case A, the trajectory was decreasing (negative slope mean p=.05) during the pre-intervention phase. This indicates an on-going decline in this climate dimension before the intervention started. During the intervention phase, the trajectory turned to be slightly increasing (change in slope mean p=.05, positive slope mean p=.19). During the post-intervention phase, the trajectory again turned to decreasing (change in slope mean p=.07, negative slope mean p=.05). In case B, the slope mean was close to zero during all three phases (Figure 3). Again, these results indicate a positive effect of the intervention in case A, which declined after the intervention, while there was no effect in case B.

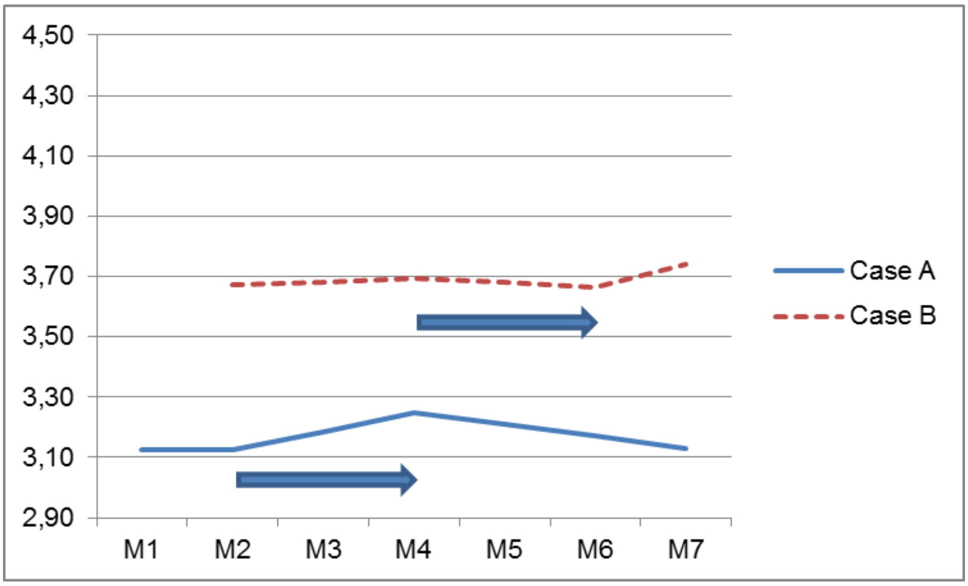

Figure 2 Estimated values for safety climate dimension Management safety priority during pre-intervention, intervention and post intervention phases. Estimated from Model 3 with random slopes. The full scale range is 1 to 5. Arrows indicate the intervention periods.

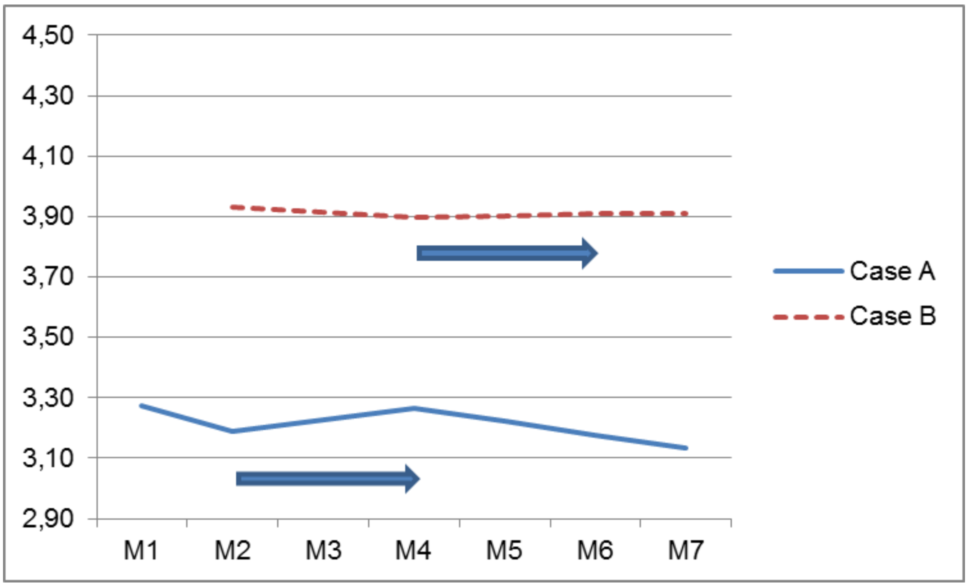

Figure 3 Estimated values for safety climate dimension Management safety activity and commitment during pre-intervention, intervention and post intervention phases. Estimated from Model 3 with random slopes. The full scale range is 1 to 5. Arrows indicate the intervention periods.

Table 2. Estimates of trajectories of safety climate dimension Management safety priority during pre-intervention, intervention and post-intervention phases, and change in trajectories. Estimated from model 3 with random slopes.

Fixed Effect	Coefficient	SE	z-value	p
Case A				
Intercept	3.124	0.062	50.387	0.000
Pre-intervention slope mean	0.000	0.056	0.000	1.000
Change in slope mean	0.062	0.077	0.714	0.475
Intervention slope mean	0.062	0.034	1.824	0.068
Change in slope mean	-0.101	0.053	-1.811	0.070
Post-intervention slope mean	-0.039	0.028	-1.393	0.164
Case B				
Intercept	3.672	0.082	44.780	0.000
Pre-intervention slope mean	0.010	0.047	0.213	0.832
Change in slope mean	-0.023	0.069	-0.333	0.739
Intervention slope mean	-0.013	0.040	-0.325	0.745
Change in slope mean	0.088	0.090	-0.333	0.739
Post-intervention slope	0.075	0.084	0.893	0.372

Table 3. Estimates of trajectories of safety climate dimension Management safety activity and commitment during pre-intervention, intervention and post intervention phases, and change in trajectories. Estimated from model 3 with random slopes.

Fixed Effect	Coefficient	SE	z-value	p
Case A				
Intercept	3.274	0048	68.208	0.000
Pre-intervention slope mean	-0.084	0.042	-2.000	0.046
Change in slope mean	0.121	0.062	1.952	0.051
Intervention slope mean	0.037	0.028	1.321	0.186
Change in slope mean	-0.080	0.044	-1.818	0.069
Post-intervention slope mean	-0.043	0.022	-1.955	0.051
Case B				
Intercept	3.931	0.053	74.170	0.000
Pre-intervention slope mean	-0.017	0.026	-0.654	0.513
Change in slope mean	0.023	0.044	0.523	0.601
Intervention slope mean	0.006	0.029	0.207	0.836
Change in slope mean	-0.005	0.065	-0.077	0.939
Post-intervention slope	0.001	0.054	0.019	0.985

3.3 Post-intervention observations

Post-intervention observations are included as results, because they illustrate contextual conditions of relevance for evaluating the practical impact of the present kind of intervention.

In case A, the plant manager (quit), the technical manager (quit), the quality manager (retired), and one of the department managers (retired) were replaced within a year after the intervention period. About a year after the intervention, corporate management decided to close down plant B and move the production abroad. In 2013, decisions were made to close down plant A and reopen plant B.

4 DISCUSSION

Could the intervention lead to management activity to promote safety and increased management safety communication?

In Case A, the intervention mechanisms could, to a certain extent, be implemented, and immediate effects in terms of increased management activity to promote safety and safety communication were observed. In Case B, the results from the process study indicated program failure. Although the structural intervention mechanisms could be implemented, no immediate effects in terms of proactive action planning were observed. In both cases, and most predominantly in case B, we were able to identify several contextual and within-intervention factors that counteracted intervention effects.

Could change in safety climate be attributed to management safety activity?

A series of management activities and decisions with relevance for safety leadership were observed in case A. During the same period, the quantitative climate measures of Management safety activity and commitment in plant A showed a change (p=0.05) in the slope, from negative to positive. In Case B, serving as comparison case for the within-corporation trend, no corresponding changes in slope were observed. These results offer support for safety climate theory since they indicate that increased management safety activity may lead to an improvement in production-staff safety climate. This implies that intervention into management safety activity could be a way to improve safety climate and occupational safety in industry. However, post-intervention, when substantial MG member turnover was on-going or imminent in case A, a change in slope, from positive to negative, was observed for both climate dimensions (p=0.07). In order to be insensitive to such substantial organizational changes and sustain employee perceptions of high management safety priority and engagement, new ways of working with safety in MGs need to be well established and integrated with MG working procedures and structures. Finding ways to achieve this is an important issue for future intervention research, and may be guided by the results of the process evaluation in the present and other empirical intervention studies.

Contextual and within-intervention factors that counteracted intervention effects.

In preparing the MGs for the intervention, much emphasis was placed on explaining the process consultative role (Schein, 1987) of the researchers, and that it was the MGs' responsibility to choose, plan and perform the safety activities. Both groups, but most notably B, still had difficulties in accepting and working according to these agreements during the intervention. Further, process data indicated that the intervention was sensitive to the priority-in-practice of safety being low or uncertain, partly due to budget restraints and high espoused while low factual assigned priority of increased safety from corporate management. MG members were also uncertain about the degree to which safety concerns were part of their job roles, since safety was seen mainly as an operative rather than a strategic issue. These aspects, observed also in other intervention research (e.g., Beer, Eisenstadt, & Spector, 1990; Nytrö et al., 2000), should be critically evaluated and be part of stricter inclusion criteria for this kind of intervention.

Specific operational and other problems beyond the control of MGs tended to occupy much time, leading to no action, causing frustration, and possibly serving a defensive function by facilitating the MGs' avoidance of problems related to their capacity to work as safety-leading teams (Wheelan, 2005). These problems contributed to a modest (Case A) or no (Case B) intended effect, and also caused negative emotions of shame, confusion, and resignation among participants. Such emotions, in turn, may have had a negative influence on participant engagement in project activities and on the working alliance with the consultants. We presupposed that the MGs were effective problem solving teams, wishing to develop their safety leadership. Earlier empirical studies (Eklöf & Törner, 2005; Stave, Törner, & Eklöf, 2007) suggested that interventions similar to the one performed here could be effective in promoting safety activity. Those previous studies, however, were performed in groups of independent farmers or small, independent fishing crews. In contrast, the present intervention was performed in groups dependent on superior corporate management decisions. The present intervention also aimed at influencing management groups´ coordinated action based on teamwork, including shared goals related to safety. We think that the modest (Case A) or absent (Case B) intervention effect was due partly to the fact that the process-consultative strategy put too little emphasis on developing and supporting the MGs' ability to function as effective teams (Wheelan, 2005). Other research found social competence to be important for safety leadership (Fruhen, et al, 2014). Such competence is important because safety leaders must be able to understand workers´ perspectives on safety, and to communicate safety effectively to workers. Our results indicate that social insecurity in front of frustrated workers acted to attenuate intervention effects. However, in Case A, the intervention, helped to overcome social insecurity, as the MG jointly took action to communicate safety on the shop-floor level and with worker representatives. Oakland and Tanner (2007) pointed out that successful change management demands readiness-for-change. Weiner (2009) presented a theory on organizational readiness-for-change, and identified two dimensions of this phenomenon; for one, the organizational members' belief in their collective capability to implement change (change efficacy), and for the other, their shared resolve to do so (change commitment). In the present study, process results illustrated a lack of both. This indicates the necessity for consultants to ask participants to evaluate their change efficacy in relation to any subject suggested for action planning in this kind of intervention.

Limitations

The quasi-experimental results should be interpreted cautiously. First, the two cases were not equivalent at baseline, and thus problematic as comparison groups in the switching replications design. Intergroup comparisons of climate measures should also be done with caution. The safety climate was lower in Case A, which may have caused the MG to be especially motivated to improve, i.e., selection bias could not be ruled out. Secondly, Case A, in its function as comparison group to B, was in a post-intervention phase and was also subject to turnover, and thus not entirely valid as a model for "practice as usual".

Further, the decrease in response rate in later safety climate measurements may have decreased the sensitivity to detect changes as well as induced a risk of the collected observations not being fully representative of the staff. However, the ideal conditions of a randomized, controlled study are very difficult to set up in organizational research and particularly so regarding an intervention study of the present kind. With this and the limitations mentioned above in mind, a quasi-experimental switching replication design, as the one applied here, does offer some reference against which data may be interpreted.

We have interpreted results with p-values higher than the conventional $p<0.05$. This, of course, makes our outcome conclusions weaker. However, organizational safety climate theory stipulates that a climate change is dependent on a collective reconceptualization of the degree to which safety is valued within the organization, based on perceptual cues of a change in policy, procedures and practice, largely emanating from managerial activities. Such a process is obviously not a quick one, and we interpret the fact that we obtained measurable results of improved shop-floor safety climate in case A, that with a more than ninety percent probability were not random, as support for the intervention theory. A strength of this study was the possibility to connect climate measures and inter-case comparisons of these to results from the process study. The fact that the qualitative studies gave reason to expect a positive intervention effect in case A, but not in case B, further strengthens the quantitative results, showing the same. This mixed methods study design enabled us to connect climate change to observed activity and contextual factors, and revealed several ways to improve the implementation strategy in future safety climate interventions.

Conclusions

Our results indicated that production staff safety climate can be positively influenced by management safety activity that need not be extremely intense or dramatic. This offers empirical support for the organizational safety climate theory. Our results also suggested that a group intervention, based on experience-based learning, supported by process consultants can achieve an increase in such management safety activity. The qualitative studies also revealed that this type of intervention is vulnerable to several sources of disturbance. The results of the study may therefore be helpful in the future design of similar interventions, in order to avoid and proactively deal with the identified contextual and within-intervention sources of disturbance.

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