

Safety culture change in two companies

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Abstract: As part of an initiative of the Dutch Ministry of Social Affairs and Employment an evaluation study was undertaken in 17 companies undertaking safety interventions to improve safety performance through changes to safety culture and management. Overall results of the evaluation of all 17 interventions [2, 3] showed that dialogue with employees about safe working, top management support and a charismatic, creative and persistent coordinator of the project were characteristics of the successes when compared to the failures. One of these initiatives, in a reinforced concrete element construction company, appeared to be particularly effective according to the available outcome and intermediate measures. It had these three characteristics alongside a number of others. This paper describes the intervention, indicating how broad-ranging it was in the changes made. Its major elements involved workers and first line supervision much more in the detection, reporting and decision making about ways to remove the hazards. There was also a major emphasis on altering risk perceptions through risk awareness workshops. The performance data available for this study consisted of injury data covering the three years before and the four years after the start of the intervention, together with data from systematic observations of behaviour. The improvements in behaviour, safety climate and the decrease in injuries were highly significant. The paper contrasts this with an intervention in a fork-lift truck maker, which shows many of the same intervention elements, but has only some of the positive changes, with the main reduction of injuries occurring before the main interventions were introduced.

Keywords: Safety dialogue, culture intervention, evaluation.

1. INTRODUCTION

Between 2003 and 2008 the Dutch Ministry of Social Affairs and Employment subsidised 23 projects to strengthen the safety culture, management and performance of the companies involved. The companies received from the Ministry 50% of the costs of the proposed intervention to achieve this result. The companies were free to propose any intervention that fell broadly under the heading of culture improvement. The Ministry assessed and approved the proposal, making the proviso that all must have as objective at least a 15% reduction in lost time injuries² compared to a reference year, that all must allow the use of a safety climate questionnaire [1] before the intervention, and during and after the evaluation period, and that companies should make available all records and statistics for the purposes of evaluating the success of the interventions and be open to interviews about how it was conducted.

The Ministry also funded a scientific evaluation of 17 of the intervention projects, , conducted by Delft University of Technology, which developed a measure of success, based on the available data trends, and reported on the findings. This study made an analysis of which types of interventions across the 17 projects appeared to be most associated with significant positive changes in safety performance and which did not discriminate between companies with significant performance improvements and those

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² Defined as absence on the day or shift after the one on which the accident occurred.

without [2, 3]. The summary paper [3] provides a broad overview of important factors for success. The most important of these were the following:

- A successful means to involve the work floor operators in a dialogue with the first line supervision either through behavioural observation rounds and discussion of good and bad behaviour by supervisors, or through empowerment of work groups to undertake simplified last minute risk analyses before starting on a task, and discussing the results with their supervisor if they were not able to answer ‘yes’ to the range of about half a dozen check points (sometimes called ‘STOP-GO cards’);
- Encouragement of the reporting of dangerous situations and near misses by the work floor;
- Training workshops for directors,
- Active support and participation by directors in the intervention and in safety
- An active, persistent, creative coordinator of the intervention programme, usually the safety professional or working conditions coordinator
- A coordinated, thematic approach to the intervention(s) and a large number of different interventions
- Key performance indicators (KPIs) for managers related to the implementation of safety measures (but not if the KPIs only addressed safety outcomes such as accidents or absence)
- Introduction of (additional) audits and inspections and attitude measurement surveys with feedback to the workforce and supervision.

Factors which did not discriminate between successful and unsuccessful companies included whether the company was involved in reorganisation, take-over or other difficult financial or market conditions, including turnover of directors, improvements to the safety management system and work procedures, making them more systematic and achieving certification of the SMS, safety training for line management and workforce and the extensive use of publicity and information channels. The last two factors may be necessary, but not sufficient, elements of an intervention, because most of the companies whether successful or not made use of them.

Other papers, in Dutch, have provided deeper insights into two of the projects [4, 5], which are presented here for the first time in English. They provide interesting case studies to enrich our understanding of what makes a successful intervention and what are the issues arising in establishing that it is a success and searching for the causal factors in that success. The data available for evaluating the interventions came from the company’s own recording of lost-time accidents and dangerous incidents, and from initiatives as part of the interventions to measure (un)safe behaviour. The accident data are all of frequency rates per million man-hours worked, thus controlling for changes in numbers of employees. The information about the interventions, about the level of safety management and culture in the company at the start of the intervention and the changes brought about, and about any other changes to the organisation, market and economy affecting the company, were collected by the first author, through two visits to each company, interviews with the responsible managers and intervention coordinators (including the 2nd and 3rd authors) and study of company records and documentation. The safety climate questionnaire [1] was developed in an earlier project and administered by another research organisation (RIGO). The results of the three applications per company, before, during and after the intervention period, were provided to Delft University for further analysis. Sections 2 and 3 describe the interventions introduced in companies A and B, the performance measures available and the results obtained over the 8 year period from three years before the intervention to four years after it. Section 4 discusses the results and how they can be interpreted.

2. COMPANY A: A CONCRETE IMPROVEMENT

2.1. The company

Company A manufactures large-scale precast reinforced concrete elements (floors, foundations, pipes, etc.) for installation in the construction industry. It has three Dutch sites, employing approximately

700 workers, many immigrants. 5% have no basic education and 67% have only the lowest level of schooling or technical training. The work is very heavy, both manual and machine work; the concrete elements are extremely heavy and bulky to lift and manoeuvre. The prevailing culture in the company was described by the safety manager and company management as of a 'macho' style, valuing hard work, robust working relations, and achieving production as a priority; a place for hard men and not 'softies' and one where accidents were accepted as a normal part of work. The company decided to take part in the programme partly as a result of having had two fatal accidents (in 2002 and 2003), and with the objective of reducing its lost-time accidents by at least 15% compared to the reference year of 2003. The intervention programme can be best described under six headings, referring to its main elements. These should be seen as interwoven strands, rather than as independent programme elements. The numbers in brackets give the month and year when the programme element was carried out – e.g. 06.04 = June 2004.

2.2. The interventions

2.2.1. Intervention programme design and conduct

One of the findings of the overall evaluation study of the 17 projects was that there was a steady flow of changes being made all the time in most of the companies studied, making it difficult to define a tidy start or end point for the interventions to be evaluated. This was also the case with Company A. Over the period from October 2003 to the end of 2007 we could distinguish 28 different changes or interventions aimed at one or other element of safety and risk control. However the occurrence of a fatal accident in October 2003 and the major change in attention to safety that that sparked off provides a convenient point to label as the starting point. It was seen by all concerned as a step change in attention to safety. The official launch of the change programme was defined by the company as the beginning of February 2004. Therefore 2004 is taken as the intervention year.

The intervention was developed, coordinated and run by the company safety adviser (2nd author of this paper), who's appointment to the company dated from immediately after the fatal accident and can be seen as the first intervention. The remaining months of 2003 were taken up with an intensive round of discussions between him and all members of the management team, to discuss their attitudes, their beliefs about the causes of the safety problems, and their commitment to the proposed program. In particular, many examples of unsafe situations and behaviour were collected during tours around the works and during the interviews and managers were confronted with the fact that they apparently seemed to accept these as 'normal'. At the end of the interviews each manager was asked to make a personal commitment to the program in a visible form, e.g. 100% attendance of steering group meetings, giving the opening words at training workshops, agreeing not to turn a blind eye to dangerous situations, providing exemplary behaviour in the use of personal protective equipment (PPE), following safety rules, etc.

In preparation for the start of the program in 2004, as addition to the appointment of the new safety adviser, 'safety, working conditions and environment coordinators' were appointed for each product group (10.03). A system of reporting of dangerous situations and near misses was also introduced for the company's own employees (extended later [01.06] to all contractors and temporary hired workers).

The company appointed a steering group (01.04) to provide the necessary link to and buy-in from the company operations and to develop the principles for the programme and to work these out into themes for action. The group was chaired by the manager director and later by a production director, with the safety adviser as coordinator and had representatives of the different management levels and the joint working conditions committee. It formulated four principles: fulfilling the law as minimum standard, treating safety as or at least equal priority to production, managers showing exemplary behaviour on safety and the right and necessity for all employees to challenge each other on safe and unsafe behaviour. The themes for the programme (01.04) were based on the statutory risk inventory and evaluation, on accident analysis and on personal risk perceptions of managers. The themes were then passed to working groups formed within the departments to work out the details of design, layout,

logistics, procedures, instruction, workshops, maintenance implications and use of standardisation and certification. The programme was launched in February 2004 with considerable publicity, which continued throughout the period in the form of posters, flyers, publication boards and news sheets.

2.2.2. Management involvement

Considerable attention was paid to achieving management buy-in. The initial efforts have been described in section 2.2.1 above. As a result of this the management explicitly gave their fiat to the programme and its inclusion in the Ministry project. As part of the launch (01.04) the whole senior management were involved in a kick-off meeting where the programme was explained in full, where their own assessment of the most important safety risks were elicited and discussed, as well as their views on what would make the project a success. The meeting distilled the ones where there was most agreement and made them explicit in policy and objectives and elicited personal commitment from each manager to them.

As part of the preparation KPIs had been defined for the different levels of management (10.03). They were formulated in terms of a target accident frequency and absence figure not to be exceeded, reviewed monthly and decreasing with time. These were given the fiat by the kick-off meeting. However, it was found that they were often not met and were felt to be too arbitrary and subject to chance factors to be appropriate, as they did not relate in any clear way to the safety measures being taken. After some time they were relegated to a more minor position and only reported on annually instead of monthly, when they did appear to be more indicative.

Managers also took part in training programmes to introduce the observation rounds described in the next section. Special workshops were introduced (10.04) for the project leaders working on clients' construction sites to train them in risk assessment and risk control.

The programme enjoyed support from the directors of the company, particularly between late 2006 and early 2007 when there was extremely active involvement from the general manager. After he moved to a company newly acquired by Company A the support from the two product directors was less active, but still broadly supportive

2.2.3. Improved safety management system (SMS) structure and functioning

The appointment of a new safety advisor and product group coordinators has been mentioned in section 2.2.1. This strengthened the infrastructure of the SMS and provided the motor of the programme in the person of the safety adviser, who had a proven track record of improving safety in his previous company.

Later in the programme the risk inventory and evaluation part of the SMS, leading to the safety plans were improved (01.05) and the SMS was submitted for the Dutch VCA scheme for certification of the SMS of contractors for work on (construction) sites (12.05). Better procedures were also introduced (05.06) for work in particularly dangerous circumstances (work at heights, electricity, confined spaces, etc.)

2.2.4. Awareness programme and confronting of behaviour

The heart of the intervention programme was the awareness programme and the related programme of behavioural observation and confrontation rounds. They were both aimed at establishing a dialogue between workforce and supervision, and behind them the management and safety professionals, about the safe and unsafe ways of carrying out all the activities and tasks in the company. The observations were not passive, but active, explicit praise for good behaviour and a discussion about why apparently unsafe behaviour was observed and what would be appropriate behaviour, leading to correction, or sometimes to modification to the workplace to make the safe behaviour more possible or attractive.

The awareness workshops of 3 hours (03.04) were given to all employees (and temporary and contractors staff) in groups of 15 and consisted of brief presentations of safety principles, but mainly elicitation and discussion of examples of risk-taking by the participants at work and at home, presentation of a film designed to arouse emotions and presentations by accident victims from the company about the consequences to them of having suffered the accident. This combination of rational and emotional presentations was rounded off with a public commitment by each participant to a visible change in behaviour, which was recorded, communicated to the worker's family in a letter and checked on at a later date to see if it had been carried out. One difficulty with this intervention was the language ability of the workforce. After initial problems with a number of immigrant workers, the workshop was later given in the mother tongue of the main groups, with the help of an interpreter. After 03.2006 all new employees received the awareness training as part of their induction training, which was commenced at that time.

When these awareness workshops were well under way, training courses (two half days) were begun initially for managers (06.04) and later for project leaders (05.05) and for foremen (08.06) in the conduct of behavioural observation rounds. In total, some 120 of the workforce of 700 received this training. This covered the theory of safety awareness, the safe behaviour objectives of the rounds as explained above, definitions and examples of unsafe behaviour illustrated with photos from the company, communication skills to be able to praise good behaviour and confront and discuss unsafe behaviour in a positive sphere and with respect for the workforce. The workshop finished with a practical session on conducting the observation rounds. Once this training had been completed, first the more senior managers (07.04) and later the project leaders (06.05) and foremen (09.06) began conducting the rounds, recording their observations of unsafe behaviour and the seriousness of its potential for injury, and discussing it with the workforce. The aim was to create a forum for discussion of safe working methods and procedures, to reduce the psychological distance between the work-floor and the management or office and, if necessary to modify and improve workplaces and methods. This also brought the senior management much closer to the reality of daily work and taught them to break through the taboo on discussion of work practices which typifies a macho culture. 74 rounds were conducted in the remainder of 2004 and between 132 and 151 per year in the subsequent three years.

The observations from these rounds also form the basis for monitoring of trends in unsafe behaviour – see the results section for these trends. The observers recorded how many workers were observed, how many unsafe operations they showed among them and what the potential result could be; death, serious injury or minor injury.

2.2.5. Monitoring and feedback

The feedback to the workforce from the observation rounds was an important aspect of monitoring. In addition, the reporting of dangerous situations (10.03 for employees and 01.06 for contractors & other hired-in staff), and improvements in the analysis of accidents and incidents (02.04) also provided more monitoring information. A board at the factory gates recording days since the last accident was also introduced as a feedback mechanism (10.06), giving rise to much discussion and controversy as to whether this was a good idea. Locations which achieved 100 days without a lost time accident were rewarded with a golden star and cake/tart for the entire workforce.

2.2.6. Thematic safety improvement

Resulting from all of the changes mentioned above, there were many specific actions taken to improve safety in specific tasks and activities, derived from the themes developed in the steering group (2.2.1). These were regularly linked to the publicity material (posters, flyers, newsheets, etc.). Such changes concerned: safe driving training for fork-lift truck drivers (05-06), training in safety in lifting for about 300 staff (06-07), safe loading training for about 100 lorry and internal transport drivers (05.06), internal transport safety at locations (high visibility clothing, route signposting, route lining, control of visitors) (05.07), speed measurements of drivers on site with a laser-gun and feedback/discussion of

results (10.07), a campaign on slips, trips and falls (08.07). In addition, there were many small improvements in workplace design, layout and work methods stemming from the earlier interventions.

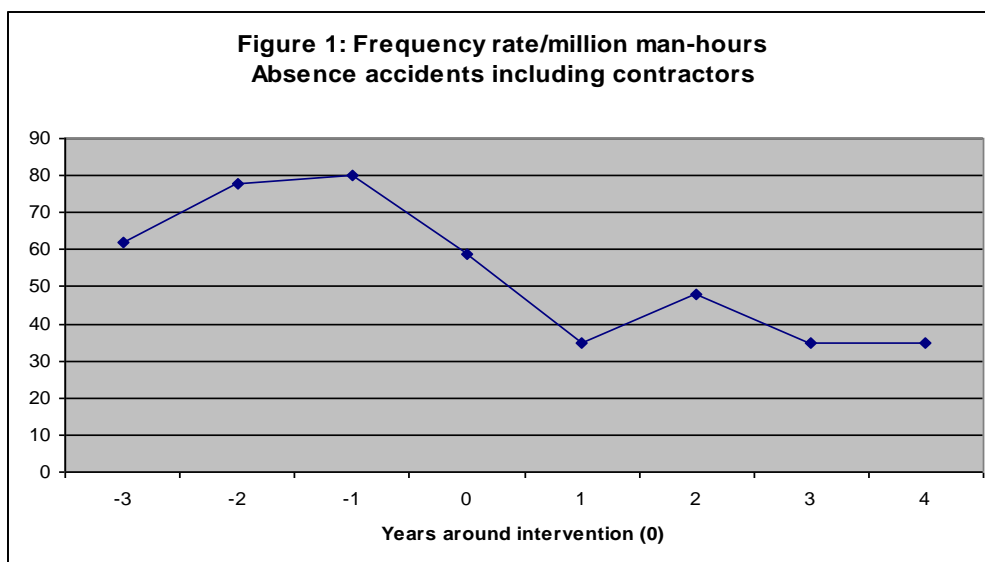
2.2.7. Other non safety changes and influences

During the period of the study there were other changes in the company. It had been taken over by another firm in 1995, but left for the next ten years to run itself more or less as before. However, in 2005 a programme of integration of the two firms was launched. This affected management in the first instance with an increased emphasis on professional development and ‘competence-directed management training’, which included introduction of regular appraisal interviews, coaching training and the despatch of a number of managers to MBA courses. The market for the company’s products was severely hit by recession in late 2004 and early 2005 and again in 2006, lasting through to 2007. At one of the three locations studied this resulted in a 60% reduction in production and a large-scale redundancy programme.

2.3. Results

2.3.1. Accidents

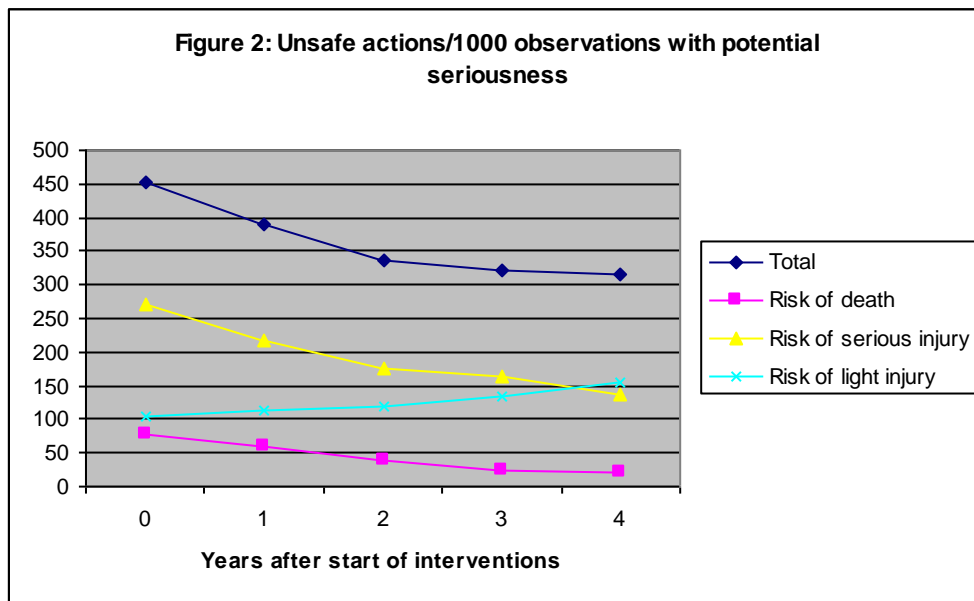
The graph of the frequency of lost time accidents (see footnote 1) over the three years before the agreed start date of the intervention, the intervention year (2004) and the four years after is shown in figure 1.



The trend upward in the three years before the start of the interventions just fails to reach the $p < 0.05$ significance level. The trend down using the years 0-4 is significant at the $p < 0.01$ level, the overall trend from years -3 to +4 at the $p < 0.05$ level. The changes introduced in 2004 and 2005 clearly have the most effect, which covers most of the management involvement, awareness training and monitoring interventions.

2.3.2. Behavioural monitoring

Figure 2 gives the results of the behavioural monitoring over the five years from the point at which it started as part of the interventions.



There is a clear and steady drop, significant at the $p < 0.01$ level, in the percentage of total observations which were considered unsafe, and in the ones considered to have the two most serious potential outcomes. The trend for light injury potential is upwards with the same significance level. This could be interpreted as an increase in those more minor unsafe acts, but we prefer to interpret it as an indication that the observers are lowering the threshold of seriousness at which they consider an action unsafe, as the more serious ones become less common.

2.3.3. Climate measures

The principal component analysis of the safety climate questionnaire led to a five scale solution [2], one of whose dimensions (5) was negative, making a low score desirable. The scales are:

1. Attention to safety in the management system
2. Stimulus from and involvement by line management in safety
3. Mutual support from colleagues in respect of safety
4. General level of housekeeping
5. Degree to which the company was seen to be reactive in its response to safety and to suffer from conflicts between safety and other company goals and violations

The response rates to the climate questionnaire from company A were high (80%, 98% and 94% for the three administrations – 07.05, 01.07 and 01.08) and the questionnaires, although anonymous were distributed to the same list of people on each occasion. This does not allow analysis of individual's changes in score, but the changes in average scores of the respondents are clearly meaningful. The scores on a five point scale for each of the scales for each measurement occasion are shown in table 1.

Table 1: Scores on 5 point scale on five climate dimensions on three occasions. Company A

Factors	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Before	2.45	3.82	4.18	3.97	3.26
During	2.85	4.28	4.43	4.39	2.62
After	2.88	4.04	4.55	4.37	2.62

They show significant shifts in the desired direction at the $p < 0.01$ level for all of the scales except factor 3 between the first and second occasions, and all of the scales except factor 2 between the first and third occasions. Scale 2 showed an increase at first and then dropped back; scale 3 improved slowly over the whole period, whilst the other scales showed an initial rapid improvement and then stayed steady. The initial reactive, macho culture is demonstrated by the fact that company A scored in

the worst three of the companies studied in the full evaluation research [2] on three of the scales at the first measurement occasion, and worse than average on the other two. By the final measurement occasion it scored best on scale 3 and in the best half on all but scale 5.

2.3.4. Conclusions about the interventions

Because of the large number and overlapping introduction of the different interventions, it is not possible in such a case study to say exactly what are essential elements in producing any results, what are incidental and what may be superfluous. We can only take the package as a whole. Such is the reality of organisational change in safety (and in other areas). This makes life difficult for the scientist wanting to isolate and evaluate discrete programme elements. However the phasing of the positive changes suggests that it was the management involvement, the awareness workshops and the behavioural monitoring which were likely to be most effective. The company also easily met its target, announced to the Ministry, of 15% reduction in absence accidents in relation to 2003 (year -1)

3. COMPANY B: SAFETY IN THE LIFT?

3.1. The company

Company B also had about 700 employees, with roughly half working in production. They came from 38 different nationalities and had on average a low education level, comparable to those in company A. The work consisted largely of steel work, assembly, welding, surface treatment and painting. The company already had a management system certified to ISO 9001 and 14001. The management felt that their accident rate was high and needed structural improvement and therefore approved the proposal to join the Ministry project. They set the target for reduction in accidents at 50% compared to a baseline year of 2004. The agreed date considered as start of the interventions was June 2005, although there had been attempts to encourage accident and incident reporting since 2004 and the preparation phase for the improvements started in late 2003. Changes went on being introduced right through until the point that intervention data collection ceased at the end of 2007.

3.2. The interventions

The interventions in company B numbered 31 compared to 26 in company A. Their focus was to stimulate good and discourage unsafe behaviour. They will be explained using the same headings as in that case study and the differences in content and emphasis will be highlighted.

3.2.1. Intervention programme design and conduct

The interventions were developed and the support for them organised through a project team (06.05) of nine managers, the safety adviser, a representative of personnel and a marketing expert. They developed the themes to be used each year and coordinated the five working groups who met weekly, reported to a monthly project team meeting and developed the interventions on each theme, based on accident analysis. These groups were: 1. Image and vision team, 2. Promotional team for information and publicity (via posters, company newspaper, photo displays, information sheets, competitions and computer screens in the canteen), 3. Guidelines team for company rules and procedures, 4. Behaviour monitoring team and 5 Safety team as link to the STOP-GO card system (see 3.2.4).

The enthusiastic, creative and persistent safety adviser played a major role in designing and implementing the interventions. This was a comparable level of project organisation as in company A

3.2.2. Management involvement

The support from the directors was present, but more hands-on involvement only took off with the appointment of a new administrative director (09.07). The general manager had a monthly meeting with line managers from the production departments with the safety adviser to push the programme

(06.05). The involvement of managers in the project team ensured line management buy-in, but there was less organised effort to involve the top directors and personalise the buy-in as in company A.

3.2.3. Improved safety management system (SMS) structure and functioning

There was a concerted effort to update company rules and procedures per theme (06.05). The safety and health team was strengthened by the employment of a physiotherapist and the designation and training of a number of ergonomic coaches to observe and help employees improve working posture (06.07) to work with the support of the physiotherapist.

3.2.4. Awareness programme and confronting of behaviour

Toolbox talks on safety were introduced (06.05). Observation rounds were started (06.05), but these differed from those in company A by only involving recording of the behaviour in most case, except for behaviour in relation to hearing protection (10.05) and later working posture (07.07) where the good behaviour was praised and the poor behaviour confronted in a discussion.

The STOP-GO card with half a dozen simple check questions to be used before starting on any job was introduced (11.06). If workers could not say 'yes' to all questions they were empowered to stop work and seek assistance from their supervisor to change things until a 'yes' could be given. This encouraged both dialogue and immediate problem-solving by the line, with referral to higher managers or support staff via the 'dangerous situation reporting system' (see 3.2.5) for monitoring purposes, or if the change needed was outside the authority of the immediate supervisor. This programme was piloted in one department and rolled out later to all (07-08). It was preceded by training for workers and supervisors; in particular the line management was given training on how to deal with situations referred in this way and individual coaching was given by the safety adviser. Later this safety related scheme was linked to the 5S scheme aimed at improvement in quality and productivity (09.07). The emphasis was placed on rewarding workers with a pat on the shoulder for both quality and safety reports and improvements. All employees were trained (in two sessions) with their supervisor to become more aware of safety and to communicate with respect about (un)safe conditions and behaviour.

Both companies had working schemes to bring about dialogue on safety procedures, methods and improvements. Company B did not have such an emphasis on awareness training or on confrontation of behaviour in normal working as company A but had more emphasis on dialogue at the start of jobs.

3.2.5. Monitoring and feedback

The encouragement for reporting accidents and incidents (06.04) was reinforced (01.06) by introducing a new procedure in which dangerous situation reporting was encouraged and the resolution of the situations was given to supervisors, monitored and backed up by the safety adviser. Managers were given a KPI of the number of dangerous situation reports to be achieved (11.06). A board was set up at the factory gate recording days since the last accident, as feedback mechanism and motivator (01.07). The two companies had comparable interventions under this heading.

3.2.6. Thematic safety improvement

There were many interventions aimed at specific themes. These covered in the first year (06.05) hearing protection, internal transport, lifting equipment, and housekeeping. Improved PPE was chosen and issued (01.06), new transport routes, priorities and signboards were introduced for internal transport (02.06). In the second year (01.07) machinery safety was chosen as theme and linked to the STOP-GO cards. 6 months later (06.07) ergonomics and working posture were added. The emphasis on a thematic approach was strong in both company B and A.

3.2.7. Other non safety changes and influences

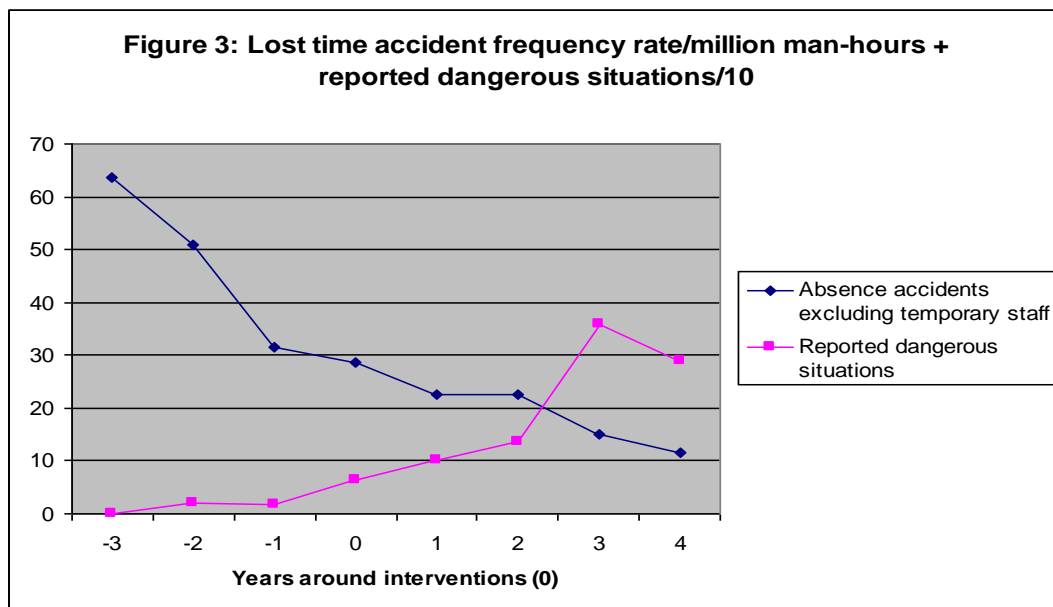
The company introduced the 5S quality/productivity scheme in parallel with the safety interventions (see 3.2.4). The impression gained was that these two schemes were complementary and did not detract from each other. The company had a large increase in orders and workload in 2007 compared to 2006, resulting in more temporary workers being hired and more stress on production.

3.3. Results

The data for the results come, as in company A from the company's own records, either those already existing before the interventions, as in the case of accidents, or introduced as part of them, as in the case of behavioural monitoring and dangerous situation recording.

3.3.1. Accidents & dangerous situations

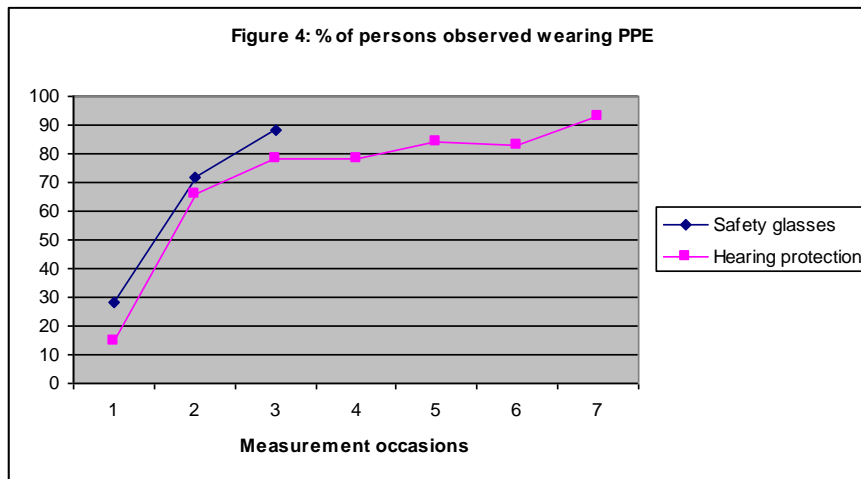
The data on lost time accidents (see footnote 1), total accidents including first aid treatments, and reported dangerous situations are shown in figure 3. The figures for dangerous situation reports are divided by 10 to fit them to the same scale.



The reduction in absence accident rate over the total 8 year period is highly significant ($p < 0.001$). The trend for the 3 years before is almost significant, at $p = 0.074$, and for the 5 years after reaches $p < 0.05$. The company did not meet its target of a drop of 50% in its absence accidents compared to 2004 (year -1). The significant ($p < 0.01$) rise in reported dangerous situations after the intervention began is interpreted as a positive opening up of dialogue, becoming more aware of safety and making the effort to report on it, and not as an actual increase in danger. It is an indication that behaviour has changed in parallel with the better safety. The analysis of these dangerous situation reports led to the physical changes in workplace, control measures and procedures mentioned under section 3.2.6.

3.3.2. Behavioural monitoring

Figure 4 gives the results of the behavioural monitoring of wearing of PPE over 3 (spectacles) and 7 (hearing protection) irregularly spaced measurement occasions covering 1 and 3 years respectively. These graphs show a clear improvement in the wearing of PPE over the periods of measurement.



3.3.3. Climate measures

Table 2 gives the scores on the climate measure scales – see section 2.3.3 for an explanation of the scales. In this company each administration of the questionnaire went to a random sample of employees, which was different each time. This is a less robust basis for comparing the average scores on the dimensions than that in company A, where the same list of recipients was used for each occasion. However the response rate was very high (80%, 95% and 100% respectively). However, the changes in scores show no pattern.

Table 2: Scores on a 5 point scale on five climate dimensions on three occasions. Company B

Factors	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Occasions					
Before	3.01	4.05	4.17	4.35	2.72
During	2.94	4.34	4.29	4.50	3.15
After	2.85	4.24	4.13	4.37	2.58

Scale 5 has a significant worsening ($p < 0.01$) between the first and second occasion, but an equally significant improvement between the second and third. Scale 1 worsens significantly ($p < 0.05$) between the first and last occasions. All the other changes are not significant.

3.3.4. Conclusions about the interventions

We see here clear improvements in behaviour, driven by targets and monitoring, little change in safety climate/attitudes and a drop in accidents which is more significant before the start of these interventions than after it.

4. DISCUSSION AND CONCLUSIONS

Company A can be seen as a clear success, turning a significantly rising trend in absence accidents into a significantly falling one and showing a corresponding change in both behaviour and attitudes (safety climate). Although it is not possible to tease out which of the many interventions can be proven to have given the effect, the most likely candidates are the extensive attention to involving the management and getting their public and personal commitment, the awareness training, with its strong appeal to emotion, to public, personal commitment and to engaging family support, and the well-prepared and supported observational rounds by managers and supervisors, leading to dialogue about safe behaviour, work methods and workplaces. This then leads through to actual physical changes in workplaces to reduce risk, which underpin the behavioural and attitudinal changes.

Company B is a less simple case. The behavioural changes are clear, but the safety climate measures do not show any pattern of attitude change, at least as yet. Above all a significant drop in accidents comes before the start date of the interventions described. The fact that there is a steep drop before the intervention year means that the interventions can be credited with sustaining a downward trend, but not with initiating it. It may be possible to see this early effect as one of the preparations for the intervention, which began in late 2003 and took the whole of 2004 before agreement for the subsidy was reached. This had the effect of rallying support and attention, which may have been enough to lead to an early drop in easily preventable accidents. However, this is speculation. The continuing downward trend for the 5 years after the intervention began is an indication that its content sustained and anchored the improvements.

When we compare the nature of the interventions in the two companies, both have concentrated on getting dialogue going between the workforce and the first-line supervision, and behind them the more senior management and safety support staff. The more active, confrontational dialogue from the observation rounds might be seen as more successful than the more purely observational, monitoring approach, even though backed up by the STOP-GO cards and the opportunities those create to get the dialogue going. Both companies had highly active and persistent safety advisers and a well organised thematic project structure with good links to the 'front-line'. Both also made improvements in reporting of situations from which learning and change was possible. Neither had consistently active support from directors, but both had it for some of the period, and more passive support throughout. Their use of KPIs was present but limited, especially in company A, where they were only related to output and not to intermediate goals related to implementing risk controls.

That the conclusions to be drawn from two case studies are relatively tentative, is the reality of using such naturalistic settings for research, where the researchers have control over neither what interventions are decided upon, nor how many there are, nor whether there is scope for control groups where no, or less interventions are introduced.

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