HOW TO INCREASE SAFETY IN THE RAILWAY SYSTEM – A PROJECT BASED ON THE TRIPOD – DELTA METHOD

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SUMMARY

The aim of this project was to improve safety in one complex urban section of the company INFRANORD AB in Sweden. The company works with new production and maintenance of the Swedish railway system. A project inspired by the Tripod-Delta method was implemented 2010 and the effects of the project were followed up 2012. The results showed a slight improvement concerning design of equipment used by technicians. A positive tendency for the quality and safety of maintenance was also noted. Efficiency showed a tendency to drop slightly but attitudes toward safety showed a positive trend. The quality of communication was improved and the work leader's competencies were now rated as higher. Incident reporting showed an increase and accidents a decrease. The results so far show a positive trend toward a safety culture. A number of other factors beside the project may have had an influence on the results.

INTRODUCTION

Work in the railway infrastructure in Sweden is regulated by the governmental agency Swedish Transport Agency and procedures and rules developed and decided by the agency. These procedures and rules are summarised in documents called JTF. In the railway system a large number of private companies are engaged in different projects according to contracts with the Swedish Transport Agency. The railway system offers a working environment where some workers regularly are exposed to risks of different kind (5). Workers in the field or infrastructure may be exposed to many different risks. One example is maintenance activities, which may involve work tasks where it is necessary to interact with heavy and fast moving machines, dangerous altitudes, electricity, and heavy equipment. Maintenance activities may, and sometimes also must, be performed under varying and extreme environmental conditions, such as low temperature, snow, ice, and darkness. Safety is an important issue for people working with maintenance and safety may sometimes be in conflict with productivity (1). Time pressure, bad working conditions, and communication problems, as some examples, may have a negative impact on, for instance, the ability and motivation to follow strict safety rules.

An important question is how it may be possible to increase safety for workers in the railway system. Tripod-Delta (2) is a safety philosophy and an integrated view of processes that may interfere with safe behaviour or encourage unsafe acts. Safety, according to the Tripod-Delta philosophy, is to a large extent an organizational problem and a key question is to know what can be controlled in organization and what cannot be controlled. Tripod-Delta defines eleven factors, General Failure Types or GFT:s, based on analysis of major accidents as well as field studies (3). These GFT:s can be regarded as latent errors in a system, a key concept in Tripod, and reducing or eliminating them is

assumed to increase safety. An assumption in Tripod is that it it easier to change or control these GFT:s compared to change or control the behaviour of people.

The Swedish company INFRANORD AB works with new production, service and maintenance of the railway infrastructure in Sweden. To improve safety for their personnel INFRANORD AB initiated a project where researchers from Luleå University of Technology were engaged to improve safety. LTU designed and implemented a project with the aim of improving safety, based on the Tripod Delta philosophy.

METHOD

The project started with seminars involving all people in the organization working with maintenance activities, field workers, administrative personnel, and work leaders. Eight seminars were held, each seminar lasted four hours. In total 65 employees participated in the seminars. During the seminars the discussion had a focus on risks in the organisation, each individual's perception of risk, and choice of method(s) to cope with risky situations. The discussions also covered attitudes to risk, psychological aspects of risk assessment, unsafe behaviour, and safety culture. The participants answered questionnaires about the type of risks they perceived during their normal working activities, and how they coped with risky working tasks. The questionnaires were collected and later processed into a list of risky working tasks and coping strategies.

The aim of the next phase in the project was to describe and understand the GFT:s in the organisation. Structured interviews were performed during 2010 with 62 employees in the ages 26-61 years. Three skilled interviewers participated and each employee was interviewed individually. The interviews lasted one to two hours. The interviews were recorded on tape (with one exception) and notes were also taken during the interviews. The answers to the different questions were later processed and transformed to separate word files. The interviews were focussed on the eleven GFT:s presented below:

- Equipment, quality, availability, and design
- Maintenance , quality, efficiency and safety
- Procedures, rules for different tasks
- Rules and their adaptation to real working conditions
- Error enforcing conditions
- Housekeeping
- Incompatible goals
- Communication
- Organisation
- Training
- Defences

The respondents were asked to make ratings on a scale ranging from 1 (does not agree at all) through 7 (agree completely) on 11 questions. For 4 questions a yes/no answer was required, and for 9 questions they answered by ticking on of three boxes (sometimes, often, always). After the rating, yes/no response, or choice of box to tick, they were asked to explain their response in their own words, and to suggest improvements. Finally they were asked to state, in their own words, if there was something else they would like to add concerning safety on their workplace.

Based on the interviews, and a summary report, action plans were formulated by a group of employees. The group decided to focus on work leaders and technicians, assuming that this could be an efficient way to speed up the process of improving safety. The action plan aimed at putting a focus on incident reporting, calibration of equipment, clearer roles for safety functions, better equipment, training, and increased time to perform field work. The group started their work late 2010 and

continued their work until autumn 2012 with a seminar where all were invited. One of the authors of this report participated in 7 of 13 meetings held by the group and helped to structure the job.

RESULTS AND ANALYSIS

The availability of equipment was not optimal according to the answers, and only about 50 % of the workers answered that the availability of equipment was very good. The design of some equipment was not optimal according to the answer, and old, heavy and not well calibrated equipment existed. The planning system and the incident reporting system were both criticised. Maintenance activities were perceived as efficient but sometimes leading to violation of safety rules, due to time pressure and problems to get permission for safety during the task, to close the track from trains until the job was finished. Safety rules were often regarded as impossible to follow and designed by people in the organization without sufficient knowledge of the real working conditions. Shortcuts were often necessary and the only way to get the job done in time. The most common error enforcing conditions were described as lack of personnel and time. For housekeeping many problems were reported concerning the maintenance of some equipment. The conflict between doing a safe job and productivity, get the trains moving, was highlighted. Productivity was considered to be more important than safety. Communication problems were also mentioned and face-to- face communication was suggested to eliminate or minimise the communication problems. The use of mobile phones could also be a problem, especially during winter time. The organisation of work teams was criticised and it was suggested that teams working together should be based on the workers knowledge of their co-workers competence and not be a task for a work leader. Training to cope with difficult working tasks could also be improved according to many answers. Defences or barriers of different kind existed but some of them were heavy and difficult to use.

To evaluate the effects of the project 49 employees in the ages 29 – 61 years were interviewed 2012. All of them had been interviewed 2010. It was not possible to interview all 61 employees that had been interviewed 2010, since some of them were not employed by the company any more. All interviews were performed by one skilled interviewer who also participated as an interviewer 2010, and with the same questionnaire as used 2010. All interviews were recorded and notes were taken during the interviews. As in the earlier interviews the answers from each respondent were processed and summarised into separate word files. Each participant was interviewed individually and took about one to one and a half hours.

The results from the interviews 2012 showed a slight improvement concerning the quality of equipment, meaning better adapted to the different work tasks. No improvement of availability or usability of equipment could be noted. The planning system used was still regarded as hard to use. The ergonomic aspects of the helmet to be used were also criticised. The use of a helmet during the performance of work tasks had been decided to be obligatory between 2010 and 2012.

Maintenance work showed a tendency to improvement for the group of technicians, but not for the group of work leaders. It was reported to be easier to work under safer conditions 2012, and get permission to close the track where work should be performed. The efficiency of maintenance work showed a negative tendency, and some explanations were lack of personnel, more actors, private companies, involved in maintenance work, and lack of communication between involved actors.

Rules for safe work were followed more strictly according to the technicians, but still hard to follow. The reasons for this problem was explained in terms of time pressure and rules that are not adapted to real working conditions. This creates informal rules and shortcuts.

The conflict between safety and productivity showed a positive tendency. Safety was now much more in focus and one reason was support from the top management to stop dangerous work tasks.

The quality of communication was improved and the work leader's competences were now rated as higher. The reporting of incidents showed a positive tendency, from 63 year 2010 to 74 year 2012. The number of accidents in the organisation showed a positive tendency. From 57 year 2010 to 38 year 2012.

DISCUSSION AND CONCLUSIONS

The results of this project showed a reduction of some general failure types (GFT:s) and a gradual improvement of safety in the organisation. The conflict between productivity and safety showed an improvement meaning that safety was now regarded as more important. The quality of the equipment used was better but availability showed no sign of improvement. The planning system was still regarded as not well adapted to the needs of the users. Maintenance work was now regarded as safer and one reason for that was an improvement in the ability to work under safer conditions. Safety rules showed a tendency to be followed more often but still not always, due to time pressure and lack of personnel. Incident reporting showed an increase in the number of reports and the number of accidents showed a decrease. A possible interpretation is that the organisation has improved its safety culture in a positive direction, even if the time between 2010 and 2012 was rather short. It must also be noted that a number of practical problems had to be overcome in order to implement the action plans.

On the other hand a tendency to a decrease in productivity was noted. The reasons for decreased productivity may have been caused by a larger number of actors working with maintenance and the lack of communication between different actors. The complexity in the maintenance of the railway system has most likely increased.

There are a number of other factors, beside the project, that may have had an impact on the results (4). Since it was not possible to design a study with a control group there are a number of threats to validity. History is one factor that most likely has had an impact on the results. From the start of the project until 2012 a number of changes in the outside world may have had an impact on the organisation. A number of new actors working with maintenance in the railway system appeared on the stage, due to a political decision. New private companies have been created and the competition for jobs has increased. Some of the employers at INFRANORD AB were recruited to new companies. The number of different companies involved in maintenance activities also increased the complexity in maintenance activities and communication problems increased. The communication process between different actors was far from optimal and may be one reason for the drop in productivity. Since some employers had left the company it was not possible to interview all employers that were interviewed 2010. Maturation may also have had an impact on the results. Some of the leaders in the organisation were newly employed 2010 and most likely learned more about the co-workers and the demands from their work tasks until 2012.

Still another possibility is that the tasks performed by INFRANORD AB were different in 2012 compared to 2010. The drop in accidents may be a result of other companies taking over some of the tasks with higher risks than the average tasks, and accident migration may have played a role. To answer the question concerning which are the reasons for the changes from 2010 to 2012 more research is needed.

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