



Safety, reliability and worker satisfaction during organizational change



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ABSTRACT

The research presented in this paper was carried out in four process industry plants in the Netherlands, to identify factors that have the potential to increase safety and reliability while maintaining or improving job satisfaction. The data used were gathered as part of broader trajectories in these firms, aiming at the simultaneous improvement of productivity and safety, while maintaining or improving worker satisfaction. The results show that participative leadership is crucial for combining an increase in safety and reliability with job satisfaction. Participative leadership has a positive effect on job satisfaction and through proper maintenance also on the prevention and absence of disturbances and on the reliability of the production process. The results of this research show the importance of participative leadership for safety, reliability and worker satisfaction, especially during organizational change. Other important factors are operator competences, teamwork, proper handling of variance and disturbances, and proper maintenance. It also confirms that apart from technological factors associated with proper maintenance, people and team related factors are important for increasing safety and reliability in the process industry, especially for being prepared for disturbances and to be able to cope adequately with them.

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1. Introduction

The process industry operates in a global competitive business environment, and is continuously challenged to operate more effectively and efficiently, according to the European Chemical Industry Council (CEFIC, 2011). This results in an on-going challenge to increase productivity while reducing costs. Papadopoulos, Georgiadou, Papazoglou, and Michaliou (2010) demonstrated that several of these changes may have consequences for occupational and public safety. One of their conclusions was that there are limits in combining flexibility at work and safety in a competitive market. There are, however, also other options for combining these two goals, such as the implementation of more productive work arrangements (e.g. transfer of tasks from continuous to day shifts, i.e. social innovations) and technical and organizational innovations to increase the reliability and capacities of production installations.

In the process industry cost-cutting focuses mostly on manpower reductions, the related topics of subcontracting and

outsourcing, and on more cost-effective maintenance. Rasmussen (1997) clarified that a continuous process of cost-cutting is likely to affect safety margins. Rasmussen introduced the term 'drift to danger', for the gradual process stemming from the tensions between safety and productivity, while Zwetsloot (2009) called it 'drift to disaster' for major hazard companies. Three examples of developments that have the potential to undermine safety margins are: 1) Delays or reductions of preventive maintenance – which after some time are likely to lead to more frequent troubles in the production process, 2) The reduction of head count to a level where low levels on staff becomes safety critical (Zwetsloot, Gort, Steijger, & Moonen, 2007), and 3) The replacement of highly qualified and experienced staff by lower educated staff. The former are examples of safety issues that especially arise during organizational change. The Center for Chemical Process Safety of the American Institute of Chemical Engineers (CCPS) gives a broader range of examples of how organizational change may affect process safety, as well as a systematic approach to deal with it (CCPS, 2013).

Safety, however, is vital to the process industry's license to operate, and it is a cornerstone in the responsible care program of the International Council of Chemical Industries (ICCA, 2006). Due to the continuous nature of most processes, high levels of safety can be and often are achieved. As a consequence of high safety levels,

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the process industries have low frequency rates of incidents in comparison to other industries (CEFIC, 2011). This is true for occupational safety incidents, while due to their nature, process safety incidents occur even more seldom. Safety and reliability of the process industries are closely linked, as problems with reliability often imply increased risks.

An often used measure for occupational safety incidents is the number of 'Lost Time Injuries' (LTI). LTI and the frequency or number of incidents are lagging indicators for safety, meaning they are 'after-the-fact' indicators (Hopkins, Hale, & Kontic, 2009). Lagging indicators have severe limitations for managing safety improvements. This is also true for ex-post evaluations of the impact of organizational change on safety and reliability (CCPS, 2013; Reniers, 2010a, 2010b). In technical and organizational change management the impact should be evaluated beforehand (CCPS, 2013). This is, however, not an easy challenge prior to or during organizational changes, as these are often complex and comprise people related factors, management factors, technological factors, as well as safety factors (Zwetsloot et al., 2007). It can include changes in corporate standards for organizational change management, modifications of working conditions, personnel changes, task allocation changes, organizational hierarchy changes, and organizational policy changes (CCPS, 2013).

In contrast to lagging indicators and ex-post evaluations, leading indicators and ex-ante evaluations have predictive qualities, and are more promising than lagging indicators for managing prevention and increasing safety. There is, however, an on-going debate about reliable sets of leading indicators, especially for process safety (see, for instance, the special issue of Safety Science on this topic; Hopkins et al., 2009). In terms of leading indicators for process safety, CCPS (2009) mentions the following categories that are related to the functioning of teams and operators: management of change, process safety training and competence, safety culture, operating and maintenance procedures, and fatigue risk management (CCPS, 2009).

The reliability of the production process is often measured by the level of availability of installations for production purposes. The reliability of production is affected by disturbances or troubles in the production process, meaning deviations from normal, which can also be regarded as 'early warnings' for potential high-risk situations or activities. A low reliability is relevant for both process safety (as many troubles indicate problems in the hazardous production process), and occupational safety (as it requires maintenance activities that are planned at very short notice and take place under time pressure). Trouble shooting activities are therefore often safety critical and the quality thereof is highly dependent on individual and team competences and the behavior of the team of operators.

In a broader sense, the relevance of human behavior and safety culture for safety is now generally accepted (Hale & Hovden, 1998), which implies that developments in reliability and safety cannot be managed responsibly without dedicated attention to people, individuals as well as teams, and their behavior and functioning in organizations. This implies that in the planning and evaluation of any organizational change as well as in normal operations and maintenance, attention for the implications in terms of behavior and functioning of individuals and teams (or shifts) are important for safety (Zwetsloot et al., 2007).

The complexity of organizational changes aiming at cost reductions or an increase in productivity is further illustrated by the fact that they may have negative effects on job satisfaction. In their 2007 paper, Zwetsloot et al. mention that safety is often used as the ostensible reason for discussions that really concern job security and frustrations about processes of (organizational) change. They also mention that especially the process of downsizing may cause a great

deal of fear and resentment on the part of the operators, which may affect industrial relations for a number of years. Examples of the latter are the strikes early 2005 in the Antwerp area in Belgium, where Total and Degussa were confronted with strikes associated with lower levels of staffing, and safety issues were communicated as the primary concern of the workers (Verelst, 2005).

Associated with increasing competitiveness, the desire to increase flexibility of production is a major issue for managers (Zwetsloot et al., 2007). This often requires greater multi-functionality from workers and better teamwork. However, it may easily lead to a severe decrease in job satisfaction and worker morale, which in the long run may also affect the attractiveness of the employer on the labor market (an important issue in the 'war for talent' and given the existing shortages in technically competent personnel in large parts of the Western world) and also the safety climate.

This raises the question how organizational change, especially developments in the quantity and quality of staffing levels and in working arrangements, can contribute to reliability and safety, without affecting job satisfaction.

The research presented in this paper is based on a secondary analysis of data from four process industry plants in the Netherlands. The aim was to identify factors that have the potential to increase safety and reliability while maintaining or improving job satisfaction. The data used in this research were gathered as part of broader participatory trajectories in these four firms, aiming at the simultaneous improvement of productivity and safety, while maintaining or improving worker satisfaction (largely following the stepwise process presented in Zwetsloot et al., 2007). That broader process was supported actively by the management teams from the industries involved. The high level of management commitment in that process facilitated the survey, which served as input for a creative participatory process to improve productivity and safety. A selection of the data thus gathered was used for a secondary analysis to answer the central research question:

- Which people and team related factors are important for increasing safety and reliability of production, while maintaining worker satisfaction during organizational change?

This was operationalized into three closely related sub research questions:

- Which people and team related factors contribute to the prevention of safety critical situations during organizational change?
- Which people and team related factors contribute to the reliability of the production process during organizational change?
- Which people and team related factors are important for maintaining or improving job satisfaction during organizational change?

2. Method

2.1. Respondents and procedure

The sample consisted of 212 employees from four process industry plants. One plant was from the pharmaceutical industry, one performed paper processing, and two were chemical process plants. The plants were participants in the network of the Netherlands Organization for Applied Scientific Research (TNO) for optimal staffing arrangements in the process industries. A questionnaire was administered in the early stages of a participatory process that aimed to support the companies to increase

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