Journal of Loss Prevention in the Process Industries 23 (2010) 60–70

Contents lists available at ScienceDirect

Journal of Loss Prevention in the Process Industries

journal homepage: www.elsevier.com/locate/jlp

Optimizing and balancing operational manning levels and SHEQ within chemical companies

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ARTICLE INFO

Article history:
Received 16 March 2009
Received in revised form
17 May 2009
Accepted 17 May 2009

Keywords:
Manning level improvement
Staffing level improvement
Performance management
Continuous improvement
Quality management

ABSTRACT

Many chemical organizations are struggling with efficiently optimizing their operational manning levels due to a lack of management insights in the subject. However, manning levels not reflecting real circumstances and not taking into account various possible accident scenarios can be financially adversarial and can even lead to (minor and major) accidents. This paper suggests a performance-based methodology to assist chemical plants in their efforts to systematically improve operational manning levels. By integrating manning level standards with the Plan-Do-Check-Act cycle of continuous improvement and providing a generic action plan for any organization to elaborate an efficient means of improving manning level performance, operational manning levels can be advanced without having to undergo a costly and inefficient trial-and-error phase.

1. Introduction

The importance of human factors, human errors, and human–machine interface for achieving high safety performance within a chemical plant is well-documented in academic and professional literature. Papazoglou et al. (2003) e.g. present a QRA method whereby a technical model is linked with a management model to integrate the effects of the safety management system into the quantification of risk of an installation handling dangerous substances. Bellamy, Geyer, and Wilkinson (2008) e.g. describe a holistic model helping to understand the relationship between human factors, safety management systems and other organizational issues within the chemical industry. Human factors literature, although not *directly* explaining staffing level improvement, is very important for *indirectly* understanding the underlying concepts, factors, indicators, models, systems, theories, etc. of staffing level optimization in the chemical industry. The interested reader in the relationship between human factors and safety is referred to CCPS (1994), Cacciabue (2004), HSE (2004), HSE (2005), and CCPS (2007).

However, literature on the link between performance management and operational staffing levels in the chemical industry remains very scarce. In their paper on evaluating safety critical manning arrangements in the chemical industry, Reniers, Dullaert, Ale, Verschueren, and Soudan (2007) discuss an instrument aimed specifically at evaluating the quality and the quantity of staffing levels required to perform safety critical activities. These activities concern tasks representing the last but one line of defense for preventing major accidents in a chemical plant. The paper thereby indicates that manning levels are critical for disaster prevention and provides a checklist for evaluating safety critical manning arrangements to meet the needs of company management. As such, Reniers et al. (2007) do not provide a generic method which can be employed to investigate existing operational staffing levels and to formulate recommendations for their continuous optimization. Such a generic method is elaborated in this article.

Exploratory research by Zwetsloot, Gort, Steijger, and Moonen (2007) uses four case-studies concerning staff reductions in the chemical process industry to build a conceptual model for optimizing operational shifts. Using people, management, technology, and safety related factors, the model suggested by Zwetsloot et al. facilitates an open discussion between all company stakeholders leading to so-called 'optimum staffing arrangements' which are perceived as being acceptable *by all stakeholders*. However, the Zwetsloot model does not link staffing levels with performance management or quality management, nor does it allow carrying out an objective evaluation of existing operational manning levels

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doi:10.1016/j.jlp.2009.05.005

within a chemical company with the aim to continuously improve them.

Although manning levels are continuously evolving and changing within chemical companies, to date no systematic methodology for optimizing the operational manning levels exists. In fact, at present, chemical organizations use data obtained by experience (trial-and-error approach) to decide on their operational manning levels. To streamline the manning levels change and optimization processes and to put forward a methodical and structured approach to enhance industrial practice on the subject, a benchmarking of best practices by highly experienced organizations can be used (Luu, Kim, & Huynh, 2008). Although in this article academic literature was studied, best available industrial practices and techniques on setting up, managing, controlling and optimizing operational manning levels were investigated, and expert opinions (of SHE and HR managers of major chemical companies) were taken into account, the described model remains theoretical in the sense that the method has not yet been validated in practical applications. Nonetheless, the methodology was described by experts as correct and sound.

Manning levels are defined as the filling in of functions within an organization. A function represents a combination of tasks that need to be carried out in an organization or a part thereof. A function thus depends on the competences of the person filling in the function (and carrying out the tasks). According to this definition, manning levels consist of two aspects: a quantitative aspect (i.e., a *number of functions*) and a qualitative aspect (i.e., the *competences of the functions*). A methodology for optimizing manning levels in an organizational context needs to take both the quantitative aspect and the qualitative aspect into account.

A major cause of errors is a mismatch between the manning level demands and the manning levels resources. To guarantee effective and efficient organizational manning levels, the difference between demands and resources need to be well-considered and well-chosen, and this needs to be accomplished for any circumstances and independent of installations or business units within the organization.

Fig. 1 illustrates the manning level demands versus manning level resources concept.

Fig. 1 shows that a distinction should be made between 'ideal manning' (representing the manning level demands) and 'measured manning' (representing the manning level resources). The former (ideal) manning concerns manning levels required by managers due to miscellaneous constraints, strategic reasons and/or management choices made in an organization. The latter (measured) manning concerns manning levels which can be measured to certain extend by manning level indicators. Hence, ideal manning can be seen as 'manning level objectives', while measured manning can be considered as resulting from 'manning level indicators' measurements (qualities, quantities, values, etc.).

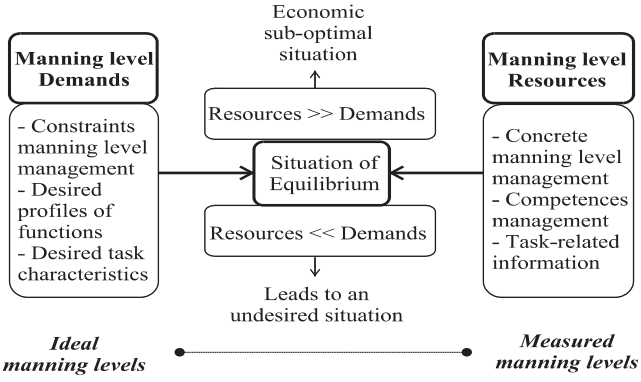

Fig. 1. Manning level demands versus manning level resources in an organization.

For effective manning level management where ideal manning objectives are well-considered and measured manning is well-measured, the well-known and much-used Plan-Do-Check-Act cycle (or Deming Wheel) of continuous improvement (Van Scyoc, 2008; Zu, Fredendall, & Douglas, 2008) should be integrated into the methodology (Das, Pagell, Behm, & Veltri, 2008). Moreover, production demands and quality, health, safety and environmental demands should be taken into account (Duijm, Fiévez, Gerbec, Hauptmanns, & Konstandinidou, 2008). To systematize the manning level optimization methodology, the next section introduces and explains five manning level categories: (i) shift system, flexibility and organization, (ii) technology and task complexity, (iii) procedures and documentation, (iv) communication, and (v) learning facilities/possibilities, training and education, competences. Demands and criteria for every category for ideal manning and measured manning are provided in section 3. Section 4 explains the systematic manning level optimization process based on three domains: Job, Human, and Organization. Furthermore, section 4 elaborates manning level standards and integrates them into the well-known Plan-Do-Check-Act cycle used in Quality management. To conclude section 4, a manning level optimization action plan is given. Section 5 concludes this paper by summarizing its main concepts and findings.

2. Manning levels evaluation categories

2.1. Shift system, flexibility and organization

In case of continuous operations within the organization, a sound shift system where flexibility exists within the shifts and between the shifts is essential for optimized manning levels. Furthermore, the manning levels need to take unexpected situations, circumstances and events into account. It would be optimal for operational teams to be organized in such a way that functions within the teams can be filled in by either functions of other teams within the organization (e.g. from another business unit), or they can be filled in by other function(s) within the team. Hence, ideal manning for this category is characterized by manning forming a flexible and reliable entity within an organization or within an organizational unit.

2.2. Technology and task complexity

Manning levels strongly depend on the technology available (or not) within the organization to help carrying out the tasks. 'Technology' refers to displays, alarms, control screens, computers, manual equipment, etc. Interaction and use of technology can be taken into account by the methodology (for describing the ideal staffing) by verifying the conformity between manning features on the one hand and task and technology characteristics on the other hand.

2.3. Procedures and documentation

Procedures and documentation form a key part within every organization. The importance of procedures and documentation with regard to the operational manning levels lie in following standardized rules for carrying out tasks and lie in elaborating consistent and well-considered documents as regards all responsibilities within the organization. Responsibility schemes, training schedules, competence profiles, absences overviews, reports for smooth transitions from one shift to the next, etc. should be kept up-to-date. Ideal manning thus considers the management, the