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Procedia CIRP 17 (2014) 212 – 217

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Variety Management in Manufacturing. Proceedings of the 47th CIRP Conference on Manufacturing Systems

Managing production complexity by empowering workers: six cases

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Abstract

To manage high product variety many companies empower their operators. Reaching the benefits of that is connected to successfully distributing role allotments and work tasks in the complex context. The characteristic of empowerment is studied in six cases where the focus is work tasks and power to affect the company. Results indicate that the workers are, in general, responsible for more than 30% of the tasks connected to the production but that they do not always have the power to make decisions that influence the organization directly. This could increase the companies' attractiveness as a future employer and its competitiveness.

Keywords: Empowered workers; empowerment; production complexity; case study; work environment; competitiveness.

1. Introduction – the role of complexity

Increased complexity is one of the biggest challenges in manufacturing today [1]. Amongst the challenges is mass-customization forcing manufacturing systems to manage high flexibility, small batch sizes, small product volume and a high number of variants [2] at a low cost [3, 4]. In a complex production settings the human role is increasingly important [5] since humans are flexible and can handle the complex and dynamic context [6-8]. Therefore, managing complexity and thereby product variety is connected to improving the operator performance i.e. to decrease process errors, achieve high quality, achieve good working conditions, fast processes, quick change-overs and to decrease cost [2-4, 9]. Although complex systems are unpredictable, it is possible to find strategies to manage complexity i.e. reduce risk, handle uncertainty, control the system and catch benefits of having such a system [1, 10]. Producing companies also has demands regarding social sustainability that makes it important for them to be attractive to a workforce with varying age, skills and health issues [11, 12].

To manage complexity many companies have started empowering their workers. However, knowing how to empower and to implement empowerment is difficult [13]. Therefore it is important to study empowered operators and how their work in real life cases is characterized. For instance, a study of 2000 Canadian motor vehicle workers showed that they were not seen as empowered. The reasons were: they did not have the power to change their work, vary the work pace or to leave their workspaces (performing other tasks, like planning) [14]. Today this is especially interesting since many companies have a policy to empower their operators. Ahanotu stated also that in order to fully incorporate empowerment the workers also need to be part of the innovative work and fundamental change done at a company [15].

If the worker's role can be increased to include innovation and other work tasks this might increase the competitiveness of production companies.

doi:10.1016/j.procir.2014.02.041

1.1. Production complexity

Complexity in a system can be defined as something that is *"difficult to understand, describe, predict or control"* [16]. Weaver stated that complexity in a system is, given the systems parts, the difficulty in predicting the system properties [17]. Although complexity has been studied there is no common approach and many models are theoretical [18-21]. Chryssolouris et al. [21] state that in order to manage and consider a complex system the system needs to be quantifiable. However, since existing quantitative methods e.g. the entropy model [20], the operator choice complexity [22, 23] often assess objective aspects of complexity e.g. number of components and tools it is important to consider the subjective aspects. Studying subjective aspects means to study how different people perceive the complexity e.g. opinions. Personnel working with the assembly system may perceive an objectively simple system as very complex e.g. although a car has few and similar parts it can still be complicated to assemble [24]. Studying how the employees perceive their work is crucial in order to successfully manage and design the system [25-27]. Based on interviews with different roles in three producing companies production complexity was defined as: "*the interrelations between product variants, work content, layout, tools and support tools, and work instructions"* [28]. The aspects in the definition will be seen as focus areas, which contributes to that a station is perceived as complex. This definition will be used throughout the paper.

The management of complexity has been considered by different approaches e.g. by [29-31]. The word manage suggests that it is not evident that production complexity should be removed. This, since many times it is not possible to reduce the complexity due to market demands. Suggested ways to manage complexity are to *prevent* or *avoid* it [29, 30] and Wiendahl and Scholtissek [31] stated that complexity should be *reduced* and *simplified*.

1.2. Empowerment

Bowen & Lawler stated that the following features should be included for a worker to be empowered [13]:

- *Sharing information* on the organization's performance,
- *Base rewards on that performance*
- *Provide knowledge* that make it possible for employees to contribute to that performance
- *Give the employees power* to make decisions that influence the organization performance directly

Wilkinson wrote about the following features: *information sharing, upward problem solving* (to both work and to choose which problems needs solving), *task autonomy, attitudinal shaping* and *self-management* [32]. A system should be managed in close collaboration with the workers [26, 33]. Grote stated that a systematic approach is needed to manage uncertainties and that it is important to include different organizational domains [33]. And although Taylor proposed efficiency which can be seen as disempowering [15] he stated: *"..these foremen and super-intendants know, better than anyone else, that their own knowledge and personal skill falls far short of the combined knowledge and dexterity of all the workmen under them" (Taylor, 1911, p. 30).*

In real life practices the empowerment level of workers depends on companies need, knowledge and time. How the personnel manage the problems with complexity can depend on individual factors for example previous experience, knowledge, training, personality type, background and mind-set. These variations between individuals need to be regarded as well as the work tasks being performed. To grasp the perceived production complexity it is therefore necessary to gain an increased understanding of different functions and their needs in the organization [34].

1.3. Purpose and scope

This paper studies how companies have empowered their workers in six case studies. The goal is to describe the empowerment levels according to work tasks to highlight similarities and differences between the cases. The complexity level in the cases is assessed for a better understanding of the worker context. The organization, company vision and planned future work are excluded. Below follows a description of the cases.

2. Case studies

Six cases in six stations have been studied in four companies. The companies are all large to medium large with production facilities in Sweden. The products they work with range from medical equipment to machine tools. In several of the cases the operators work with machining or processing of products, while operators in case B and D work with final assembly.

The cases are derived from the project the Operator of the Future* where they have different scopes (decided together with the companies). The aims of case A, B and D is to empower the operators while in case C and F the aim is to make information more accessible (for instance in order to perform better maintenance but also to some extent to empower the operators. Case E has the aim to increase the maintenance efficiency.

The cases have been classified in Table 1 according to their different contexts. It is a classification of the companies according to: number of product variants, batch sizes and the expertise level of the operators.

Table 1. Classification of companies

Case	Product variants	Batch size	Operators expertise
Case A	Many	Small	Mix, many Experts
Case B	Many	Small	Experts
Case C	Few	Large	Mix
Case D	Medium	Medium	Mix
Case E	Many	Medium	Mix many new
Case F	Few	Large	Experts

* http://www.vinnova.se/sv/Resultat/Projekt/Effekta/Framtidsoperatoren1/