

Participatory ergonomics in industrial engineering projects: The case of a new cheese packaging line work system

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1. Introduction

The application of participatory ergonomics (PE) in complex engineering design projects is a challenge for ergonomists that to a limited extent has been studied and reported in the literature.

The aim of this study is to explore and conceptualize the challenges that ergonomists meet when seeking to introduce PE methods into an industrial engineering design project in order to optimize the new work system. Based on a case study in a Danish cheese processing plant we set out to investigate the following research question: What are the challenges for a PE intervention in a complex industrial engineering design project?

2. Methods

Case setting. The case study took place within a packaging department of a large cheese factory. The department was in the process of designing a new packaging line in order to increase the production capacity. This piece of engineering design was structured in a project organization and steered by a stage-gate project management approach dividing the activities into distinct phases with gatekeepers. The new packaging line was specified by the project organization and two main suppliers of the equipment were selected.

The research was aiming at developing and testing PE methods in relation to engineering design projects. After an introduction meeting and some negotiations it was decided by the project management and the internal human factors (HF) department that the best case would be the design of this new packaging line. The research team was allowed to come up with suggestions for PE activities towards the project management. The HF department would not be part of the intervention since the project management had not requested their service.

Participatory ergonomics intervention. The PE intervention included: 1) observation studies in existing packaging lines, 2) a workbook session in which operators commented on pictures of the existing packaging line, and 3) two workshops with operators and managers focusing on the layout of the new line and auxiliary equipment. The project organization and packaging managers were provided with a set of design guidelines

elaborated by the research team based on the PE activities. They were also provided a commented layout blueprint made in the workshops by the participants.

Data collection. In order to follow the progress of the engineering design project we had 10 interviews with members of the project organization over a period of one year. In the same period observations and informal interviews were carried out in the packaging facilities. Finally, based on a guided walk-through in the new packaging line we registered to what extent the design input from the participatory ergonomics events had been taken into consideration.

3. Results

The new packaging line. The new line was based on another packaging technology than the existing one making some of the design guidelines based on the existing line non applicable. Many of the design guidelines were otherwise fulfilled in the new line. The basic layout was in line with the workshops proposal. This was made possible because the machine supplier was able to shorten the length of the line on request from the project organization. In general, it was not possible to evaluate to what extent the fulfillment of the design guidelines were attributed to the PE inputs. The main issues not fulfilled included auxiliary equipment for reducing operators physical workload. It turned out that work organization was a major issue that was only sparsely addressed in the PE activities. The new line was aimed at reducing the number of workers from four to one line operator and one truck driver.

Challenges for PE intervention. Based on the case study the challenges could be categorized in four main dimensions: 1) Characteristics of the engineering design project, 2) Conditions for the PE intervention, 3) Contextual PE planning and methods, and 4) Integration of PE outcomes into the engineering design project. In this paper we will focus mainly on the first dimension.

The case study provided an insight into the characteristics and work practices of one type of industrial engineering design project. We conceptualized the engineering design process of the new packaging line as a sociotechnical specification and configuration process involving the interaction between several actors. The configuration process included taking into account heterogeneous elements such as machinery from suppliers, hygiene regulatory requirements, sales department requirements, spatial constraints among others. The functional requirements and technical specification of the new line seemed to dominate the work in the project organization whereas the new line only to a minor degree was conceptualized as a work system. The future work system of the packaging line was not designed on beforehand but slowly emerged as a result of the outcome of interactions in the configuration process. The emergent nature of the future work system challenged the PE intervention. Two or three discrete PE events in a 1-2 year engineering design project were not fully able to keep up with the ever-changing configuration details of the new packaging line.

The conditions for the PE intervention were subject to re-current negotiations between project management and the research team along the process. The planning of the PE intervention had to be contextual because of the emergent nature of the work system design. Finally, the integration of PE outcomes into the engineering project was not organized. The PE inputs to the design process was kept on the agenda especially by the middle-manager of the existing packaging line. The case study illustrates the need of human factors practitioners able to understand the dynamics in this type of industrial engineering projects and able to navigate the challenges outlined in the four dimensions.