

Ergonomics is profitable – Experiences from a holistic manufacturing plant level development process

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Abstract. In industry, to enhance the operating conditions of companies, development measures are required for work, work environment, technologies and products. Development of the work affects the quality of working life, which is one of the factors that make it possible to experience well-being at work. The goal of ergonomics is to organize the work and the working environment so that the changes benefit both the company and its staff. Thus, it is important to look at ergonomic work and work environment development at the same time as productivity and well-being at work. This study examines an ergonomics development process in one manufacturing plant in Finland. The aim of this process was to improve productivity and promote well-being at work by improving production capacity, reducing non-productive work, and optimizing material flows. The project was facilitated through a participatory ergonomics process. As a result of the process, the plant's total productivity increased by 5 percent, meaning an annual increase of 250 products in manufacturing capacity. The process also contributed significantly to health and safety, with decreased sick leave and occupational accidents and with increased perceptions of well-being at work. The company's total cost saving in two years was €210,700.

Keywords: Ergonomics, Participatory, Manufacturing

1 Ergonomics: a driver of development

1.1 Ergonomics as a system perspective

As a discipline, ergonomics examines the interactions between people and other parts of an operating system and applies the theoretical principles, data, and methods of ergonomics to optimize human well-being and the efficiency of the operating system [1], [2]. In this review, the operating system is a multidimensional concept. It can be viewed microergonomically, focusing on an individual's work system, or it can be viewed macroergonomically, for example from the perspectives of the work community, organization, or organizational networks [2]. The concept of the operating system can also be extended to influence, for example, global challenges of sustainable development [3]. At its simplest, ergonomics looks at individual employees and their work environment. However, this perspective limits the development activities of several employees and can lead to sub-optimization at the expense of other parts of the larger system [2]. The fourth industrial revolution challenges companies to explore and develop the interaction between technological and social systems for a larger perspective [4].

A work system and the humans who use it are in constant interaction. Disruptions between work and health can pose a complex challenge to an organization. Problems at work can be reflected in workers through various psychosocial and organizational processes [5], [6]. Changing and developing the operating system serve as a functional guideline for ergonomics. Ergonomics can be used to find solutions for the system, which at best appear in terms of operational flow, organizational productivity, and staff well-being and health [2].

Ergonomics, by its nature, is a multidisciplinary field that provides tools for understanding and developing both microergonomic and broader macroergonomic entities. Managing and developing this requires the

consideration of different actors and stakeholders. Participation and participatory planning are central to ergonomics. Participation within a company can take place in many ways, but it often means the involvement and commitment of all relevant employee groups and management [7], [8]. Participatory ergonomics uses staff skills to make working conditions healthier, safer, and more efficient [9], [10]. There are indicators that ergonomics can be effective to the companies [11], [12]. On the other hand, there are also challenges in efficacy research, such as the difficulty of conducting randomized controlled trials and of comparing cost–benefit calculation results between countries [11], [13].

The smooth implementation of demanding and large-scale development projects in the workplace requires cooperation with different levels of the organization. Thus, the development of ergonomics is best realized when it integrates the skills, experience, and solution ideas of the entire staff. Involving users of the operating system in planning the work means modifying their own activities, environment, and tools as appropriate. Incorporating employees' practical knowledge into a broader development package increases the chances of successful project implementation [14].

1.2 Promoting ergonomics

As the ergonomics literature shows, the development of work conditions, community, and environment can be impactful, improving well-being and efficiency at work and eventually contributing to productive work [11], [12]. To contribute to this discussion, we describe in this paper a systematic, ergonomic change process in one small manufacturing plant in Finland. The company is part of a larger, Finnish-owned industrial group, MSK Group, which has six production units located in Finland, Germany, and Slovakia. The company operates as its own production unit, producing trailers and boat trailers to Scandinavian markets.

At the start of the development process, the production unit had fourteen blue-collar and four white-collar workers. The employees mainly did manual assembly work, divided into subassembly and trailer assembly sections. The production facilities also had a paint shop and a proto department, and included sheet metal machinery for part production, a sheet metal cutter, and two edging machines.

In this study we describe the development process and analyze its impacts on productivity and well-being at work. As an indicator describing productivity, we use product manufacturing capacity before and after the change. As indicators describing well-being, we use annual accident frequency (accidents at work per million working hours) and number of sick-leave days. As an indicator describing well-being at work, we use daily “Happy or not” measurements, whereby staff have the opportunity to comment daily on their current state of well-being, on a four-point scale from “very negative” to “very positive”. Commenting is made on a terminal located outside social facilities. We also use notes from interviews conducted between the staff, the occupational safety and health manager (1st author), and the production manager at the start of the development process. In addition, we use workstation-specific workload measurements taken at the start of the process.

1.3 The development process of production facilities

This study focuses on a development process in a manufacturing plant. The available workspace in the plant assembly area posed challenges for efficient manufacturing. This led to a lot of unproductive work in the form of in-house logistics and moving of goods, for instance. Staff faced constant interruptions. Several tasks required heavy manual work. Well-being was not at a satisfactory level, and the amount of sick leave was high. A change process was therefore launched, with the goals of promoting productivity, improving well-being, reducing indirect work, and streamlining material flows.

The company's production manager started a development project. The aim was to improve competitiveness and well-being at work by involving staff. Before the change process began in 2018,

physical load measurements were conducted with the workers to understand better the proportion of harmful working postures during the workday. Measurements were taken in a group consisting of the occupational health and safety (OSH) manager and the occupational physiotherapist. The production manager had overall responsibility for the change process and staff involvement.

At the start of the process, the production manager determined the workers' needs through individual interviews. Productivity metrics related to competitiveness were gathered in the company's HR accounts. The OSH manager acted as ergonomics expert throughout to ensure a human-centric approach to design. Weekly meetings were held in order to systematize worker participation. At these meetings, the change process and practical implementation issues were discussed openly and systematically, and design documents were openly shared. The production manager went through past and future changes and the Happy-or-not measurement situation. Workers had the opportunity to bring development proposals to the attention of the production manager.

During the change process in late 2018 and the first half of 2019, the production facilities were reorganized. The subassembly workstations were relocated and reorganized into areas with enough space to perform the work based on ergonomic principles. The trailer assembly was changed to a line model, allowing parts to be brought into truck racks without interrupting assembly work. The end-product logistics were improved. Working hours were harmonized among the workers. The Enterprise Resource Planning (ERP) process and tools were updated to meet new production requirements.

2 Results

The aim of the change process was to improve production capacity, decrease non-productive work, optimize material flows, and promote well-being and productivity. The company invested €50,700 altogether in this change process, as calculated from the project bookkeeping. The investments in the plant operating system made it possible to reduce unproductive work and thus transfer resources to productive work. As a result of the change process, the plant's total productivity increased by 5 percent. This means an annual increase of 250 products in manufacturing capacity.

The change process led to clear cost savings, with a reduction in the number of sick days. Sick days were also affected by the improved possibilities of occupational health care to target suitable work at workers with temporary limitations in ability, because the work-related load was known more accurately from the load measurements (Fig. 1). In 2018, the production unit had 399 days of sick leave, while in 2020 there were 100 days. In addition, 34 days of replacement work were done in 2018–2020.

Fig. 1. Assembly workload measurements.

The reduction in sick leave for 2020 compared to 2018 resulted in a cost saving of €198,800, plus €11,900 due to increased replacement work, for a total cost saving of €210,700 related to sick leave, compared to the situation in 2018 (Fig. 2).

Fig. 2. Annual sick leave days and costs.

The frequency of accidents at work fell to zero in the second half of 2019 and remained at zero at the end of 2020. Workers' daily experiences of well-being at work improved significantly during the process (Fig. 3). The company stopped measuring well-being at work at the end of 2019.

Fig. 3. Response distribution of Happy-or-not monthly measurements of employee well-being. In the figure, the negative experience describes the options "very negative" and "negative", and the positive experience describes the options "very positive" and "positive".

3 Discussion

It is important to identify what needs to be developed at work, so the resources can be used effectively. Promoting ergonomics is based not on emotion but on knowledge of the interaction between work and staff. This requires the application of information to practice, from a variety of sources. There are countless ways to develop work using different methods, limited only by the creativity of staff and the number of insights available. The ability to perceive the entire operating system and to understand the synergy in maximizing the use of technology and workers' ability is a key factor in maintaining a successful business and well-being at work. While useless, irrelevant, and unproductive work decreased, the meaning of work seems to have increased. This had a positive effect on well-being at work. The smoothness and uninterrupted operation of work was also promoted by the simultaneous development of the production control system. By developing this system, the planning of work became more logical and predictable, which also made the planning of work and work processes easier to manage. Thus, well-being at work and productivity in organizations can be promoted through practical solutions applied to the nature of work. Meetings and discussions alone may not be enough to improve well-being at work. It seems that well-being does not increase until changes are successfully implemented in practice.

The goal of ergonomics is to influence the development of the operating environment through two simultaneous approaches: to promote organizational performance and to improve workers' well-being [2]. This means investing in the continuous development of work, the work environment, products, systems, and methods. Work needs to be adapted to meet people's characteristics and needs. It is important to realize that constant change is not a threat but an excellent opportunity to improve one's well-being and ability at work and the competitiveness of one's company. What happens to companies that don't strive to change and develop their own practices? The fourth industrial revolution is forcing companies and managers to consider more social and technical system cooperation [4]. In industry, optimizing the operating system to achieve positive results requires understanding the capabilities of the social system and coordinating the growing potential of technology. Implementing change offers companies the opportunity to succeed in global competition, which is likely to be a common goal from a societal perspective.

An inclusive, collaborative change process offered employees a tangible opportunity to make an impact. Applying ergonomics and implementing changes requires the expertise of all staff, and the key word is cooperation. Knowing the practical work of supervisors and employees, combined with knowledge management and solid engineering skills, produces health and well-being for both company and staff. This is work ability management at its best. The outputs generated by the development are reflected in companies' business indicators. Productivity and well-being at work arise from understanding and adapting the social and technical system to smooth cooperation using ergonomic methods.

4 Conclusion

Ergonomists strive to improve well-being at work and productivity simultaneously. The rapid development of working life and technologies will make this synergistic development even more complex yet also even more desirable. The key element is that investments should be directed at developing the operating system in accordance with the principles of ergonomics. Settling on goals for the development of operating systems is the focus for modern and healthy organizations that seek to increase their competitiveness. No one will donate competitiveness or well-being at work to companies that operate in the global markets. Companies must be able to do this themselves. In practical work, this requires that companies consider ergonomics in development activities. The key question is, who can facilitate such a development process at company level? The development process leader must be able to combine the technological and social systems from a practical point of view.

Ergonomics can improve well-being at work and can enable more efficient and productive work through the development of working conditions and environments. Changes and improvements are more readily accepted if workers feel valued and consulted. While discussion and consultation with staff are important, productivity and well-being at work appear to increase only after practical measures have been taken. It is essential to plan the work so that both company and staff can benefit from the work. When unnecessary, burdensome, and unproductive work is eliminated, the meaning of the work increases, and the effect is reflected positively in workers' performance. The success of planning, development, leadership, and collaboration is reflected in how easy and smooth the work is ultimately. We argue that ergonomics and ergonomists have not succeeded in finding their place in company-level development processes.

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