

## INPUT DATA OF SCENARIOS FOR THE IMPLEMENTATION OF ERGONOMIC PROJECTS IN A MANUFACTURING COMPANY

Wiktoria CZERNECKA

Poznan University of Technology, Faculty of Engineering Management, Poznań;  
wiktoria.czernecka@put.poznan.pl, ORCID: 0000-0003-2060-4488

**Purpose:** The main aim of the research undertaken within this article is to identify the factors that are important for the successful implementation of ergonomic projects, which can be used to effectively manage such projects.

**Design/methodology/approach:** As part of the research undertaken in this article, a literature review was carried out on the success factors of ergonomic projects. Then they were assessed using an expert opinion survey method in order to establish their importance according to the experts involved (participants of the ergonomic commissions operating in production companies). The results of the research can be used to develop scenarios for the implementation of such projects, which was shown on the example of an ergonomic project undertaken in a selected company.

**Findings:** The result of the research is identification of the success factors of an ergonomic project presented in five categories: factors related to the implementation of projects in the enterprise, factors related to stakeholder requirements, factors related to the specificity of ergonomic assessment, factors related to the internal environment of the enterprise, factors related to the external environment of the enterprise. Taking into account the factors assessed by experts as the most important may contribute to their effective shaping in order to conduct an ergonomic project with success, as shown in a practical example.

**Research limitations/implications:** The presented findings are limited by showing them only on one practical example. The further direction of the research development may be the presentation of decision models for managing ergonomic projects based on the identified success factors.

**Practical implications:** The results of the conducted research can be used in practice in the implementation of ergonomic projects in various production companies.

**Originality/value:** This article presents a new approach to the identification of success factors of ergonomic projects and presents the possibilities of including them in the implementation of ergonomic projects in manufacturing companies.

**Keywords:** ergonomic project success criteria, proergonomic approach in project management, ergonomic interventions, ergonomic project management.

**Category of the paper:** Research paper.

## 1. Introduction

The interest in ergonomic workstations began to develop in the 1950s as a result of noticing that insufficient adaptation of the workplace to the abilities of employees resulted in making mistakes, achieving below-assumed efficiency, accidents at work and not using the full potential of the machines and devices used (Stuster, 2006). It was then indicated that working conditions should be developed on the technological level and by ensuring a greater level of employee's safety, as well as by implementing the assumptions of the macroergonomic approach in work processes (strategic shaping of ergonomic quality of workstations and paying attention to the study of employees' behavior) (Kleiner, 2006). Over time, in addition to the above-mentioned assumptions, the following were adopted as the goals of implementing ergonomics into work processes: optimization of production processes (better adaptation to users' abilities), reduction of the number of mistakes made by employees and thus reduction of the number of product returns from customers, greater employee satisfaction from working conditions, improvement of work safety manifested by a smaller number of near-accident events (DeRango, 2003; Górny & Sadłowska-Wrzesińska, 2016). However, in order to achieve the above-mentioned effects as part of ergonomic implementations, there was a need for a thorough analysis of the existing state of the changed workplace in order to identify the needs in this regard (also in relation to the requirements of the project stakeholders) and to indicate what factors will determine their fulfillment. It can be indicated that they will be identified in various aspects of the project implementation, e.g. they may result from the way it is conducted in the enterprise (for example according to the adopted project management methodology). They may also be related to the specificity of the analyzed production process, and depend on the adopted method of ergonomic evaluation (e.g. in the context of the selection of an employee participating in the research, selection of methods and tools for ergonomic evaluation, or the adopted method of analysis of the results obtained in the evaluation) (Bukłaha, 2012; Hendrick, 2008). Therefore, the scientific problem discussed in this article is a methodical approach to the implementation of ergonomic projects. The aim of the research undertaken is to identify the factors that are important for the successful implementation of such projects. They were assessed using an expert opinion survey method and constitute input data for building scenarios of conducting ergonomic projects.

## **2. Ergonomic projects in manufacturing companies**

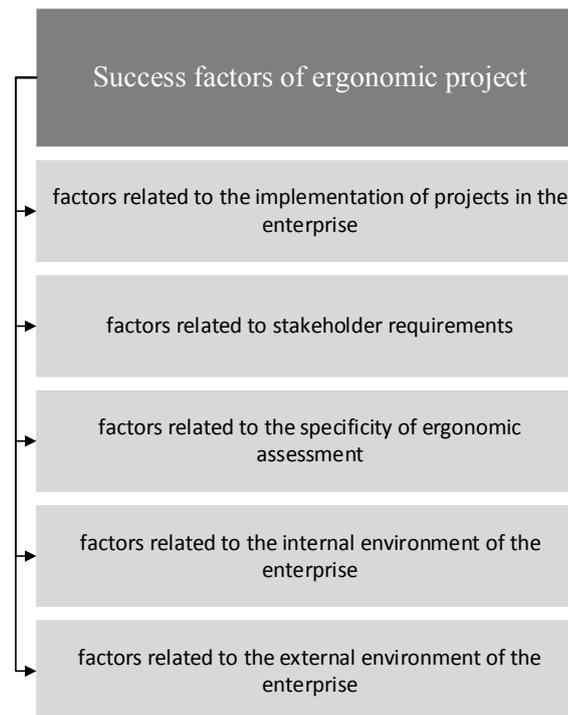
When undertaking ergonomic activities in production companies, particular attention is paid to integrating the proposed improvement solutions with the ongoing production processes. Therefore, such interventions are carried out in a specific order, which allows all relevant issues to be taken into account. The following stages are distinguished in the implementation of ergonomic projects in production companies (Pikaar, 2007; Somers & Nelson, 2001; Realyvásquez, Garcia-Alcaraz, Maldonado, 2018):

- defining the purpose of the project and preliminary assessment of its feasibility (also in terms of the possibility of using ergonomic assessment methods and their implementation),
- establishing the project assumptions (related to the production sphere and the expected ergonomic benefits),
- analysis of the workplace being the subject of the project (characteristics of the ongoing processes, solutions, employees),
- performing the required ergonomic analyzes and presenting the first results and solutions that can be implemented at the workplace,
- designing detailed solutions based on the obtained analysis results (as well as determining the possibility of their implementation),
- implementation of the results of the project (taking into account the limitations identified in the phase of preliminary analysis of the workplace) and possible training of future users in their use,
- evaluation of the proposed solutions and removal of any problems noticed during their use (e.g. reported by employees or persons supervising production).

The implementation of ergonomic projects based on the above- described stages allows to increase the chance to meet the goals and requirements of stakeholders assumed at the beginning of implementation, and to recognize the implementation possibilities of the solutions developed in the project.

## **3. Determinants of the success of ergonomic projects**

In the implementation of ergonomic projects, it is important to determine what factors will affect its successful completion and how to manage them in order to carry out the project in an optimal way. These factors can be distinguished in several areas (Fig. 1).



**Figure 1.** Success factors of ergonomic project. Source: own preparation based on: Dutier, Guennoc, Escouteloup, 2015; Pikaar, 2007; Hendrick, 2003.

The first category of factors that may affect the implementation of ergonomic projects are factors related to running projects in a given enterprise. These include: application of an appropriate project management methodology, determination of the budget, schedule and resources necessary for the implementation of the project and monitoring of the milestones of the project (Yang, Su, Song, 2019; Karaman & Kurt, 2015).

Among the factors for the success of the ergonomic project related to the requirements of the stakeholders, it is possible to distinguish the precise determination of the objectives of the project implementation (including ergonomic ones) and the expected end result (especially from the point of view of future users of the ergonomic solutions developed in the project) (Dul et al., 2004).

Project success factors related to the specificity of ergonomic activities include: selection of appropriate ergonomic assessment methods, selection of appropriate employees to participate in these assessments, proposing ergonomic solutions adequate to the ongoing production processes and work organization at the assessed workstations (Karsh, 2006; Hignett, Wilson, Morris, 2005).

Among the factors determining the success of ergonomic projects, there are also factors related to the external (legal regulations, business environment, competition) and internal (elements of organizational culture) environment of the enterprise. They indirectly affect the result of ergonomic projects, but may have a significant impact on their implementation (e.g. they may generate significant difficulties, especially in the area of convincing employees to use the solutions developed in the project) (Dezdar & Ainin, 2012; Jugdev & Müller, 2005; Stare, 2011).

#### 4. Scenarios for the implementation of ergonomic projects in manufacturing companies

The study consisted in the assessment of the factors of ergonomic project success identified on the basis of a literature review in terms of their importance by five experts (experienced in conducting ergonomic projects in manufacturing companies) (Alarabiat & Ramos, 2019; Hernandez et al., 2019). The evaluation was carried out in two rounds – in the first round the experts assessed all the presented factors, and in the second round they selected among the factors assessed as the most important in the first round. Then the list of factors was used to develop their management scenarios, which were later evaluated in the selected manufacturing company on the example of a project involving the reorganization of a selected workstation.

The success factors of ergonomic project indicated as the most important by experts are shown in the table 1 below.

**Table 1.**

*Success factors of ergonomic project assessed by experts as the most important*

No.	Ergonomic project success factor	Description and identification of its manageability
1	Reliable identified ergonomic goals adopted in the project	Establishing ergonomic goals in the project is conducive to directing activities that are undertaken as part of the project in order to meet the assumed requirements. Goals should be specific, achievable and set within an appropriate time frame. Managing this factor in ergonomic projects should consist in including this step in the initial phase and constant monitoring during the project implementation.
2	Reliable determination of the resources necessary to carry out the project	By identifying the resources needed to implement an ergonomic project during the planning phase, the project team can manage activities optimally. Technological resources (required equipment), financial resources (setting a detailed budget), human resources (appropriate skills and knowledge of the people involved in the project), organizational resources (providing space and time for project activities) should be taken into account.
3	Providing internal and external consulting in the implementation of ergonomic activities	Internal consultancy regarding the undertaken ergonomic activities includes, in the implementation of projects, providing support from employees of reorganized workplaces, as well as specialists dealing with ergonomics (if they are present in the organization). External support may be necessary in the event of problems beyond the competence of those implementing the project and it means the involvement of external ergonomics specialists or EuroErgonomists.
4	Selection of appropriate methods of ergonomic assessment	The choice of ergonomic assessment methods depends, among others, on problems identified at the workplace (especially in the area of physical and informational stress on employees). Their proper application determines the obtaining of correct conclusions on the need to reorganize the workplace and the prioritization of places where actions should be taken to improve the ergonomic quality of the workplace.
5	Proposing, based on the results of ergonomic assessments, adequate solutions for implementation	Ergonomic solutions taken at the workplace as part of the project should be properly applied to it. The possibilities of implementation (including adaptation to the production process), as well as the resources assumed at the beginning of the project and the needs of future users of the solutions should be taken into account.

Cont. table 1

6	Risk management at every stage of the project implementation	The risk may appear at any stage of the project implementation and may be related to, for example, inappropriate use of resources, failure to adapt solutions to the processes taking place at the workplace, failure to recognize the needs related to the project and thus setting incorrect goals for its implementation. Therefore, risk management should cover all stages of the project implementation and be carried out with the use of appropriate methods.
7	Reliable presentation of the results of the project to all interested persons from the company	In order to successfully complete the project implementation, its results should be presented in an appropriate form to all stakeholders (especially employees who will use the solutions developed in the project). In some cases, the presentation should be completed with detailed training, especially in the case of implementing solutions for new machines and devices that require appropriate knowledge to operate them.

Source: own preparation based on: Pikaar, 2007.

It was decided to evaluate the possibility of managing the factors indicated in the table above in the selected manufacturing company.

## 5. Conclusions from the implementation of an ergonomic project in a selected production company based on the developed success factors

The above-presented and characterized success factors of an ergonomic project were used in practice when carrying out an undertaking in a selected production company. The project consisted in the reorganization of the workstation in the production department, where the process of transporting production materials by handcart (in the form of blocks weighing approx. 80 kg) takes place. The project input data is shown in the table 2 below.

**Table 2.**

*Project data which has been used to evaluate the ergonomic project success factors*

No.	Data in the project	Description
1	Workstation and work process	Production workstation, transport of material blocks with a handcart
2	Time, budget, schedule	Project implementation time set for 3 months, budget at the level of PLN 15 000, stages of implementation: problem identification, designing the scope of the project, conceptualization and implementation of ergonomic solution
3	Involved project team	The ergonomics commission operating in the company and an employee working at the assessed workplace
4	Ergonomic problem to be solved	Too heavy materials for transport, unwieldy handcart, no adaptation of the transported material to the size of the handcart

Source: own preparation.

In the context of success factors of ergonomic project presented in the previous subsection of this article, they have been taken into account in the project as presented in the table 3 below.

**Table 3.***Success factors of ergonomic project in the context of practical application*

No.	Ergonomic project success factor	Consideration of factors in the project
1	Reliable identified ergonomic goals adopted in the project	The following ergonomic goals were established in the project: - providing a more manoeuvrable and lighter handcart for transporting goods, - ensuring that the dimensions of the handcart are adapted to the goods transported, - providing support for the transfer of goods from the handcart to the storage place.
2	Reliable determination of the resources necessary to carry out the project	The following resources necessary for the implementation of the project have been established: - financial (in accordance with the budget indicated in table 2), - technical (parts to construct a new handcart), - human (work of the ergonomics commission and external engineering support in the construction of a new handcart), - organizational (possibility to test and implement a new handcart).
3	Providing internal and external consulting in the implementation of ergonomic activities	Involvement of the ergonomics commission and an employee working at the assessed workplace, as well as external engineering support in the construction of a new handcart.
4	Selection of appropriate methods of ergonomic assessment	The following methods were used in ergonomic assessment: NIOSH, REBA and force measurements. After a review of the available methods, they were found to be the most appropriate for the performance of the assessments.
5	Proposing, based on the results of ergonomic assessments, adequate solutions for implementation	After the evaluation and presentation of the results, a decision was made to construct a new handcart with a mechanism facilitating the transfer of goods to the storage place. The lighter weight of the handcart was achieved by the changed structure of the spans, and more maneuverability was provided by additional wheels.
6	Risk management at every stage of the project implementation	Risks related to the project implementation were identified at each stage of the process. The risk was assessed as small, medium or high and due to the impact on the success of the project and the priority of actions that should be taken to minimize it. The most important identified risks in the project were: exceeding the budget due to the specific design of the new handcart, extension of the project implementation time due to the availability of materials, difficulties in convincing employees to use the new solution after its implementation.
7	Reliable presentation of the results of the project to all interested persons from the company	The project was completed with the implementation of the new handcart and detailed training on its use for all employees (with the participation of the supervisor and the ergonomics commission).

Source: own preparation.

Due to the fulfillment of the initial assumptions and the appropriate shaping of the project implementation factors, the persons implementing it considered it a success. The focus in the project on managing strictly defined implementation factors has contributed to paying more attention to whether the activities undertaken are bringing the project closer to completion while meeting the initial assumptions. It should be noted, however, that each ergonomic project will have its own specificity, therefore, scenarios for managing project success factors should be developed, which can be shaped appropriately to the situation.

## 6. Summary and conclusions

Ergonomics is a field of study that is constantly evolving, especially in manufacturing companies. Adapting workplaces to the psychophysical abilities of employees is becoming more and more important in such companies, due to the noticing of many benefits from the application of ergonomic principles (including increasing work efficiency, greater employee satisfaction with working conditions, reducing the occurrence of health problems caused by work in employees, a systemic approach to shaping optimal working conditions, including both production and auxiliary processes performed by employees). It is noted, however, that despite undertaking many ergonomic projects in various production organizations, few scientific studies deal with the possibility of shaping specific factors for the implementation of such projects, which can be concluded from the literature review. Therefore, this article deals with this subject and presents the conducted research aimed at identifying and determining the possibility of controlling such factors. Then, the obtained results were evaluated in a selected production company, on the example of an ergonomic project consisting in the reorganization of a workplace where materials are transported with a manual handcart. After the project was completed, it was concluded with the project team that the established factors that had to be managed contributed to a more efficient project implementation and evaluation of the final result (which is the main result of the research carried out). However, it should be noted that the identified set of project success factors will be different for other projects, therefore scenarios should be developed that can be modified depending on the project input data. This implies a further direction of development of the presented study – in relation to the factors identified on the basis of the literature review and expert research, it is possible to use, for example, decision models that will ensure a greater level of controllability depending on the specificity of the ergonomic project being undertaken. This would allow for greater universality of the scenarios proposed in manufacturing companies, which could also be used in projects of indirect ergonomic nature (e.g. improving the production processes).

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