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ORGANIZATIONAL ASPECTS FOR PERFECTING PRODUCTION PROCESSES BASED ON THE ANALYSIS OF CHANGES USING THE OEE INDICATOR

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Abstract: The article presents the essence of the method of value stream mapping on the example of a selected production process in an automotive company. The analysis presented in the paper concerned the indication of potential organizational possibilities of actions aimed at implementing changes in the organization based on the results of measuring the process with the use of the OEE (Overall Equipment Effectiveness) indicator. All stages of the production process were explained, which allowed to obtain the results of the process efficiency analyses. Further on, the results of the analysis of process improvement in accordance with the PDCA approach are discussed. The significance of establishing the method in order to improve the functioning of the process and the meaning and usage of the value stream mapping methodology in building successful relations with the end customer were emphasized. The undertaken activities constitute a research gap defined as follows: the effectiveness of management methods in an organization depends on the efficiency of using the applied indicators and reacting to changes. Thus, defining models with potential application capabilities in order to increase management effectiveness is one of the most important issues in the area of enterprise organization.

Keywords: value mapping, quality, process optimization, improvement.

1. Change as a determinant of improvement.

Change is a key determinant for individuals, groups and organizations, including enterprises. Change is always present and always affecting the functioning of any organization. One of the essential characteristics of difference is its pace, which has increased significantly

today. Understanding and managing changes in an organization should be one of the fundamental activities in the management of each organization, including the planning of all improvement activities, in particular, the processes implemented in the organization (Todnem, 2005).

Potential sources of change for today's organizations (Tushman et al., 1986) can be characterized by internal dynamics regarding the intellectual capital of the organization. Process management or changes in the portfolio of activities, successively refer to the product life cycle that forces in connection with subsequent stages of the life cycle, the generation of changes throughout the organization, including all technical, technological, but also managerial aspects to fit strategic goals. Organizations should, hence, be subjects with a prospective interest not only in diagnosing changes in both their internal and external impact, but also in using this knowledge in the process of value building (Dudek-Burlikowska, 2019). The effectiveness of introducing changes in organizations depends not on declarations in terms of understanding and openness to changes and related transformations, but on the implemented actions resulting from the entire spectrum of management activities put in place in organizations in this regard (Roszak, 2006).

One of the most important theories regarding the issue of change concerns the theory of "organization ambidexterity" (Birkinshaw, and Raisch, 2008), which holistically explains the sense of the existence of an organization, and also the reason for its change. This theory distinguishes in each organization two main forces: exploitation power – focused on maintaining the status quo in a given organization and the pursuit of ever-greater efficiency in performed operational processes, and exploration power – quite the opposite, focused on transformation, change, development and following long-term organizational vision, on formulating organizational development strategies. Both forces exist in parallel, and their understanding forces the management process to optimize them in order to make accurate decisions, both operational and strategic. The above should allow the organization to use its potential, synchronizing planned and implemented activities evenly, because change is an indispensable part of the existence of every organization, in every process, at every management level of the organization (Roszak, 2014).

A method commonly used today to support decision-making in the area of production processes is value stream mapping, which uses the OEE Overall Equipment Effectiveness indicator. Both value stream mapping and OEE indicator analysis allow diagnosing changes in the production process.

Value stream mapping can bring to an organization, the following benefits:

- aids in visualizing the value stream not only at the level of a single process,
- helps to illustrate the flow through which it will be possible to respond quickly to the changing needs of customers,
- enables the organization to see the waste, but more importantly, helps to understand its sources,

- provides the right language, common to the entire organization, to discuss all processes (graphic language),
- combines Lean management concepts and techniques, prevents their ad hoc use and determines the correct order of implementation,
- forms the basis of the Kaizen implementation plan, helping design how flow in the process should work.

Benefits of using VSM analysis include:

- imaging the flow of information and resources in the company as doing this enables waste identification in the company and, consequently, the reduction of costs,
- integrating plant indicators with customer needs, maximizing value-added for the recipient,
- shortening the flow time of a product or service by a company by up to 80%,
- increasing the company's cash flow,
- improving the organization of work in the enterprise.

All this means that this tool seems to be definitely more friendly than the current quantitative methods or layout diagrams, which show the results in the form of long registers of activities that do not add value, their transition times or distances traveled or the level of inventory. It is a qualitative method that allows the characterization of how a given company can operate to ensure the continuity of its operations as evidenced by an appropriate level of value creation.

An important element in the functioning of the company is the management of the machine park. Appropriate machine management strategies are used to enable best effective use of company-owned machinery and plant (Hys, 2014). The Overall Equipment Effectiveness (OEE) indicator is used to assess the condition of a machine park. The OEE indicator describes three main areas of the company's operation: availability, efficiency of use and quality of manufactured products. Application of this verifies the efficiency and efficiency of production in production plants. This is the main measure in overall maintenance (Furman, 2014). Determining the indicator allows defining improvement actions in the scope of performed production processes. It measures their effectiveness and showcases existing errors so that they can be eliminated. The application of OEE also identifies major production cycle problems and narrow grades (Janisz, Liszka, 2018). Moreover, use of the OEE indicator enables initiating treatments that will reduce the time needed for additional production activities.

The strategy for effective and efficient use of the OEE indicator to achieve the best production results is to make measurements and to know all losses occurring in the production cycle. It indicates not only problems related to machines, but also in the organization of social work, the production cycle and the flow of raw materials. The use of the OEE indicator is associated with many benefits, among others, improving the efficiency of machines and devices, enhancing the quality of manufactured products, enabling greater access to computers and devices, providing continuous control over the machine park, as well as increasing the involvement of the staff in the care of production devices and machines.

2. Planning changes in the production process – case study

This study is based on a selected production process implemented in the automotive industry. The company that has been analyzed carries out machining processes using modern production lines with a high level of automation and the use of CNC machine tools.

The company has implemented quality management systems and meets the quality requirements defined for the automotive industry. The company uses methods and tools for quality management, including mapping the value stream so as to determine the level of waste occurring in the company, and including the OEE – Overall Equipment Effectiveness indicator for lines and individual production cells.

It was assumed in the enterprise that improvement actions are taken on the basis of value stream analyzes, including the OEE indicator analysis. In the enterprise in which the analyzed process is implemented, expected minimum level of the OEE indicator is 80. However, the analysis of the selected cylinder head machining process has shown that the OEE indicator on the cylinder head processing line is disturbingly unsatisfactory, as shown in Figure 1.

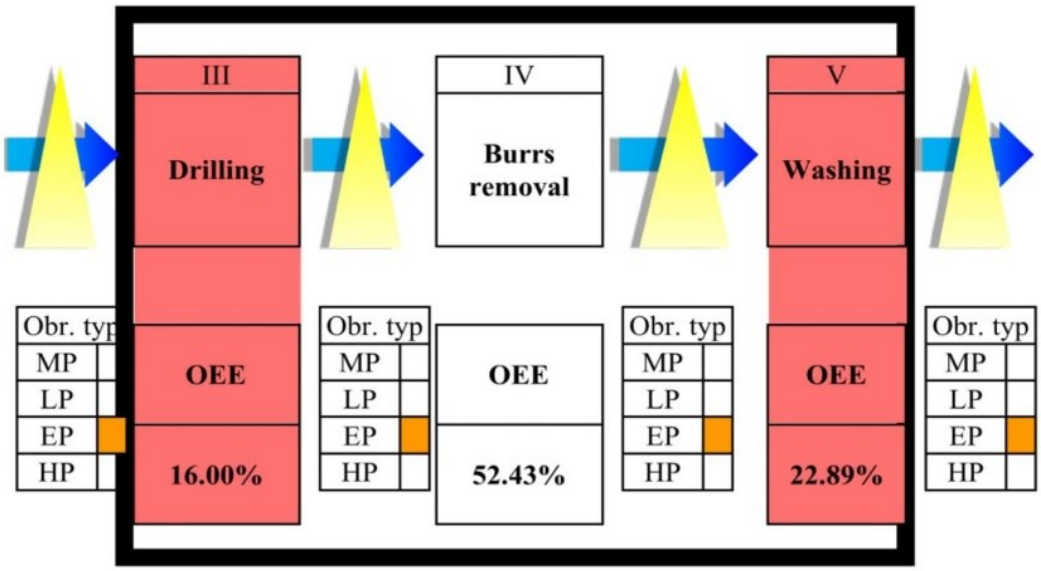

Figure 1. Present condition value steam map. Source: own study based on data from the enterprise.

In connection with this, analysis and preparation of recovery plans were commenced using organizational solutions already enacted and functioning in the enterprise.

The following schedule of improvement actions implemented by the diagram in Figure 2 has been adopted in the enterprise.

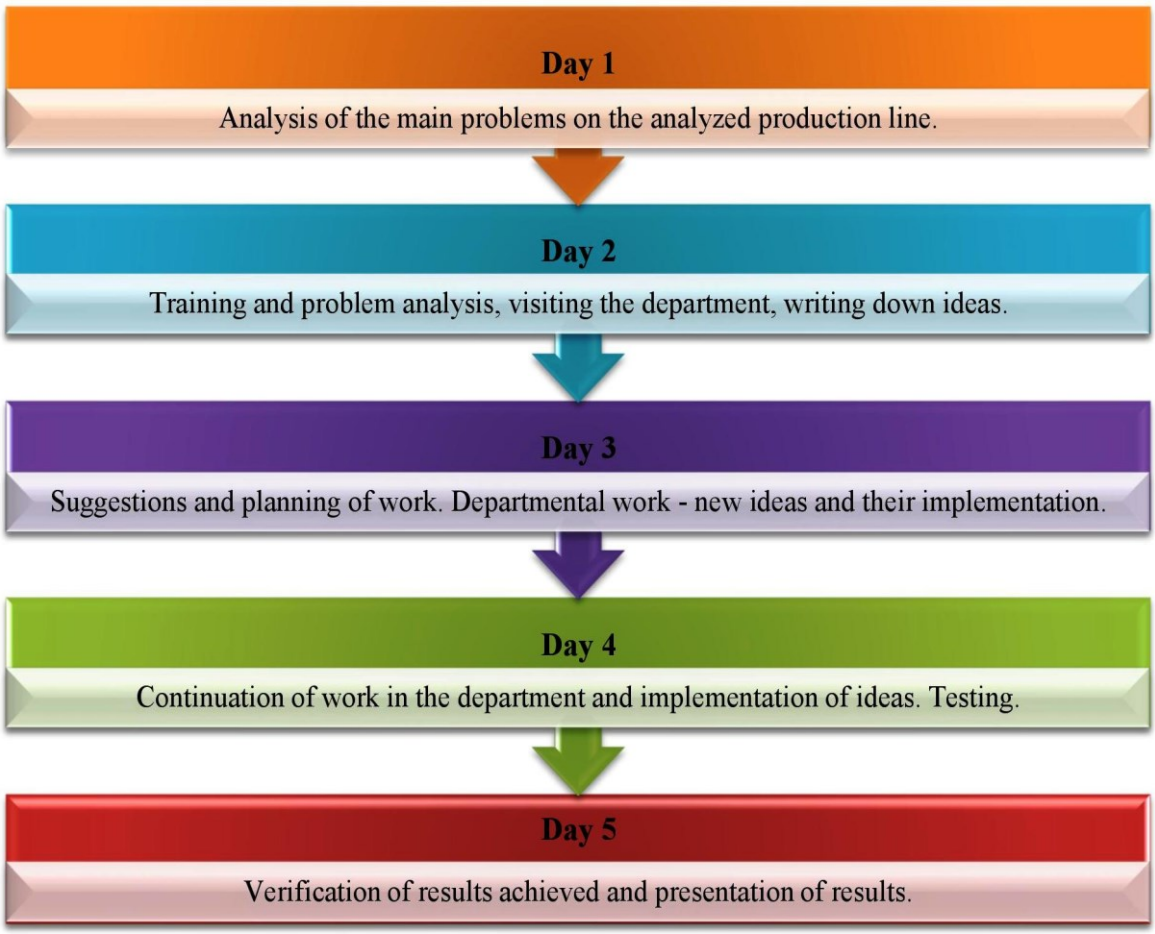

Figure 2. Scheme of organizational activities related to the implementation of changes. Source: own study based on data from the enterprise.

As a result of systematically carried out activities aimed at managing production processes, including diagnosing problems, it was noticed during mapping of value streams that on one of the production lines, in two operations, the OEE indicator was significantly below the required level – Fig. 1.

So as to define the irregularities, a design team of 4 employees was appointed. This team was composed of: technologist, leader of the production line on which the problem was defined, quality control employee, maintenance employee. Employees were excluded from their daily duties, thus having a 100% opportunity to get involved in the project. The target group was set to achieve an expected level of OEE that is not lower than the one adopted in the enterprise.

In this company, an employee participating in the task entrusted to him is obliged, in the event of a "problem" that may directly affect the process and the product or indirectly the Customer or end-user, take the corrective actions provided for in the work instructions, record the date of these activities on the back of the control card and inform about this fact to the immediate supervisor. If the oral notification is ineffective and the defect repeats, after determining the immediate corrective actions with the supervisor or other responsible persons, he completes the system form. Herein, immediate corrective actions should be taken

simultaneously with verbal information from the employee about the existence of a defect in the event that the removal of irregularities can be immediate due to the fact that the problem is easy to solve.

If the Quality Control Department catches a defect or noncompliance, a member of this department notifies the operator (employee responsible for the machine, line, etc.). In addition, he informs the production supervisor of the existence of irregularities. The intent is to ensure that other defects do not get through to the next operation during the production cycle.

The operator of the machine, line, etc. on which irregularities were found must then take corrective measures to eliminate the causes of defects. Corrective actions are recorded on the back of the process control card, one copy of which goes to the Quality Control Department, and one copy to the line supervisor. The Quality Control Department subsequently analyzes the effectiveness of the remedial action by examining the first manufactured components.

If the causes of irregularities go beyond the scope of the Production Department and cooperating departments, the Technical Director or the Managing Director of the Plant shall be informed about the need to solve the problem. Corrective and preventive measures should be then directed and conducted within the existing organizational system of the Production Department, and coordinated by the Quality Control Department after approval by the Technical Director or the Managing Director of the Plant, by the information flow diagram.

In accordance with participatory approaches to management, when establishing and developing activities, it is advisable to maximize the participation of employees of various Departments so that, in addition to the main goal, i.e. solving and eliminating a given problem, these Departments are sensitized and stimulated to solve problems within the standard, accepted course proceedings.

Each record of proposed actions should include description of the situation (that which should be improved), description of actions taken so far, resulting losses, degree of urgency of implementation, cost, solution suggestions, goals and results to be achieved, implementation schedule and verification of intermediate and final results. Activities should be managed and conducted within the existing organizational system of individual Departments and coordinated by the Quality Control Department after their approval for implementation.

Applications for corrective actions, as well as providing information on its course are prepared by filling out the appropriate "8D" form, the original of which is retained by the working group and a copy by the Head of the Quality Control Department. The Quality Control Department Manager must be notified of each corrective action completed by the working group. The Plant Quality Control Department is responsible for keeping the register and archiving the implemented activities. The costs of conducted activities should be recorded on an ongoing basis throughout the year by the Chief Accountant so that on their basis, it is possible to plan expenditure for the next and subsequent years.

In the case of achieving the required effectiveness of corrective actions confirmed by the working group on the "8D" report, the group leader responsible for the activities informs the Quality Control Department Manager, providing him with the fully completed original of the "8D Report" form. Assessment of the effectiveness of the entire program of activities that were put in place is conducted based on the obtained qualitative and economic indicators in a given time in relation to the achieved goals set in the schedules.

If their effectiveness is confirmed, the Head of the Quality Control Department signs the completion of activities, informs the interested parties about this fact and submits the form for archiving in the Quality Control Department. In particularly essential cases concerning defects found at the Customer, the approval of the structure may be made by the Technical Director or the Managing Director of the Plant.

The fact of having achieved effective corrective actions, as well as any delay or difficulties are recorded in the Plant Quality Report, in which the percentage rate of application of corrective actions conducted and implemented at the Plant is tracked.

The results of the analysis for the problem in Fig. 1 are presented using the Ishikawa chart – Fig. 3.

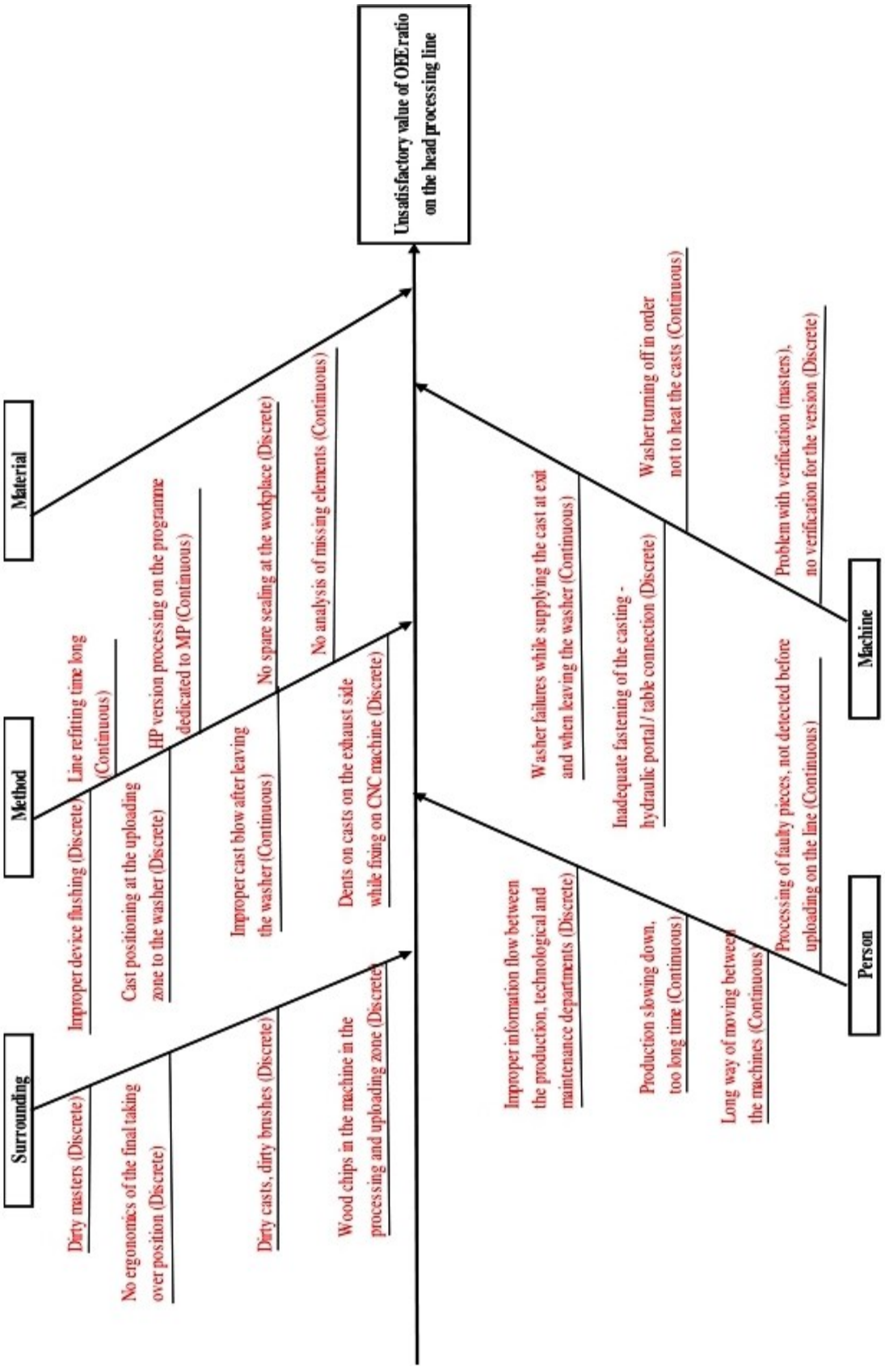

Figure 3. Problem analysis, unsatisfactory OEE level for the process. Source: own study based on data from the enterprise.

3. Summary

Due to the quick reaction of the company's management board and significant results of the analysis carried out by the interdisciplinary group established especially for this task, the expected results were obtained.

It was assumed in the enterprise that the activities undertaken in connection with analyzing the problems are carried out on the basis of the Deming: Plan-Do-Check-Act (PDCA) improvement cycle, and the supreme goal of this approach is to implement in the enterprise activities constituting a learning process, including change management.

The error-learning model used in the enterprise is inspired by systematic research and analysis of production processes at all stages of their implementation, i.e. in:

- the design phase,
- the industrialization phase,
- production phase.

The error-learning model applied in the enterprise is based on learning as gaining experience - and then transforming it into knowledge and skills. In the particular problem, the learning basis is experience based on which the interdisciplinary group makes a critical reflection and assessment of the problem - which in turn leads to the acquisition of new information about the product and the process.

This type of learning cycle includes the following phases:

- observations are drawn from experience,
- reflection on occurring events,
- shaping general patterns of conduct to be adopted in such situations, which are subject to generalization,
- checking the developed models of conduct in practice by using these formulas in new and unknown cases.

The information obtained during this type of process is constantly improved as a result of their use in new problem situations for new products and procedures, as well as thanks to unique experiences incorporated into the structures of conducted production activities. The model of learning through experience used in the company is identical to the Deming approach based on the PDCA spiral used for problem-solving.

The first six stages of the problem-solving process are implemented as part of the planning phase, from problem identification to prioritization and decision-making.

As part of the next phase, the implementation process of developed solutions takes place.

Next, through the control and evaluation of designed solutions, the results control phase is carried out with the assumed plan. Based on the results of the monitoring and evaluation of the implemented solutions, a decision is made to perform or refrain from activating the new standard. In the case of a favorable decision, a new standard is prepared and acted upon

(the stage of implementing the new solution is also utilized for related and comparable products and processes). In order to be able to assess it in the final stages of problem-solving, the team at the beginning of problem-solving precisely defines the goal to be achieved, which is a brief description of the results the team intends to achieve by solving the problem. When setting a goal, account should be taken of available resources, working conditions and the impact of the project on other processes. The goal of the project, to properly fulfill its task (assessment of the solution to the problem) should be given in the so-called SMART formula, which means it should be: Specific, Measurable, Achievable, Relevant, Time-Bound.

Presenting the goal to be achieved in a standard form resulting from the use of the SMART formula not only helps in better understanding of the idea that guides the project team, but also provides a platform for comparing the effects of work of different teams.

The detailed examination of the production process made it possible to draw conclusions for the future by introducing organizational activities in the enterprise consisting of quarterly reviews of production processes as a permanent element that fits into the management mechanisms in the examined enterprise.

The application in the enterprise of the approach based on the "learning" model, which was used in the problem analyzed in this study allows for:

- generating new ideas,
- shaping a higher level of awareness of the benefits obtained,
- perceiving the benefits of developed implementations as a result of teamwork,
- increasing commitment to problem-solving,
- looking at the product and process from many perspectives,
- generating changes enabling a better process result, better products,
- gaining new experience,
- shaping systematic and consistent results-oriented work among employees,
- paying attention to potential risks that may occur during the process.

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