USE OF TOOLS TO IMPROVE PRODUCTION AND LOGISTICS PROCESSES

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Introduction/background: This article presents the functioning of a production company in the construction chemicals industry. Based on the literature research, the following thesis was formulated: the use of tools to improve logistics processes significantly improves and increases the efficiency of production processes in the analysed enterprise. In the article, the following issues were indicated: analysing the course of logistics and production processes in the analysed enterprise, developing a map of the production implementation process and the products on Line retooling process, analysing the possibilities of implementing tools to improve logistics and production processes and developing recommendations for the enterprise.

Aim of the paper: The main purpose of the study is to identify irregularities in the implementation of logistic processes in the examined enterprise and to propose improvement measures.

Materials and methods: In the research part, the authors proposed Lean Production improvement tools (SMED, TPM) to optimize logistics processes and production.

Results and conclusions: The work created by the authors is a research article that includes a full analysis of the production and logistics processes of a company from the construction industry. The paper presents irregularities occurring during logistics and production processes, and proposes improvements. The authors argue that it is important to introduce the proposed improvements to optimize logistics processes and production, and that they are possible to implement in other manufacturing companies.

Keywords: Construction Industry, Lean Production, SMED, TPM.

1. Introduction

Changes occurring in the environment and changes arising in the enterprise force it to adapt to the prevailing conditions. This can mean the need for improvement, and its subject can be both materials (products, functions, structures) and people (employees and managers, specifically their skills, attitudes and behaviours) and processes in the company. The logistics and production processes analyzed in the article support the core processes of the enterprise and are subject to continuous improvement. Improvement of this processes can be in the form of ongoing adjustments and/or major changes. It becomes extremely important to properly manage the logistics and production processes in a company. As a result, various concepts, such as project management, process management or quality management, can be applied simultaneously in the optimization of a company's logistic and production processes. The article presents the characteristics of production processes, production capacity and production systems in theoretical aspect. In the research part of the article, the authors proposed selected Lean Production improvement tools (SMED, TPM) for the optimization of logistic and production processes in a selected enterprise.

2. Selected literature issues related to logistics and manufacturing processes

2.1. Production process

The term production refers to the use of various technical means, materials and services to create new products desired by the customer (Burchart-Korol, Furman, 2007). On the other hand, the production process is the process of evolution of the input elements of the production system into the output elements of the production system. It is a set of ordered activities, actions and operations, whose purpose is to produce a product desired by the customer, the user. In an industrial company, the production process will include all activities, starting from the collection of input materials and raw materials from the warehouse, through the control activities, transport, storage and technological operations, up to and including the delivery of the finished product (Pasternak, 2005). The structure of the production process is shown in Figure 1.

The production process includes: manufacturing processes, development and research process, customer service and distribution process (Burchart-Korol, Furman, 2007). The manufacturing process refers to the production of a product, that is, the transformation of the components of production into services and finished goods. It includes operational scheduling, operation planning, quantity and quality control of manufacturing (Burchart-Korol, Furman, 2007). The process of research and development in all three areas: organizational, construction and technology is responsible for the preparation of production. It is concerned with financing the company, forecasting and strategic planning, training personnel, raising capital, designing the product, process and location, and providing the raw material base (Pajak, 2006). The customer service and distribution process deals with the operation and organization of marketing research, service and sales. This process is responsible for establishing distribution channels to deliver the final product to customers (Burchart-Korol, Furman, 2007; Pajak, 2006). Figure 2 shows the elements of the manufacturing process.

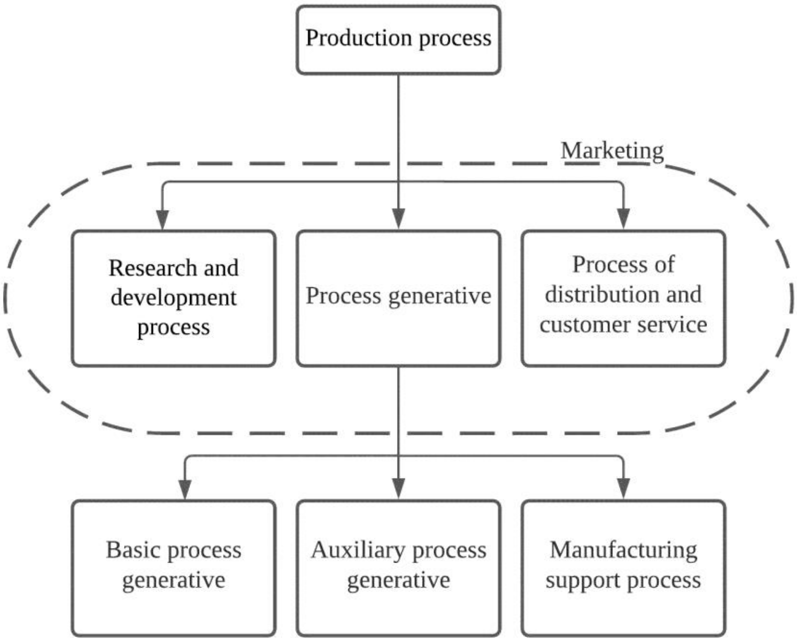


Figure 1. Structure of the production process. Adapted from: "Zarządzanie produkcją i usługami" by D. Burchart-Korol, J. Furman. Wyd. Politechniki Śląskiej, Gliwice 2007, p. 33.

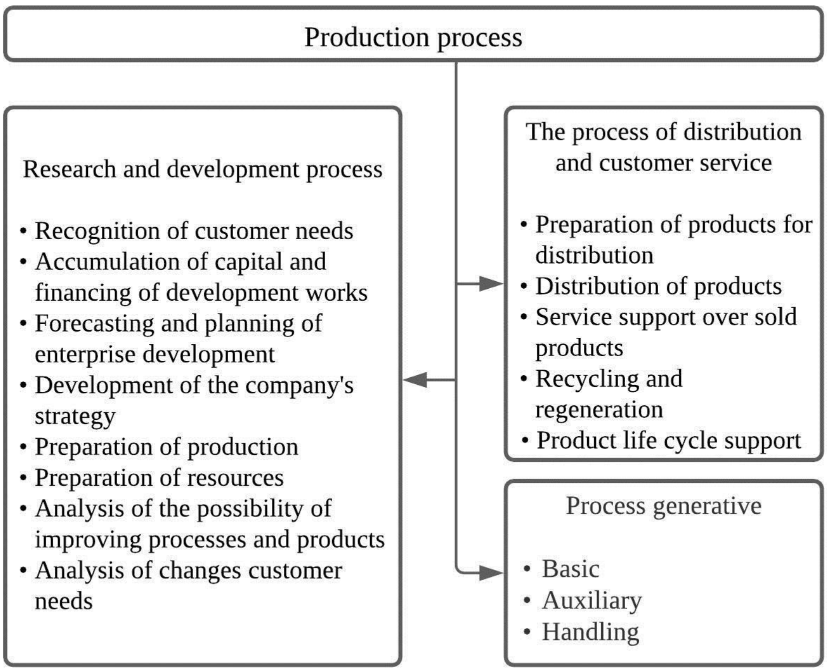


Figure 2. Production proces. Adapted from: "Zarządzanie produkcją" by E. Pająk. Wyd. PWN, Warszawa 2006, p. 85.

The type of production organization is called the specialization of individual workstations and their associated levels of stability, associated with the performance of designated operations and parts of production processes. The type of production is taken from the frequency of changeover of workstations in the company and refers to individual workstations, which are the production links that determine the structure of the manufacturing process (Szymonik, 2012). There are three types of production: unit, serial and mass production (Burchart-Korol, Furman, 2007). Unit production is characterized by repetitive in irregular stretches of time or unique production of several or one piece of products. Unit production occurs if demand has been misestimated, demand is one-time, production standardization and plant specialization is limited. Production planning reveals: large scope of preparation, uneven use of production capacity, requirement to employ qualified specialists, variety of products, increase in storage space, low efficiency and productivity of production, variety of operations and activities, extension of the production cycle (Burchart-Korol, Furman, 2007). Serial production is characterized by periodical production of a certain number of identical products. The start of serial production does not depend on the number of products, but on the periodicity of their repetition and similarity. The stabilization of production is led by the reduction of manufactured products, it is characterized by an increased frequency of operations to be performed at individual workstations. Batch production increases the efficiency of work, increases the possibility of automation and mechanization of production processes, reduces the idle time of machines and breaks in work, increases the skills of employees as well as the specialization of individual workstations (Burchart-Korol, Furman, 2007). Mass production is characterized by a constant range of production over a long period of time. In mass production, the continuity of production and repeatability of activities at individual workstations is important. It is characterized by full automation and mechanization of production processes, specialized equipment, lack of retooling, good inventory management and efficient material supply (Łubniewski, Wacławek, Zymonik, 1986).

The production process and its structure differs in different industries and sectors. Different processes are found in the steel industry and completely different in the engineering industry. The difference is due to the different products produced and the technology required to produce them. To be able to proceed to the design of production or its initiation, the production organizer must know the detailed technical characteristics of the manufactured products.

2.2. Production capacity

Production capacity is a fundamental problem of production organization. It is a factor that determines the production capacity of an enterprise. Production capacity can be defined as the possibility of producing in an enterprise, in a given period of time, the maximum number of products in accordance with the observed quality standards, with the proper use of production factors and the use of the most advantageous methods of production (Borowiecki, 1990). Depending on the time and management level, three different levels of production capacity are distinguished (Muhlemann, Oakland, Lockyer, 1995):

- effective – represents the actual utilization in the current planning period of the enterprise,
- potential – represents what the top management of the enterprise can give within its competence,
- actual – represents what can be achieved with the budget planned for the given planning period.

Production capacity is determined by optimal technical and economic standards, which determine the maximum use of production space, equipment and machinery, taking into account the most favourable conditions for the organizational and production process of work. When calculating the production capacity, only the elements of the basic production departments are taken into account, the other elements should ensure the correct operation and preparation of the main production process. The calculation does not take into account elements lent to other plants and departments, but also equipment and machinery that are delegated to a permanent production reserve and are used only during the downtime of the actual production machine. Production capacity is never determined only once for a given company, since after a longer period of time it can show an increase due to improvements in manufacturing methods, modernization, structural improvements and the replacement of old machines with new ones. Production capacity is designed to determine the production capacity for a given company and to show the reasons why the production capacity is not fully utilized (Borowiecki, 1990, Brzezinski, 2002).

The basic factors affecting the production capacity are internal factors that determine the production capacity (Burchart-Korol, Furman, 2007):

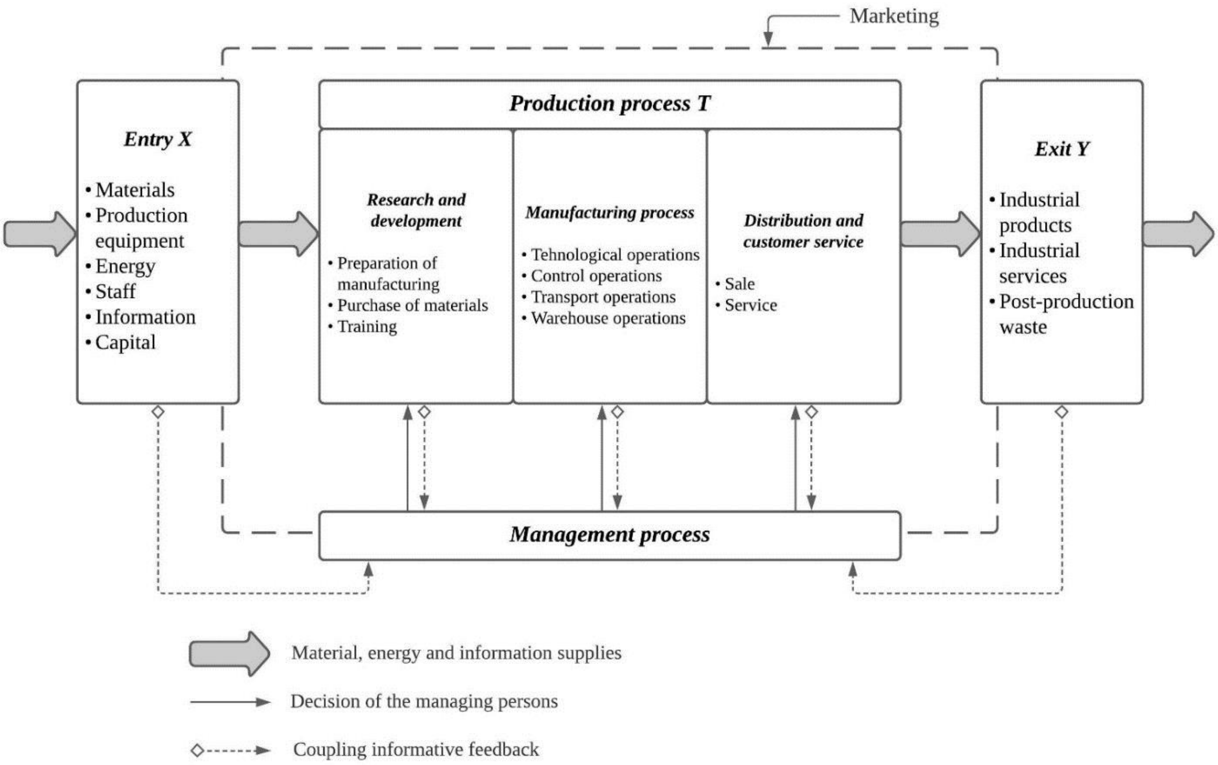
- production organization – technical standards representing the production technology, only possible to achieve thanks to the owned machinery, the optimal operating time of equipment and machinery and the production area of the enterprise throughout the production year and the appropriate level of work organization and type of production,
- factors of production – owned production equipment and machinery of the enterprise, their number, types and size of work area and technical characteristics,
- the assortment structure of production – the technical fuel, raw materials, materials used and the full assortment program of production.

External factors affecting the production capacity are defined as macroeconomic factors, political factors and demand expressed in terms of assortment, quality and quantity of products needed (Wojownik, 1984).

2.3. Production system

A production system is a deliberately organized and designed system of information, material, and energy operated by employees and used to produce various products, outputs, and services to satisfy the customer. Five elements enter into the production system. These are (Burchart-Korol, Furman, 2007):

- input X – all factors of production are included in this element,
- output Y – this element includes services, production waste and products,
- product process T – in this process input X is transformed into output Y,
- system management process,
- information, material and energy couplings – occurring connections between elements of the production system.



The elements of input X, output Y, production process T and the connections occurring between these elements are called the production or processing subsystem, and all information couplings together with the system management process constitute the management subsystem. Figure 3 shows the general accepted model of the production system (Burchart-Korol, Furman, 2007). The elements of input X and output Y are presented in Table 1.

Figure 3. A general model of the production system. Adapted from: "Inżynieria zarządzania cz. 1" by I. Durlik. Agencja Wydawnicza Placet, Warszawa 2007, p. 130.

Table 1.
Input elements X and output elements Y

Input elements X of the production system	Output elements Y of the production system
Capital frozen in finished goods, equipment, semi-finished goods, materials and capital placed in banks, cash or with customers.	Secondary raw materials and production shortages.
Knowledge, information, decisions.	Waste that harms the environment such as garbage, noise, solid waste and sewage.
Object of work – semi-finished products, materials for assembly or further production, human factors.	Information about the status of the production process, the actual cost of ownership, the quality of the product, and the experience of the production crew.
Technical means of production – buildings and structures, production area, industrial plant premises, IT networks, power installations and technological equipment.	
Energy factors – electricity, solid and gaseous fuels, heat and cooling agents, water, compressed air and gases.	

Adapted from: "Inżynieria zarządzania, cz. 1" by I. Durlik. Agencja Wydawnicza Placet, Warszawa 2007, p. 132; "Zarządzanie produkcją i usługami" by D. Burchart-Korol, J. Furman. Wyd. Politechniki Śląskiej, Gliwice 2007, p. 32.

Businesses, in pursuing their main objectives, strive to earn a certain profit. Costs, profits and revenues are dynamic and depend on many factors related to the operation of the production system. There are three goals of designing and building production systems (Burchart-Korol, Furman, 2007):

1. to reduce manufacturing costs,
2. gaining higher productivity,
3. obtaining modern products of high quality.

2.4. Lean Production

Lean Production can be considered one of the most significant contributions to the history of operations management (Zhang et al., 2019; Krafcik, 1988). This concept was introduced by Krafcik (Womack, Jones, 1991) and was first used by scientists from the Massachusetts Institute of Technology. At the turn of the 90s, Daniel Roos, James P. Womack and Daniel T. Jomes published The Machine That Changed the World *(*Abualfaraa et al., 2020) where they compared the parameters of results and outlays in American, European and Japanese enterprises. Toyota Motor Production was been recognized as a leader along with its Toyota Production System (Alhuraish et al., 2016). The authors defined the system as the first lean production system and referred to as Lean Production. Current references also use terms like Lean Manufacturing and Lean Thinking. In production practice, Lean Production and Lean Manufacturing are used alternatively and have the same meaning. Lean Prodution refers to "a methodology designed to reduce production costs to minimize waste" (Snee, 2010). Snee defined Lean Manufacturing as "a business strategy and methodology that increases process efficiency, which translates into greater customer satisfaction and better financial results" (Szymonik, 2012). The concept of lean manufacturing stems from the use of the fewest of these factors during the production process compared to the traditional production method (Vanichchinchai, 2019):

- half of the time spent by engineers working on newly designed products,
- half of the funds used for tools and devices,
- half of the efforts by employees,
- half of the space used in production,
- implementing newly designed products in half the time.

Lean Production as a concept leads to overcoming the number of production shortages and increasing the range of manufactured products due to maintaining only half of inventories (Womack, Jones, 1996). The organization of production, where the goal is to minimize all the resources used for various types of activities in the enterprise, provides for the identification and elimination of activities that do not provide value added in supply chain management, production, customer relations and design (Hines et al., 2004). Entrepreneurs operating according to certain rules use robots that allow them to produce larger quantities of products with an increased degree of diversity. Manufacturers at various levels of the organization also employ specialized multi-tasking employees. In lean production, a number of practical tips and principles must be used to reduce costs by eliminating wastefulness and simplifying service and production processes. The main principle at Lean Production is continuous improvement. Once the goals have been achieved, the efforts to improve the process should not end (Zhao, Heng, 2019). Better solutions must be sought and the standards of functioning must be raised, as the environment of the enterprise is constantly changing (Wu et al., 2019). Toyota, which is the leading production company in the world, bases its success on this principle. Lean Manufacturing was created based on the Just in Time system, which was later transformed into the entire enterprise management system, namely Lean Management. All this is the essence of a modern Lean Management company where one of the most important tasks is now digitization of the global business space (Koranda et al., 2012). The basic principle of Lean Management is to reduce waste of resources by asking if a given task or process constitutes any value added to the enterprise (Al-Aomar, 2011). The concept of cost-effective management identifies waste as any type of process or resource that is unnecessary or increases costs or time consumption (Aziz, Hafez, 2013; Issa, 2013). Lean Production includes organization, material order control, planning, development and research. Tasks and procedures associated with the supply chain are viewed from a project-focused perspective, rather than from a general or standardized perspective, which makes it easier for project managers to focus on specific project results and unique customer requirements (García-Alcaraz et al., 2019; Abdallah et al., 2018). The implementation of Lean principles requires the implementation of many typical tools that will improve the functioning of the company (Filla, 2016). In practice, these techniques are usually referred to as Lean Toolbox (Corrizo Moreira, Torrez Garcez, 2013). In the research part, the authors proposed using Lean Production tools such as: SMED and TPM.

3. Research part

3.1. Improvement tools introduced in the examined enterprise

SMED (Single Minute Exchange of Die) means shortening changeovers time or putting it more precisely, the impact on reducing the production batch is the basis of Lean Manufacturing and Just in Time methods (Pawłowski et al., 2010). SMED is defined as improving production flexibility and a TPM element, which is designed to enable retooling of the production line in less than ten minutes (Godina et al., 2018; Boram, and Ekincioğlu, 2017). The SMED methodology gives us three concepts: external retooling, internal retooling and retooling itself. Retooling, i.e. introducing changes to a group of machines or a machine, involving replacing the mounting fixture, mould, matrix, tools, etc. to allow other products to be made in the manufacturing process. The time needed for retooling is counted from the last product "A" to the first product "B" in appropriate quality with standardized parameters. External retooling is part of the overall retooling, carried out during the production line or machine operation. Usually, these are preparatory activities before stopping the production line. Internal retooling is part of the retooling performed when the production line or machine is stopped. Achieving standard performance, start time and device start-up are included in the time of internal retooling (Díaz-Reza et al., 2018; Horzela, Semrau, 2020). This tool is increasingly used in enterprises that have variable and complex production lines (Gligorijevic et al., 2016; Sayer, and Williams, 2015).

TPM (Total Productive Maintenance) is one of the most important Lean Management tools and it is a global maintenance management in an enterprise (Nakajima, 1998). It is the method with which we can maximize productivity and ongoing maintenance of tools and equipment. TPM's goal is to minimize production losses associated with breakdowns or malfunctions, maximize the efficiency of production equipment and optimize the entire maintenance program established throughout the enterprise (Bon, and Lim, 2015). Equipment performance as an indicator of performance is recorded in a balanced table, especially in manufacturing companies. TPM method is divided into three areas (Imai, 2012):

- Preventive maintenance – cost control and proper people management allow predicting the occurrence of failure event by performing maintenance at the right time. Also, parts necessary to have in stock for routine and scheduled maintenance can be defined.
- Autonomous maintenance – means that a team of employees performs maintenance as part of activities of the work schedule. Thus specialized employees can focus on heavier tasks that are to prevent malfunctions and are planned in the department work schedule. A description of maintenance work is used for tasks allowing employees to perform them regularly and on time.

- Planned maintenance – heavily used or high risk parts must be regularly replaced or maintained. This type of work must be planned because tools, parts or equipment must be out of service. In a Lean environment, maintenance planning is very important. When replacing parts, data must be downloaded to allow making predictions about possible failures.

TPM can also be defined as an approach which, due to the involvement and empowerment of employees, dramatically improves production processes (Jiménez et al., 2019).

3.2. Production line retooling process

The process of retooling the production line in the examined company is a very important element that has a direct impact on the highest quality of manufactured products and their reliability. When starting the production line, no material may be present that is not part of the product's composition, which may affect its physical and chemical properties. The process of retooling the production line begins with the introduction of the Betolix waste dissolving substance into the main mixer. The entire dissolution process takes 10 minutes and the substance can be used only once. After being pumped out of the mixer, it is sent in metal tanks to a recycling company. The equipment and machine maintenance worker must then check the mixer ducts manually, using the engine control module. All parameters should be within the standards and the operation report must not show any errors. Depending on the production line settings, the mixer rotor must be replaced for the production of the product.

The next step in retooling the production line is to replace the conveyor belt appropriate for a given product. It must be replaced in every process of retooling the production line. After the installation of a new belt, the conveyor motor must always be tested under operating conditions. The maintenance worker blows all of the fifteen channels of the packing machine with compressed air to prevent unwanted substances from entering the newly manufactured product. Betolix waste dissolving substance is then being introduced into the packing machine. The packing machine is started to flush the channels. All channels must be properly dried with compressed air. During the inspection of the packing machine, the bags are also replaced with other bags, appropriate for the material subsequently produced.

The production department manager archives on the disk of the production line control module the settings for previous production and uploads new settings for the next product. After programming the line, the production line must be started to check the proper functioning of all devices necessary for the production of new products. Production line employees, after receiving guidelines from the production manager, are tasked with preparing new semi-finished products that will be used during production. The times of the above-mentioned activities are presented in table 2.

Table 2.
The times of tasks performed when retooling the production line

No.	The activity performed during the retooling of the production line	Time
1.	Introduction of waste dissolving substance into industrial mixer.	12:15 min
2.	Rising the tank industrial mixer.	10 min
3.	Pump down the dissolving substance.	13:10 min
4.	Inspection channels industrial mixer.	5:30 min
5.	Inspection engine industrial mixer.	12 min
6.	Replacement of the rotor for the corresponding product.	31:10 min
7.	Disassembly conveyor tape.	14:20 min
8.	Installation of a suitable conveyor tape.	10 min
9.	Inspection conveyor engine.	7 min
10.	Blowing with compressed air channels packing machine.	2:45 min
11.	Introduction of waste dissolving substance to channels packing machine.	2 min
12.	Rinsing the packing machine channels.	10 min
13.	Pump down the dissolving substance.	2 min
14.	Desiccation channels packing machine.	5 min
15.	Replacement of bags in a packing machine with a suitable for product.	15 min
16.	Saving software from the production line.	1 min
17.	Uploading new software from the production line.	1 min
18.	Test launch of the production line.	5 min
19.	Production line inspection.	5 min
20.	Preparation of materials for production.	21 min

Source: author's own research.

The process of retooling the production line described in table 2 is presented using the process map in fig. 4.

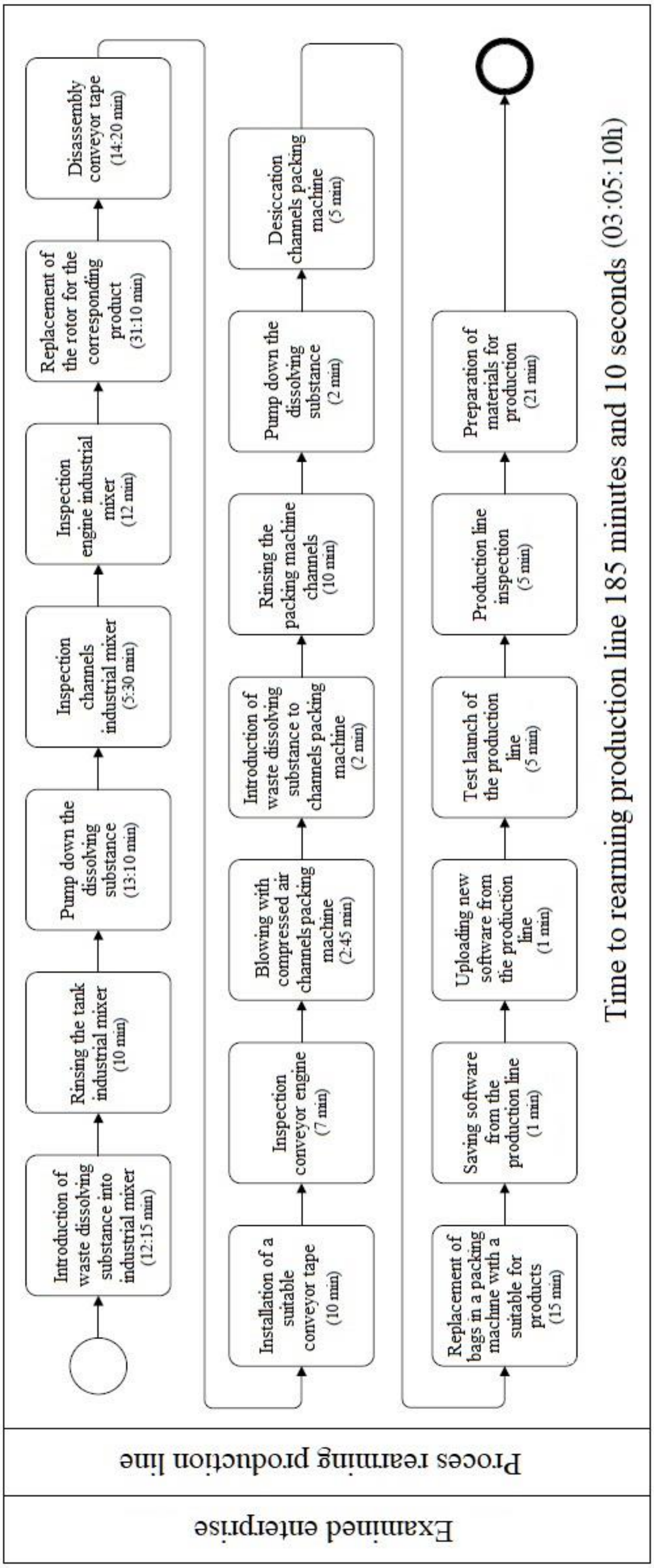


Figure 4. Production line retooling process map. Source: author's own research.

3.3. Results

Based on research, implementation of several process improvement tools was suggested for the examined company.

3.4. SMED – shortening the retooling duration

In the studied company, the retooling process is very common due to the large range of manufactured products. Currently, the retooling process is 3 hours, 5 minutes and 10 seconds. In order for the company to minimize the time needed to retool the production line, it must introduce several modern solutions to the entire process. The first proposed solution is to create an installation for the introduction and pumping of substances dissolving waste from the main mixer and packing machine channels.

The use of a modern system together with a single-stage centrifugal pump can shorten operation times and facilitate the entire process. Centrifugal pumps are used to introduce and pump hydrocarbons, acids, lyes and aggressive chemicals affecting the corrosion resistance of devices used in the enterprise. Centrifugal pumps are currently among the best and most often used in industrial plants. Due to the relatively simple construction and easy disassembly and operation, they allow access to all existing parts without the need to remove the entire pump from the system in the event of a breakdown or periodic inspections. Pumped-off dissolving liquids must be properly stored and prepared for transport to companies dealing with the recycling of chemical substances. The substances must be stored in IBC tanks adapted for the transport and storage of chemical, petrochemical and agrochemical liquids. The use of IBC tanks will save space in the storage area. The tanks can be stacked due to the internal polyethylene containers, plastic pallet and external grille made of stainless steel. The IBC tank when pumping a chemical in an enterprise must be placed on a capture pallet to ensure the safety of employees posted to the process of retooling the production line. The capture pallet is equipped with removable grilles, which allow keeping the container clean and make emptying the chemical from the pallet very easy. The pallet, as it has specially made bottom, is adapted for transport using forklifts used in the enterprise.

Another solution that can save a significant amount of time is the possibility of facilitating the replacement of the main mixer rotor. Currently, rotor replacement is performed using a forklift, which is inefficient and very dangerous for the life and health of the company's employees.

The company should invest in an electric crane that would be attached to the transverse reinforced concrete structure of the production zone. The crane is equipped with a 12-meter long rope, its lifting capacity is 800 kg, it has an IP54 safety certificate and an emergency system for emergency situations, i.e. an automatic brake. The device has a torsion-resistant steel rope, which reduces the rotation of the load being lifted. With such devices used to support the retooling process, the time needed for the activities can be significantly reduced. The total time needed to retool the production line can be reduced by 40 minutes and 55 seconds. Table 3 shows the times for shortened retooling steps before and after upgrading.

Table 3.
The times of the shortened steps of the retooling process

Sequence number during the retooling process	Action	Time before modernization	Time after modernization	Time saved
1.	Introduction of waste dissolving substance into industrial mixer.	12:15 min	2 min	10:15 min
3.	Pump down the dissolving substance.	13:10 min	2 min	11:10 min
6.	Replacement of the rotor for the corresponding product.	31:10 min	15 min	16:10 min
11.	Introduction of waste dissolving substance to channels packing machine.	2 min	0:20 min	1:40 min
13.	Pump down the dissolving substance.	2 min	0:20 min	1:40 min
Suma				**40:55 min**

Source: author's own research.

The introduction of the SMED improvement tool allowed to increase the production capacity of the company and to minimize the losses generated by the production line downtime. The production time for an 8-hour working day of the production line, in which the retooling process is planned, before the introduction of SMED in the company was 04:54:50 h. On that day, the production capacity of the company was approximately 15.58 tonnes of the manufactured product. After the introduction of the SMED tool, the production time of the line increased to 05:35:45 h, which resulted in an increase in the production capacity on a given day to about 17.75 tons.

Figure 5 shows a comparison of a production line's working day before and after the improvement.

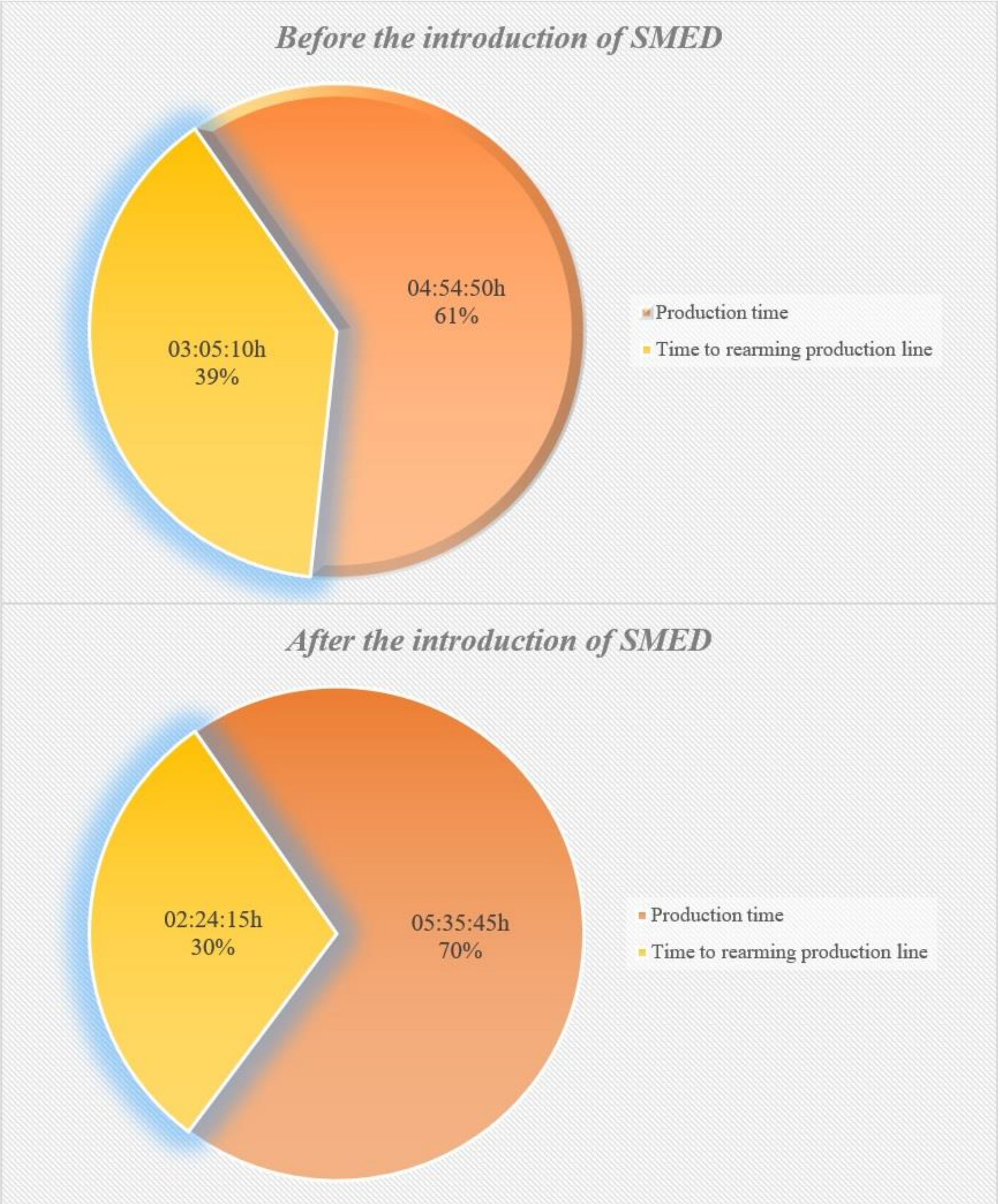


Figure 5. Comparison of the working day of the production line before and after the application of SMED. Source: author's own research.

3.5. TPM – equipment and machinery maintenance carried out by production staff and operators

By organizing appropriate cooperation between production and maintenance, the examined company found it possible to significantly improve the efficiency of a utilized machine park and reduce risks to production continuity, such as unplanned downtime or production line failures. The main purpose of introducing TPM in the examined company is to reduce the costs of maintaining equipment and machinery, extend the life and increase stability during the production process. The key objectives for the examined company under TPM are:

- Involvement of all company employees in the design, use, planning and maintenance of the equipment used in the company.
- The production line employees taking over simple activities, e.g. equipment adjustment or inspection.
- Extending the life of the company's equipment by developing a maintenance system.
- Involvement of operators of individual devices in independent reviews.
- Maximizing device performance by eliminating losses.
- Obtaining the support of all employees and the entire management of the company.

Figure 6 shows the proposed organization of working time changes.

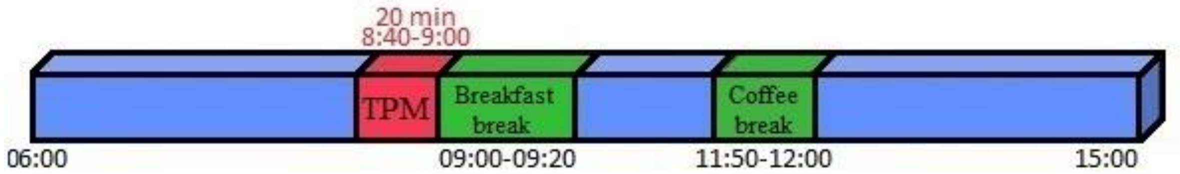


Figure 6. Organization of working time changes. Source: author's own research.

Elements of TPM implementation used in the company:

- Purchase of the necessary tools for employees - cutters, brushes, screwdrivers, etc.
- Creation of about 7 working instructions for the maintenance and operation of machinery and equipment.
- Allowing 20 minutes to change the production time to TPM.
- Placement of about 10 TPM boards, including a reporting system to notify of the smallest failures on TPM cards.
- Training employees in individual departments – 2 hrs on the basics of TPM operation and the operation and construction of production line equipment.

Table 4 shows an example of a mixer failure before and after application TPM.

Table 4.
Example of a mixer failure before and after application TPM

Before the introduction of TPM		After the introducing of TPM	
Time	Action	**Time**	Action
6:00 – 6:20	Introduction of the production program to the computer of the production line.	**6:00 – 6:20**	Introduction of the production program to the computer of the production line.
6:21	Production start.	**6:21**	Production start.
6:22 – 8:58	Production realization.	**6:22 – 8:38**	Production realization.
8:59	Stop production.	**8:39**	Stop production.
9:00 – 9:20	Breakfast break.	**8:40**	Beginning TPM.
9:21	Production start.	**8:50**	Detection of a faulty operation of the mixer rotor by a production worker. Blunt rotor blade.
9:22 – 10:45	Production realization.	**8:51 – 9:20**	Sharpening the mixer rotor by a production worker.

Cont. table 4.

10:46	Production line failure.	**9:21 – 9:29**	Mixer impeller operation test.
10:47 – 11:15	Detection of damage to the mixer rotor blades by a production worker.	**9:30 – 9:50**	Breakfast break.
11:16 – 11:25	Management approval to replace the mixer impeller.	**9:51**	Production start.
11:26 – 11:57	Mixer rotor replacement.	**9:52 – 11:48**	Production realization.
11:58 – 12:06	New mixer impeller operation test.	**11:49**	Stop production.
12:07 – 12:17	Coffee break.	**11:50 – 12:00**	Coffee break.
12:18	Production start.	**12:01**	Production start.
12:19 – 14:58	Production realization.	**12:02 – 14:58**	Production realization.
14:59	Stop production.	**14:59**	Stop production.
15:00	Employees going to the cloakroom.	**15:00**	Employees going to the cloakroom.
Total time of uninterrupted operation of the pro-duction line.	6:43h	**Total time of uninterrupted operation of the production line.**	7:14h

Source: author's own research.

By using TPM, it is possible to extend the working time of the production line by 31 minutes. Thanks to the applied tool, the company is not exposed to losses generated by downtime of production lines.

4. Conclusion

Logistics has a direct impact on shaping the economy of the company, i.e. its cost level, revenue dynamics or inventory optimization. Planning is an important element of production logistics, especially at the stage of designing the flow of raw materials, materials, as well as parts for production. In order to improve the efficiency of logistics and production processes in the company, it is necessary to understand them properly. Logistics and production processes have a direct relationship with the short- and long-term objectives as well as the overall activity of the company. Logistics process issues and selected Lean Production methods describes in the article allow to properly use them as a set of means and tools for the implementation of operational and strategic objectives, which, if properly managed, allow to maximize revenue from the company's activities and can also be a source of cost reduction.

Summing up the obtained literature and empirical research results carried out in a company from the construction industry, it can be concluded that the thesis of the article has been confirmed. Production line optimization has a significant impact on the functioning of the company. The proposed Lean Manufacturing tools improve production processes and all activities related to them. Implementation of all the proposed tools is a must in reducing losses by the manufacturing company under study. I t will also improve and increase the efficiency of production processes in the analyzed enterprise.

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