No. 133/25, 30–44
ISSN 2657-6988 (online)
ISSN 2657-5841 (printed)
DOI: 10.26408/133.03

Submitted: 08.11.2024
Accepted: 25.02.2025
Published: 28.03.2025

VALUE STREAM MAPPING AS A METHOD ENABLING THE OPTIMIZATION OF THE TECHNOLOGICAL PROCESS BASED ON THE EXAMPLE OF THE ZPS "LUBIANA" S.A. PORCELAIN TABLEWARE COMPANY

Małgorzata Blicharska[1], Iwona Szmaglik[2], Lech Murawski[3], Adam Szeleziński[4*], Krzysztof Jasiński[5], Tadeusz Januszewski[6]

[1, 2] WSB Merito University, Grunwaldzka Av. 238A, 80-266 Gdańsk, Poland, Faculty of Computer Science and New Technologies

[3,4] Gdynia Maritime University, Morska St., 81-87, 81-225 Gdynia, Poland, Faculty of Marine Engineering

[5,6] Gdynia Maritime University, Morska St., 81-87, 81-225 Gdynia, Poland, Faculty of Electrical Engineering

[3] ORCID 0000-0003-0089-5492, e-mail: l.murawski@wm.umg.edu.pl

[4] ORCID 0000-0003-2842-0683, e-mail: a.szelezinski@wm.umg.edu.pl

[5] ORCID 0000-0001-8355-6167, e-mail: k.jasinski@we.umg.edu.pl

[6] e-mail: 51567@student.umg.edu.pl

[*]Corresponding author

Abstract: Value Stream Mapping (VSM) is a technique aimed at optimizing the manufacturing process by minimizing waste and other losses that affect the amount of value added. It is a graphical method that uses a block diagram to illustrate the key stages of the production process, pinpoint areas and causes of delays in receiving the final product, and provide numerical process data as indicators of efficiency and profitability at each production stage. This article presents the method of building a value stream map using the example of ZPS "Lubiana" S.A. and attempts to assess the effectiveness of this method.

Keywords: Value Stream Mapping, Lead Time, added value, timeline, waste.

1. INTRODUCTION

Value Stream Mapping (VSM) is one of the tools used to improve the production process, aimed at producing and delivering a high-quality product to the customer [Kowalik and Klimecka-Tatar 2017; Roy and Dutta 2018]. This technique is part of a broader production management system known as Lean Management, which literally means "efficient management." VSM, like the entire Lean Management methodology, aims to streamline, reorganize, optimize, and manage individual stages of the production process to minimize waste, reduce inefficiencies, and simultaneously increase the amount of value added. These actions are implemented by manufacturers and service providers because, in the face of growing competition and changing customer demands, they are focused on increasing the sales of products and services. In this context, it is important to remember that value for today's customer is anything they are willing to pay for. Without a doubt, customers will pay for value that meets the required quality, is delivered in the desired quantity, on time, and at the lowest possible cost.

2. WHAT IS THE VSM METHOD?

The Value Stream Mapping method is a graphical approach that visualizes the production process. It involves tracking the product's path from the consumer to the supplier, and carefully depicting, through symbols, each process, material, and flow of information [Urban, Rogowska and Krawczyk-Dembicka 2023; San 2024].

The VSM method has also been standardized and published as an international ISO standard, which defines it as an effective tool for collecting, evaluating, and continuously improving the flow of products and information within an organization [ISO 22468:2020].

Creating a map for a given enterprise involves recreating a specific schematic consisting of several levels (sections). Each section of this schematic contains detailed information about the production facility, specifically about the production process itself.

The order and scope of information on each level of the schematic during the map-building process are presented below:

Level 1 – Located at the very top of the schematic, this level relates to the customer, the recipient of the value stream. This section includes information about customer needs, such as the average demand for a product or service and the specific product features they are interested in. In this context, it is also necessary to define the scope and mode of communication between the analyzed company and the recipient of its products/services [Czerska 2014; Operational Excellence Standards 2023].

Level 2 – This level divides the production process into several main stages or activities that lead to the creation of a product or delivery of a service. Under the symbols for each stage, information tables contain what are known as process data, which include:

a) Full-Time Employees (FTE) – the number of full-time employees involved in specific production stages;
b) Cycle Time (C/T) – the duration of a single cycle of the process, such as producing one unit of a product (from the completion of processing one unit to the completion of processing the next unit of the product) [Czerska 2014;

Réquillard 2020], completing an individual order, or processing a service or request;

c) Right First Time (RFT) – the number of correctly completed elements on the first attempt that are passed to the next stage in the production process;
d) Batch size (Batch) – the number of items in a production series, indicating how many items are passed to a specific stage at one time [Burbidge 1966];
e) Up Time – the percentage of time during which an employee or machine is effective, meaning they are operating in production mode.

At this level, during the creation of the map, it is crucial to detect minor errors and issues at various stages of the process. These observations are typically recorded next to the previously collected data in the form of "starbursts," which clearly highlight gaps in the process or areas requiring reorganization or optimization.

Another key element of this level is the "backlog," which refers to incomplete tasks. In practice, this involves specifying, in numerical terms, the total number of items on which work has begun but not been completed (within a given time period) and which are waiting further action. On the VSM map, backlogs are represented by a triangle symbol and indicate the magnitude of a major type of loss in the production process. This element is sometimes also referred to as waste, meaning any human activity that, while consuming material, financial, and human resources, does not contribute to the creation of value [Rother and Shook 2003; Contras 2022]. In a VSM map, backlogs (waste) are represented by a triangle symbol, which illustrates the magnitude of the main types of losses in the production process.

Level 3 – This level shows how long each of the stages identified in Level 2 takes and the duration of the delays between these stages. As a result, a timeline is created, alternating between the time spent on specific tasks at each stage (Value Added Time, Process Time) and the waiting time between them.

Level 4 – This is the lowest level on the VSM map and serves as a summary. Here, the durations of each stage are totaled, representing the time for which the customer is paying and which has value for them (Process Time), as well as the total time for the entire process (Lead Time). The total duration of the process, along with the sum of delays and waiting times (all values from the timeline), reflects the time the customer experiences.

By dividing the Process Time by the Lead Time, we obtain information about the proportion of the entire process that consists of activities truly important to the customer:

Value Added Time Ratio = (Process Time / Lead Time) x 100%,

where:

Value Added Time Ratio – the proportion of value-added time.

The resulting VSM map enables the analysis of the current state of the value stream, known as Value Stream Analysis (VSA), often referred to as the current state map. This map represents the production process in its actual form, including its flaws.

Step 1 is the most critical step in the mapping method, serving as a starting point for further actions.

Step 2 involves creating a future state map. By redesigning the map obtained in the previous step, specifically by identifying non-value-adding activities, highlighting waste, addressing issues with the flow of materials and information, pinpointing delays, and subsequently improving or eliminating these undesirable actions, a new model future state of the value stream is created, known as Value Stream Designing (VSD). In the proposed model, value-adding activities or necessary but non-value-adding activities from the perspective of the production process's success should dominate.

Step 3 involves developing an improvement plan and implementing solutions, known as the Value Stream Work Plan (VSP), to ensure a smooth transition from the current state to the target value stream state.

3. ZPS "LUBIANA" S.A.

3.1. History of ZPS "Lubiana" S.A.

ZPS "Lubiana" S.A. is a Polish company located in the Kashubian village of Lubiana near Koscierzyna, in the Pomorskie Voivodeship. The factory was built between 1966 and 1969, with production beginning on 1 September 1969. In 1973, the company became part of the "Cerpol" united tableware ceramics organization in Walbrzych [Blicharska and Szmaglik 2023; Blicharska et al. 2024].

In mid-1981, the company regained independence as a state enterprise, then in 1992 the company was transformed into a single-shareholder joint-stock company owned by the State Treasury, ZSP "Lubiana" S.A., which later resulted in its inclusion in the national investment funds.

In 2002, the Wistil S.A. silk company acquired a majority share of ZSP "Lubiana" SA. Between 2003 and 2012, ZSP "Lubiana" S.A. gradually acquired the share capital of Chodziez S.A. (99% of shares) and Cmielow sp. z o.o. (86% of shares), leading to the formation of Polska Grupa Porcelany in 2018.

3.2. Porcelain manufacturing technology at ZSP "Lubiana" S.A.

The technological process of porcelain production at the Lubiana factory consists of seven main stages, each associated with a specific department [Blicharska and Szmaglik 2023]:

1) PIN – associated with the New Products and Tools Development Department;

2) P1 – related to the Mass and Glaze Preparation Department;
3) P3 – connected to the Dish Molding and Casting Department;
4) P4 – associated with the Kiln and Glazing Department;
5) LP5 – related to the Decorating Department;
6) White Sorting – associated with the Finished Goods Warehouse (ŁMWG);
7) Packaging Section – also linked to the Finished Goods Warehouse (ŁMWG).

The primary raw materials used in the porcelain production process are kaolin, quartz, and feldspar. These materials are ground in proper proportions in specialized ball mills. The resulting mass is then transferred via technological systems to the next production departments.

During **P1**, the liquid mass is processed, which, after passing through filter and vacuum presses, is formed into rods of specific diameters. These rods are delivered to subsequent departments for further processing.

Also during **P1**, the casting mass is produced, which is used for granulate production. The casting mass is directed to a separate facility, where it is mixed with plasticizers and other ingredients before being pressed into a dryer. This process produces granules with a moisture content of 2.5% to 3%, which are then forwarded for further processing.

During **P2**, plastic molds are produced, which are then used to create gypsum molds for traditional casting. At this stage, used molds are also restored by washing and drying them, allowing them to be reused for new product production. Hence, stage P2 is closely connected with stage P3.

Stage **P3** involves material processing related to shaping and casting dishes of various forms and shapes. At this point, the technological flow splits into three production lines. Lubiana manufactures its products through pressure casting, gypsum mold casting, and isostatic forming.

Pressure casting is performed using specialized DORST machines, based on epoxy resin. During this process, the casting mass is injected at a pressure of 80 bars into specialized molds. The epoxy material used in this process absorbs water, leaving the casting mass in the desired shape. After the tools are cleaned with water, the process is repeated cyclically until the required number of ordered products is achieved.

During the **gypsum mold casting**, the plastic mass in rods is passed through a vacuum press to remove air from the material and obtain a smaller product diameter. The resulting mass plates are picked up by mechanical suction cups and placed into gypsum molds. These molds, along with the material, are placed under forming heads, which shape the product's outer form from the mold and its inner form from the forming head. Excess material is removed with a knife and, through centrifugal force, is directed to a waste mass pallet, where it is reprocessed during the P1 stage. The shaped mass body is dried in a dryer, and the edges are smoothed with sponges.

Isostatic forming is primarily carried out using production machines from the German companies Dorst and Sam, which utilize previously produced granulate (from stage P1) in the casting process. These machines use special forming tools equipped with membranes. Such membrane-based molds are automatically closed, and the granulate is injected into them. Then, under a pressure of approximately 250 bars, the granulate is pressed to form a semi-finished product. Once the forming process is complete, the tool opens, and the finished component falls from the membrane directly onto transport conveyors where it is positioned. Subsequently, a series of operations are performed, such as breaking off excess material using a deflashing tool, grinding with abrasive paper belts, dust removal with compressed air, and washing the edges of the semi-finished product.

The semi-finished products from the aforementioned operations are stored on racks (dried) for seasoning and then placed on biscuit trolleys in preparation for the next phase of production — the first firing in the P4 department.

During stage **P4**, all manufactured and dried semi-finished products undergo the first firing process, glazing, and a second firing ("hard firing") at 1360°C. After this phase, the products are manually unloaded from the kiln carts by workers and placed in pallet baskets for deepware items, while flatware products are sent to automatic grinders to smooth their bases. The products are then transported using battery-powered carts by the Transport Department for sorting, packing, or decorating. At this stage, the products are sorted and assigned to the appropriate orders. Once prepared, the products are sent either to the Packaging Department or to the Decorating Department (P5), according to the orders.

During stage **LP5**, the products are decorated according to their assigned orders, which may include adding a logo or other design. All decorated items are carefully placed on specially prepared trays and transported for the next firing, aimed at securing the decorations. After the firing process, the products are manually unloaded and placed in pallet baskets before being transported to the **White Sorting** stage. From the sorting department, the products move to the **Packaging Section**, where they are packed and labeled with the appropriate codes, ready for distribution to domestic or international markets.

4. RESULTS

4.1. Creating the current state map of the porcelain production process at ZSP "Lubiana" S.A.

ZSP "Lubiana" S.A. is a well-established company in the market. Over the past 55 years, the production process at the ceramic factory has undergone multiple modernizations and upgrades aimed at increasing production, improving employee working conditions, maximizing profits, and meeting customer expectations. Among these improvements, modern solutions such as cross-flow heat exchangers have been installed. This innovation has allowed the factory to achieve energy savings by providing heated water, central heating, and the supply of warm air for heating the production areas and the product drying chambers.

The most recent effort to find effective solutions to improve the porcelain manufacturing process was Value Stream Mapping (VSM). For this purpose, a support team was assembled, which focused primarily on the following aspects during the mapping process:

- visualizing the individual stages of production;
- meticulously filling in process data;
- representing the flow of materials and information;
- identifying bottlenecks;
- calculating value-added and non-value-added activities.

When building the map of the current and future state, the icons shown in Figure 1 were used.

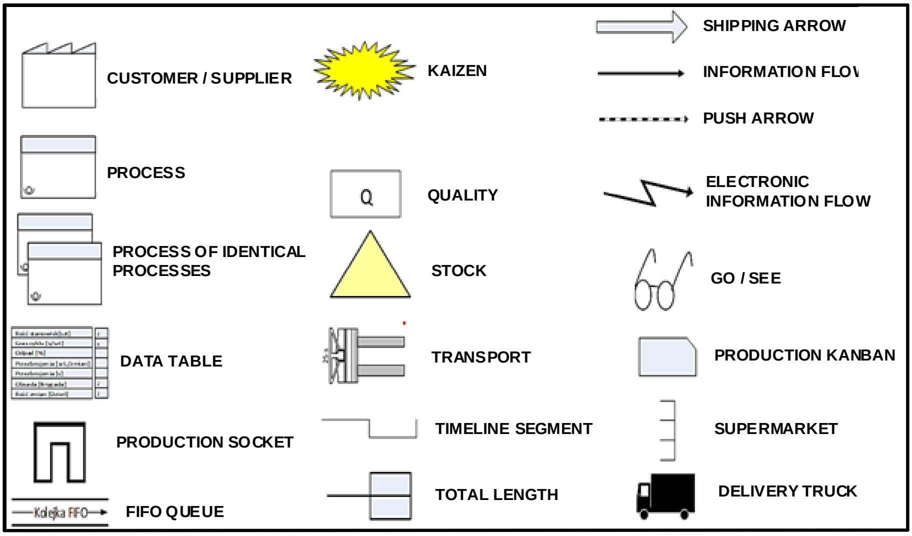

Fig. 1. Icons used at ZPS "Lubiana" S.A. when creating value stream maps

Source: https://leanactionplan.pl/mapowanie/ (13/11/2023).

4.1.1. Listing of the most important stages of production – step 1

The first stage in creating a map of the current state was to select a suitable target area, i.e. to isolate the most important stages of production in the flow of porcelain from the supplier of raw materials to the shipment to the customer.

A block diagram illustrating the production of 1 ton of porcelain divided into 7 basic stages is shown in Figure 2.

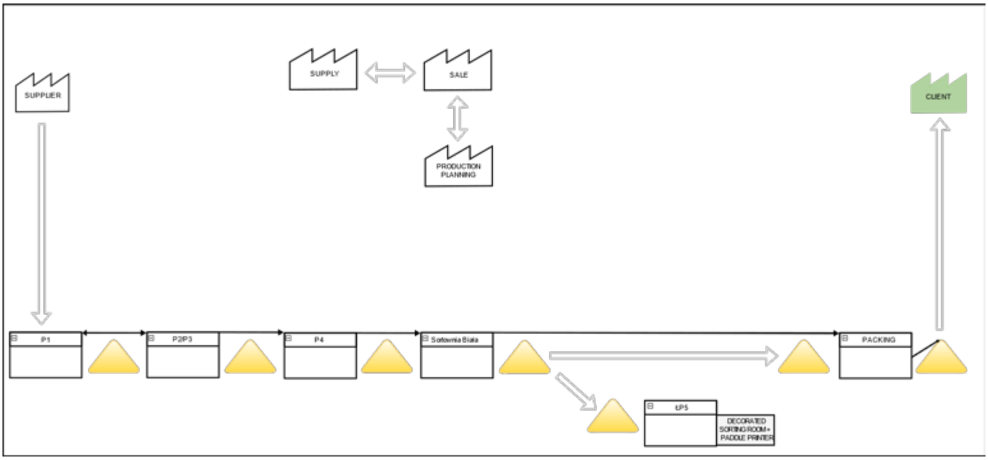

Fig. 2. Map of the current state detailing the 7 basic stages of production of 1 ton of porcelain – step 1

Source: own study based on data obtained from ZPS "Lubiana" S.A.

4.1.2. Defining the mapping objective and collecting process data – steps 2, 3 and 4

The second stage in developing the current state Value Stream Map (VSM) for the porcelain production process involved defining the objective of the mapping exercise. It was determined that the main goal was to assess the **lead time** for the process, i.e., the total time required to produce 1 ton of porcelain, including the cumulative downtime, delays, and other factors contributing to process extensions.

Step 3 focused on collecting process data, such as:

- production volume during individual shifts during various stages of production (depicted on the maps as numerical values within symbols representing each production stage);
- processing time for producing 1 ton of semi-finished or finished products at each stage (shown on the maps as numbers under the symbols representing each production stage);
- quantities of raw materials, semi-finished products, or finished products generated at each stage (represented on the maps by symbols with corresponding numerical values, e.g., granulate, forming mass, casting mass, noted under the symbols representing each production stage);
- cycle time: the frequency with which products exit a specific production stage, considering such activities as packaging, loading, etc. (marked on the maps by the symbol "C/C" with corresponding numerical values placed under the symbols for each production stage);

- number of shifts (shown on the maps as numbers inside rectangles);
- workforce – the number of employees working at each stage or shift (represented as numbers inside rectangles on the maps);
- inventory levels (depicted as numbers within triangles on the maps);
- labor costs associated with producing 1 ton of porcelain (represented as numbers beneath the symbols for each production stage).

All values on the maps are expressed in tons.

In addition to these, other metrics such as takt time, changeover time, quality levels, and equipment availability were collected from the MRP MOVEX system and directly from various production departments.

Step 4 involved creating the actual map.

The process data collected above are shown in Figure 3.

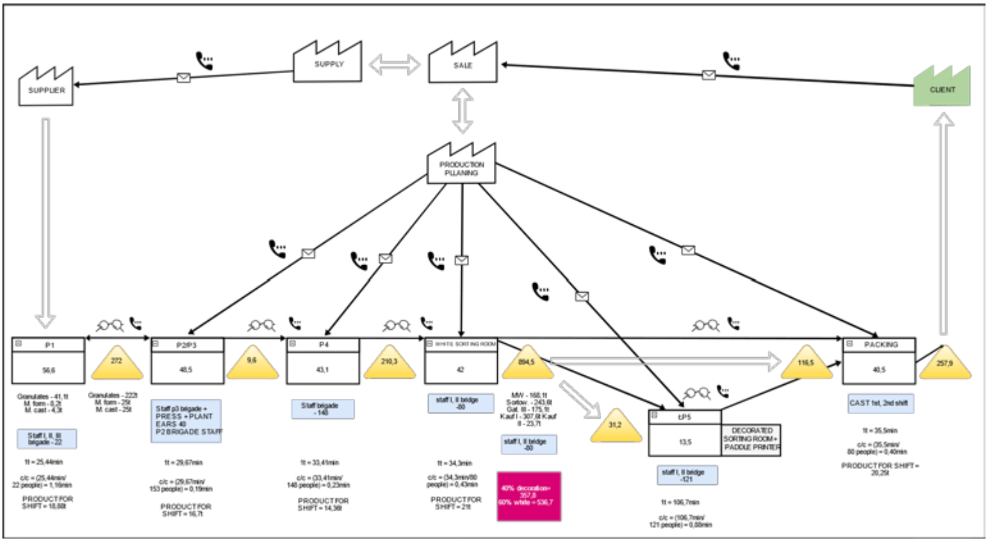

Fig. 3. Map of the current state, including process data at individual stages of production of 1 ton of porcelain – step 2

Source: own study based on data obtained from ZPS "Lubiana" S.A.

4.1.3. Identification of sources and locations of waste in the process and determination of their magnitude – step 5

Step 5 in creating a map of the current state of tableware production is a graphical illustration of the size of the main types of losses resulting from, for example, overproduction, delays and waste.

Figure 4 shows the places in the process sequence (in the form of clouds) where these problems occur.

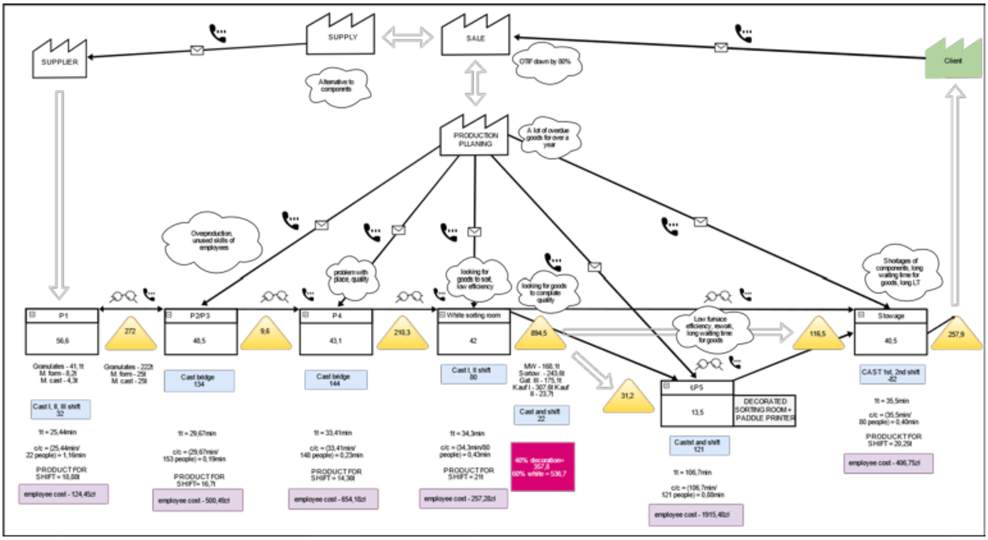

Fig. 4. Map of the current state, including areas where waste occurs and other types of losses in the production process of 1 ton of porcelain – step 5

Source: own study based on data obtained from ZPS "Lubiana" S.A.

4.1.4. Constructing the process timeline – step 6

During step 6 of completing the current state map, a timeline of the production process was developed. This timeline includes both **value-adding times (VA)**, which represent the duration of individual production stages, and **non-value-adding times (NVA)**, representing downtime and delays that occur between production stages.

By summing the VA and NVA times, the total **Lead Time (LT)** for producing 1 ton of porcelain was calculated:

Value-Adding Times + Non-Value-Adding Times = **Lead Time**

Before modernization, the Lead Time was calculated as 61.58 days.

Figure 5 illustrates the VA (Value-Adding) and NVA (Non-Value-Adding) times, as well as the calculated total process duration (Lead Time, LT).

The timeline is the level on the map that most vividly shows what losses the company incurs as a result of wasting time. It describes the time involved in freezing cash in the stream (L/T) and its effective use (P/T and V/A) [Czerska 2014].

The total value-adding time across the entire process is shockingly lower than the total non-value-adding time:

$$\Sigma \mathbf{VA}_{\mathrm{PROCESS}} = \mathbf{4.3} \text{ hours} < \Sigma \mathbf{NVA}_{\mathrm{PROCESS}} = \mathbf{1473.6} \text{ hours.}$$

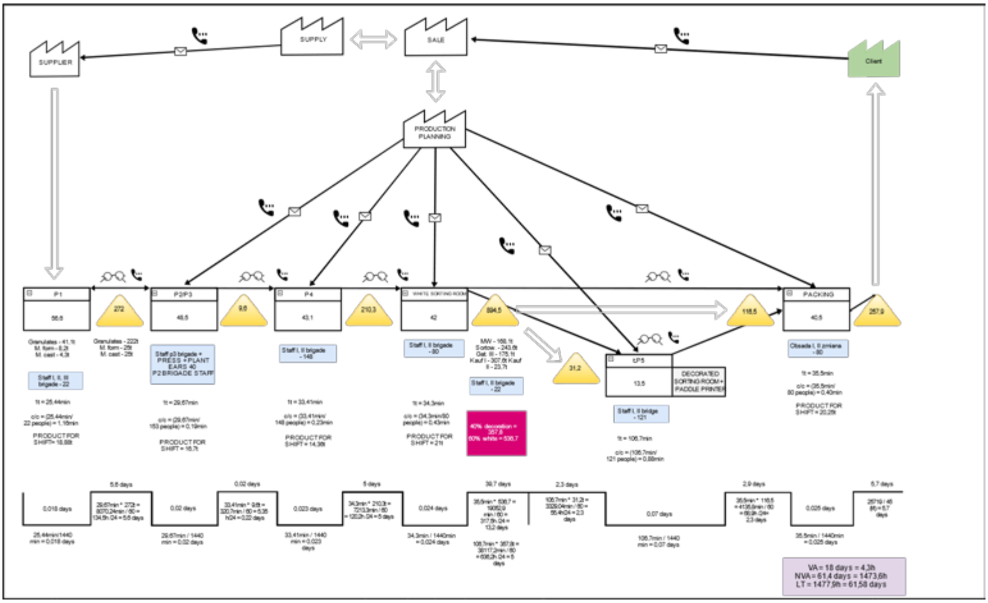

Fig. 5. Current state map including Value-Adding and Non-Value-Adding Times in the production of 1 ton of porcelain – step 6

Source: own study based on data obtained from ZPS "Lubiana" S.A.

4.2. Creation of the future state map of the porcelain production process at ZPS "Lubiana" S.A.

4.2.1. Identification of areas requiring modernization in the process – step 7

The result of visualizing the existing production process, along with identifying the degree and locations of waste, is the construction of a future, ideal state map from which all sources of waste are eliminated (Step 7). After gathering all the improvement ideas, four areas were identified where changes are necessary:

- sorting stage – searching for items to sort reduces the efficiency of the entire process;
- assembling stage – searching for items to assemble reduces the efficiency of the entire process;
- decorating stage – low efficiency of the "Adam" kiln, used for fixing decorations on the tableware, reduces the efficiency of the entire process;
- packing stage – long waiting times for products and shortages in components reduce the efficiency of the entire process.

Implementing improvements in the aforementioned process areas, according to the outlined assumptions, is the key to minimizing waste and losses. This supports the main goal of mapping at ZSP "Lubiana" S.A. – reducing Lead Time.

4.2.2. Implementation of the process improvement plan – step 8

The implementation of changes in the identified areas, in line with the established assumptions, were aimed at optimizing the process and shortening its total duration (LT).

Figure 6 (page 13) presents a model of the porcelain production process at ZSP "Lubiana" S.A., which includes theoretical and calculated process data after reorganizing selected activities and operations (Step 8). The calculated total value-adding time (for the entire process) remains significantly lower than the total non-value-adding time:

$$\Sigma \mathbf{VA}_{\text{PROCESS}} = 3.6 \text{ hours} < \Sigma \mathbf{NVA}_{\text{PROCESS}} = 1096.8 \text{ hours}.$$

The total value-adding time after modernization is 42 minutes less than before the technological sequence was updated:

$$\Sigma \mathbf{VA}_{\text{BEFORE MODERNIZATION}} = 4.3 \text{ hours},$$
$$\Sigma \mathbf{VA}_{\text{AFTER MODERNIZATION}} = 3.6 \text{ hours}.$$

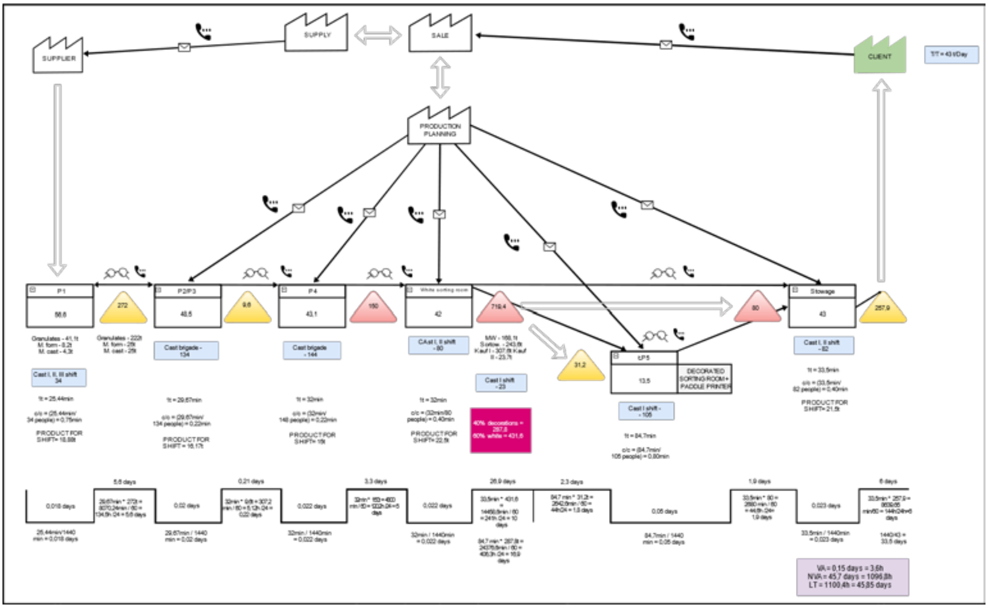

Fig. 6. The future state map presents the forecasted values of process data achievable after the modernization of selected stages in the production process of 1 ton of porcelain – step 8

Source: own study based on data obtained from ZPS "Lubiana" S.A.

5. CONCLUSIONS

The creation of the VSM current state map at ZSP "Lubiana" S.A. allowed for a broader view of the porcelain manufacturing process and led to the following conclusions:

1) Dividing the production process into 7 main stages enabled the collection of specific data on efficiency, profitability, and workforce allocation.
2) The current state map of the plant identified the flow of information, but most importantly the flow of materials: raw materials, semi-finished products, and finished products.
3) The process data collected on the current state map highlighted areas that reduced the efficiency of individual stages.
4) These areas included the sorting, assembling, decorating, and packaging stages.
5) This information enabled the introduction of a process improvement plan in the form of a future state map.
6) The future state map of ZSP "Lubiana" S.A. eliminates the issues that hindered the value stream flow, resulting in the reduction of certain process parameters, such as the duration of production stages (VA) and the duration of stoppages and delays (NVA)
7) Based on the VA and NVA times, the calculated theoretical total time to produce a product, known as Lead Time (LT), was significantly reduced to 45.85 days (compared to 61.58 days before modernization).

   $\mathbf{LT}_{\text{BEFORE MODERNIZATION}} = \mathbf{61.85}$ days $> \mathbf{LT}_{\text{AFTER MODERNIZATION}} = \mathbf{45.85}$ days

8) The creation of the future state map demonstrated that Value Stream Mapping is an effective method for estimating the economic viability of technological sequence modernization.

6. SUMMARY

The Value Stream Mapping (VSM) method enables the analysis and optimization of the processes within an organization. The application of this tool should lead to the elimination of waste in the company, the identification of bottlenecks, inappropriate inventory levels, and inefficient information flows [Hamrol 2018; 2022]. Implementing VSM should result in shorter order fulfillment times, cost reductions, and improved customer service quality [Werpachowski 2012; 2018]. The results obtained by the authors during the implementation of the Value Stream Mapping method in ZPS "Lubiana" S.A. indicate the effectiveness of this tool, provided that the mapping process is correctly planned and executed step by step.

However, it is important to note that the effectiveness of VSM implementation depends on the proper identification of the process constraints and the resources of a given organization, which requires accurate data collection. The mapping process must be carefully planned: mapping everything that happens in a company does not always lead to the right solutions. The resulting maps may become unclear and difficult to interpret [Werpachowski 2018; Hamrol 2022].

The VSM tool may not deliver the expected results in companies that produce a wide variety of products without identical material flow maps. Additionally, the VSM method does not provide economic value measures, such as throughput, operating costs, inventory expenses, and profit [Werpachowski 2018; Hamrol 2022]. Process maps are created on a two-dimensional plane and do not represent the full spatial structure of the analyzed object. To obtain a comprehensive view of a process, a digital twin can be created using process maps and specialized software.

During the implementation process at ZPS "Lubiana" S.A., to gain a complete picture of the processes, the authors of the article supplemented the VSM method with additional tools, such as Kaizen, 5S, root cause analysis, standardization, and the determination of the OEE index based on an analysis of manual labor [Blicharska and Szmaglik 2023; Blicharska et al. 2024].

REFERENCES

Blicharska, M., Szmaglik, I., 2023, *Projekt wstępny wdrażania narzędzi Lean Management w przedsiębiorstwie na przykładzie ZPS „Lubiana" S.A.*, praca inżynierska, Uniwersytet Merito w Gdańsku, Wydział Informatyki i Nowych Technologii, Gdańsk.

Blicharska, M., Szmaglik, I., Murawski, L., Szeleziński, A., Jasiński, K., 2024, *Analyzing the Implementation Process for the Kaizen Method Based on the Example of ZSP „Lubiana" S.A.*, Scientific Journal of Gdynia Maritime University, no. 132, pp. 70–84.

Burbidge, J.L., 1966, *Zasady organizacji produkcji*, WNT, Warszawa.

Contras, O., 2022, *Untangling with Value Stream Mapping, Productivity Press*, Sebastopol.

Czerska, J., 2014, *Doskonalenie strumienia wartości, LeanQ Team*, Gdańsk.

Hamrol, A., 2018, *Zarządzanie i inżynieria jakości,* Wydawnictwa Naukowe PWN, Warszawa.

Hamrol, A., 2022, *Zarządzanie i inżynieria jakości. Ze spojrzeniem w rzeczywistość 4.0*, Wydawnictwa Naukowe PWN, Warszawa.

http://lubiana.com.pl/.

ISO 22468:2020, *Value Stream Management* (VSM).

Jóźwiak, Z., Golec, P., 2015, *Optymalizacja procesu produkcyjnego metodą mapowania strumienia wartości*, Systemy Wspomagania w Inżynierii Produkcji: Inżynieria Systemów Technicznych, z. 2(11), pp. 98–109.

Kędzior, W. (ed.), 2012, *Badanie i ocena jakości produktów spożywczych*, pp. 195–210

Kowalik, K., Klimecka-Tatar, D., 2017, *Mapowanie strumienia wartości w procesie obsługi klienta w przedsiębiorstwie usługowym*, Archiwum Wiedzy Inżynierskiej, t. 2, pp. 9–11.

Mapowanie strumienia wartości, https://leanactionplan.pl/mapowanie (15.10.2024).

Operational Excellence Standards, 2023, *Value Stream Mapping Workbook*: *Designing Lean Processes*, Independently published.

Rother, M., Shook, J., 2003, *Naucz się widzieć,* Centrum Transferu Technologii, Wrocław,

Roy, M., Dutta, A., 2018, *Value Stream Mapping: Streamlining Processes for Optimal Performance*, Independently published.

San, J., 2024, *Value Stream Mapping in Supply Chain Management*, Independently published.

Urban, W., Rogowska, P., Krawczyk-Dembicka, E., 2023, *Zarządzanie strumieniem wartości. Źródło trwałych korzyści*, Oficyna Wydawnicza Politechniki Białostockiej, Białystok.

Werpachowski, W., 2012, *Podstawy zarządzania w przedsiębiorstwie,* Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa.

Werpachowski, W., 2018, *Doskonalenie metod zarządzania produkcją w wybranych przedsiębiorstwach sektora MŚP*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa.