POLISH JOURNAL OF MANAGEMENT STUDIES
Klimecka-Tatar D.

2021
Vol.23 No.2

ANALYSIS AND IMPROVEMENT OF BUSINESS PROCESSES MANAGEMENT – BASED ON VALUE STREAM MAPPING (VSM) IN MANUFACTURING COMPANIES

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Abstract. Business process management is a very important factor in assessing the effectiveness of production systems (entire enterprises or departments). And while the planning and management of business processes is mastered, it is difficult to create relationships between coexisting processes within one production system. Usually, business process management refers to extracted (isolated) processes, in this case relationships between different processes were looked for. This paper is devoted to the assessment and analysis of the interaction of business processes related to the implementation of one engineering project. The paper presents the results of research carried out in relation to four coexisting business processes in a manufacturing company – with assumption that the four analyzed business processes are located within one project. Business processes were defined on the basis of areas determined in the Big Picture analysis (in Value Stream Mapping analysis). As indicators of the impact of business process elements, the correlation coefficient was taken into account, the value of which determined the impact (or lack of impact) between the components of the various business processes. It has been noticed that the attributes from process 1 (Launching the project implementation) and process 2 (Scheduling and project management) show a very strong and strong correlation with the attributes in other processes 3 (Management and supply of materials) and 4 (Production and distribution). On the basis of the presented results, the critical points of the information / decision flow between the coexisting business processes have been indicated.

Key words: value stream mapping, business processes management, VSM, process improvement

DOI: 10.17512/pjms.2021.23.2.13

Article history:
Received April 28, 2021; *Revised* May 20, 2021*; Accepted* May 26, 2021

Introduction

Business process management (BPM) is a management field responsible for the design, administration, configuration, implementation and analysis of business processes (Ahmad and van Looy, 2020). At the same time, business processes are a set of combined activities, actions or tasks that are fully correlated with the pursuit of the company's business goals and mission (Hernaus, et al., 2012). Business processes in the area of one enterprise (or a network of cooperators) are constantly changing. The determinants of these changes are not only economic conditions, but also the development of technology. Assessment of the impact

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of business process elements is also very important, especially taking into account the principles of sustainable development, technological revolution - Industry 4.0 or 5.0. Increasing the efficiency of business processes also increases the activity in the area of creating new technological processes (Erasmus, et al., 2020; Guizani andGhannouchi, 2021; Ingaldi and Ulewicz, 2020; Krynke and Mielczarek, 2018). In the world literature there is no detailed information about the strength of the interconnection between concurrent processes in entire project. And it should be assumed that these connections may be decisive for the success of the entire project. From the point of view of project management, it seems important to try to manage individual processes based on the strength of connection with the attributes of concurrent processes. The purpose of this paper is to presents a new way of identifying business processes (in entire engineering project) based on the typical Value Stream Mapping (VSM) analysis. Based on VSM, four business processes were selected for which the most important attributes were defined. It was assumed that business process management decisions should be based on the analysis of these correlations.

Development and business processes management maturity

The correlation of the content in business processes depends to a large extent on the organizational structure of the enterprise (Schmiedel, Recker and Vom Brocke, 2020; Vom Brocke et al., 2021). Business Process Management focuses on improving the organization's performance through implementing modern management techniques and tools. BPM is a dedicated strategy for improving, unifying the work organization and managing the processes of the entire organization (Kahrovic and Krstic, 2015; Závadský, et al., 2016; Kononov, 2017; Raczyńska and Krukowski, 2019). Business process management is developed by business functions and processes improvement - business process improvement efforts emphasize better integration (Berente et al., 2009). The following are very important from the point of view of the functioning of the organization of business processes:

-the management process - guides the operation of the entire system, includes business management and strategic management,

-the operational process - the core of the added value, e.g. material economy (procurement), a system of operations aimed at creating value (production), marketing and distribution processes,

-auxiliary processes - supports main processes, e.g. accounting, human resource management, technical maintenance, security maintenance, etc.

A fundamental approach in business process management (BPM) is that design / redesign is a form of business process improvement. In BPM, it is very helpful to create a workflow, from the point of view of operational goals (what and who is to do at a given moment) in relation to one indicated process attribute (Cselényi et al., 2002; Leymann et al., 2010; van der Aalst, 2003). When building a workflow process in accordance with the BPM concept, the following steps should be performed:

-define the process for analysis,
-define process participants,
-define and bind documents / information / data to appropriate process states;
-define events and process steps - define the initiating event, logical process flow diagram, process ending event.

Due to the high dynamics of the market, the increasing demand for products, as well as the constant striving for the intensification and development of production companies, there is an increased activity related to the adaptation of management methods to the high demands of the competitive economy, more and more companies use new forms of organization and process management. As indicated in the literature (Dharmawan et al., 2019; Koehler, Hofstetter, and Woodtly, 2010; Pinto and dos Santos, 2020; Willaert et al., 2007), it is possible to select 5 levels of companies' maturity in terms of the effective functioning of the BPM strategy- general characteristics of the maturity levels are presented in Fig. 1:

-Level 1: The processes carried out in the company are not defined, but the organization still functions.
-Level 2: Main (leading) processes are defined and people responsible for various areas of the process undertake joint actions to coordinate them - regular meetings are held to solve current BPM problems
-Level 3: All processes are defined; the entire organization is conducted in a systemic manner (with division of responsibilities, process monitoring and their optimization)
-Level 4: Both internal cooperation and cooperation with contractors and suppliers are process-oriented. The functional organizational structure is fully subordinated to the process structure.
-Level 5: The processes are managed and run properly. They are still being improved in the pursuit of perfection.

BPM maturity →				
Level 1 ↓ *Initial*	**Level 2** ↓ *Opportunistic*	**Level 3** ↓ *Repeatable*	**Level 4** ↓ *Managed*	**Level 5** ↓ *Optimizing*
Culture of heroes	Processes improved at department level	Processes organized at entrprise level	Processes managed and monitored at enterprise level	Coninous improvement of processes

Figure 1: General classification for BPM maturity (based on Snabe et al., 2008).

Business process management (BPM) is a very effective tool in the development and of processes. Unfortunately, its weakness is the fact that BPM's knowledge

does not take into account the wider variety of business contexts. Moreover, most models in BPM suggest one universal path, making this approach prone to failure because it does not sufficiently address situational requirements (Vom Brocke et al., 2016).

Improvement and business processes management

Nowadays, in the global economy, it is observed that more and more companies are characterized by a dispersed corporate structure (departments located throughout the country, continent and even the world), which results in increasing interest and intensification of activities in the field of improving the efficiency of business processes. The dispersed corporate structure creates more complexity and an urgent need for standardization. Thus, it is essential to continuously model, analyze, simulate and evaluate corporate activities and processes (Dumitriu, 2018; Gomes
et al., 2020; Hussain et al., 2020).

As evidenced by the division into BPM maturity levels, improvement is the highest form of maturity. However, it should be noted that reaching this level requires cyclical changes towards perfection. Such small steps towards the development of BPM are also called improvement, and their best technique may be to lean over the Kaizen philosophy - step by step / small steps improvement (Kiran, 2017; Kovács, 2020; Umeda et al., 2020).

Over the past decades, BPM has become a generic description of all the continual improvements in the approach to process management. Total Quality Management, Workflow Management, Lean and Six Sigma - all these concepts are part of the BPM discipline. While these approaches (TQM, Lean, Six Sigma, etc.) focus on solving specific process-oriented problems, BPM has been recognized as a common determinant of these concepts complemented by the use of complex automation techniques and procedures (Dumitriu, 2018; Jacka and Keller, 2009).

Value stream mapping as a BPM supporting tool

The life cycle of BPM is nothing more than the systematized successive phases of the business process (iterations), which start with the identification of the process and its development, through the analysis and redesign of the process, leading to implementation, and finally maintenance with constant monitoring and control (Dumas et al., 2013; Tkachenko et al., 2021).

In order to be able to manage any business process, it is necessary to define and characterize it. A clear diagram of the business process can later be used as a starting point for the design of support information systems for performance measurement and simulation studies (Reijers, 2021). The scope of the BPM initiative may refer to intra-organizational processes or processes that cross organizational boundaries - processes flowing between contractors (Kir and Erdogan, 2021).

The literature proposes a number of methods that deal with the complexity of inter-organizational and intra-organizational processes - managing strategy, culture, quality and other aspects that are part of the general outline of organization

management (Karrach and Pivarčiová, 2020; Krynke and Mielczarek, 2018; Matuszny, 2020; Pietraszek et al., 2020; Saab et al.,2018; Siwiec and Pacana, 2020; Ślusarczyk et al., 2020; Tran et al., 2020). These methods focus on the flow and exchange of information, coordination of physical (material) flows and the integration of business processes (Grabara et al.,2019; Straka et al., 2019; Ulewicz et al., 2020). Among the numerous tools, visual management tools deserve special attention. One of such tools mapping and visualizing information flows in enterprises are process mapping methods - value stream mapping (VSM), Big Picture analysis, logical maps, etc. Usually, internal and external (small range) processes are identified with the use of big picture analysis. Value stream mapping and, consequently, big picture analysis is one of the most important lean tools. A properly constructed map consists of 5 areas: (1) The specification of customer requirements; (2) Identification of information flows; (3) Identification of material flows; (4) Relation between material and information flows; (5) Analysis and estimation of added value (Klimecka-Tatar, 2018; Klimecka-Tatar and Ingaldi, 2020). Graphical representation of the entire information and material flow system is the basis for the design and improvement of processes - mainly based on Kaizen ideas. There is a lack of research in the literature on how to identify and characterize the interrelationships between coexisting processes.

Methodology

The basis for identifying business processes in large engineering projects is the analysis of Value Stream Mapping (VSM). Value stream mapping is a well-known tool supporting process improvement, and its source and basis are the principles of Lean (Lean Management, Lean Production). Usually VSM is used to visualize the materials and information flows, to define the adding (VA) and non-adding (NVA) operations (Klimecka-Tatar, 2018). However, VSM does not analyze the interrelationships (strength of correlation) between the key areas of the project. Thus, VSM enables the visualization of flows, but unfortunately it does not make it possible to indicate the interactions between project areas. Therefore, in this paper two research tools have been used: VSM (as a basis for identifying business processes) and questionnaire for assessing the implementation of business process elements. Figure 2 shows the current state map (CST) for an exemplary VSM - material and information flow in the project. Based on the VSM analysis and observation of the functioning of business processes in the entire production process, it was estimated that the maturity of the organization in terms of BPM can be classified as level 2 - which means, main (leading) processes are defined and people responsible for various areas of the process undertake joint actions to coordinate them.

The interaction between business processes was assessed on the basis of the correlation matrix.

The results of the analysis are also intended to present the matrix of correlation of individual states of business processes based on the material stream (flow) and

information stream (flow) in a serial production companies (with Flexible Manufacturing System - FMS). This paper argues that BPM needs to be contextual in order for projects to be the most efficient and effective.

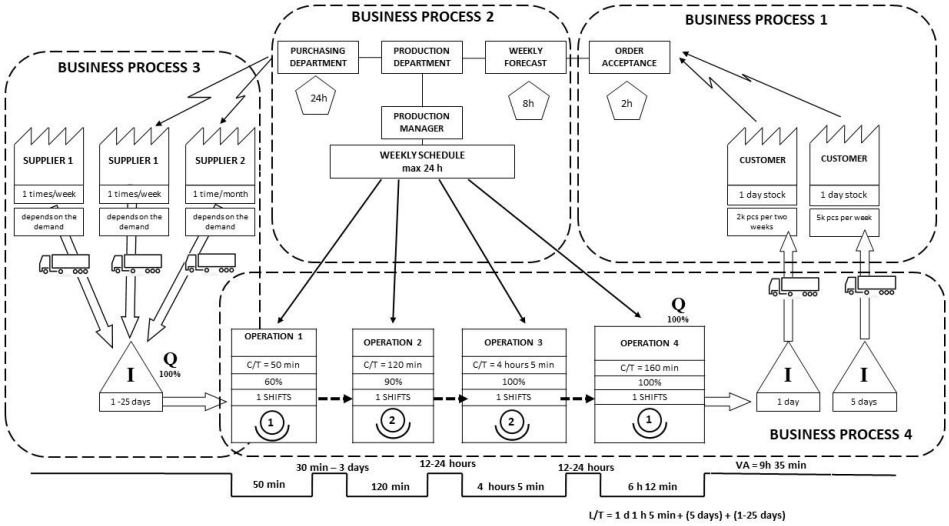


Figure 1: Process Big Picture - an overview map of the process flow within one of the discussed projects. Mapping created with the use of the Value Stream Mapping tool.

The research was carried out on the basis of the form / questionnaire assigned to individual projects implemented by the enterprises. In the period in which the analysis was conducted, 31 engineering projects were started and partially implemented. In this case, a project is understood as one series of production carried out for one customer in a specific period of time. Due to the fact that the companies in which the analysis were carried out, characterized by flexible production systems, it was assumed that one series is the production volume between changeovers (calibration of machines in main operations).

Each item in the form / questionnaire was completed by a process participant responsible for its individual elements (in terms of business process management). The form referred to 4 main business processes (fig. 2), the importance of which for the success of the projects is the same. The four main business processes were deffinied as: (1) Launching the project implementation; (2) Scheduling and project management; (3) Management and supply of materials; (4) Production and distribution (processes represented in Fig. 2). Below, there are four selected business processes with a set of key attributes for each process that were taken into account during the research and analysis.

Business process 1 – Launching the project implementation

- Determining the terms of the project implementation

- Determining the requirements and technical parameters
- Valuation - project quotation
- Risk assessment of success

Business process 2 – Scheduling and project management

- Organization of flows and distribution of responsibilities
- Production scheduling
- Defining material, technical and human needs
- Planning control activities - implementation of a quality control plan

Business process 3 - Management and supply of materials

- Identify inventory levels in relation to demand
- Offering and purchasing the necessary basic and auxiliary materials
- Collecting the required material stocks (or scheduling delivery)
- Effectiveness of delivering materials to the production hall

Business process 4 – Production and distribution

- Course of production operations
- Assessment of the quality level of products
- Timeliness of completing the order
- Distribution

All processes element were assesed based on detailed guidelines attached to the form. 5-point Likert scale was used for the assessment, where 1 - no problems in the area, 5 - significant problems making the project difficult to realize. After the end of the research period, all assessments were collected along with project references. To summarize a large amount of data, where the goal is to see the patterns and the system of dependencies. The analysis included the Pearson's linear correlation coefficient (r) – as a perhaps the strongest, most reliable factor. A correlation coefficient determining the level of linear dependence between random variables. Assuming the value of Pearson's correlation coefficient r in the interval:

-0-0.3 weak correlation;
-0.3-0.5 moderate correlation;
-0.5-0.7 strong correlation;
-0.7-1 very strong correlation.

Results and discussion

The research took into account the assessment of attributes in 31 engineering projects. Each of the project was divided into 4 business processes. The assessments were made by the persons responsible for the given business process. The general characteristics of the research group are presented in Table 1. Characteristics of the respondents divided into the discussed business processes.

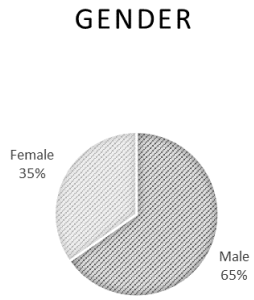
Table 1. General characteristics of the research group divided into the discussed business processes

	Business process 1 Launching the project implementation		**Business process 2** Scheduling and project management		**Business process 3** Management and supply of materials		**Business process 4** Production and distribution	
Feature	Answer	percentage	Answer	percentage	Answer	percentage	Answer	percentage
Gender	Male	54.8	Male	90.32	Male	77.4	Male	38.7
	Female	45.2	Female	9.68	Female	22.6	Female	61.3
Age, years	up to 30	6.5	up to 30	9.68	up to 30	32.3	up to 30	48.4
	31–40	29.0	31–40	41.94	31–40	35.5	31–40	29.0
	41–50	48.4	41–50	38.71	41–50	19.4	41–50	16.1
	over 50	16.1	over 50	9.68	over 50	12.9	over 50	6.5
Education	primary	0.0	primary	0.00	primary	0.0	primary	6.5
	lower secondary	0.0	lower secondary	3.23	lower secondary	12.9	lower secondary	32.3
	vocational	0.0	vocational	9.68	vocational	35.5	vocational	41.9
	secondary	22.6	secondary	51.61	secondary	41.9	secondary	16.1
	higher	77.4	higher	35.48	higher	9.7	higher	3.2
Work seniority, years	up to 5	3.2	up to 5	9.68	up to 5	22.6	up to 5	35.5
	6–15	32.3	6–15	35.48	6–15	51.6	6–15	48.4
	16–25	51.6	16–25	45.16	16–25	19.4	16–25	12.9
	over 25	12.9	over 25	9.68	over 25	6.5	over 25	3.2

It should be noted that the structure of the research group characteristics differs significantly in the discussed business processes. Only in the business process 4 (Production and distribution) women have a significant share. Also in this process, the largest number of employee were young workers (up to 30 years old), with the least work seniority and the lowest education. On the other hand, business process 1 (Launching the project implementation) was assessed mainly by the oldest employees, with the highest education, and with the highest work seniority.

General characteristics for all respondents participating in the research are presented in Figure 3 - percentage share in relation to features: gender, age, education and work seniority. As it is easy to see, the majority of respondents were men, as much as 65%. The largest group, as much as 33%, were employees of the age group 41- 50 years old. The group of employees in the 31-40 years old counted slightly less (31%). The significant majority were employees with secondary and higher education (33 and 31% - respectively). Whereas, 42% of the respondents are a group of employees with work seniority from 6 to 15 years.

a)



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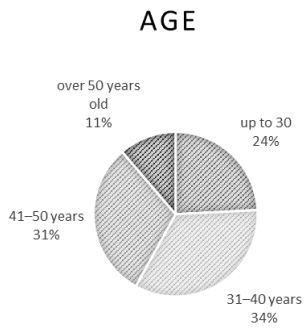

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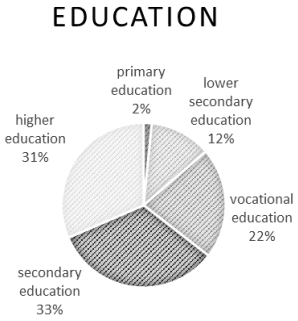

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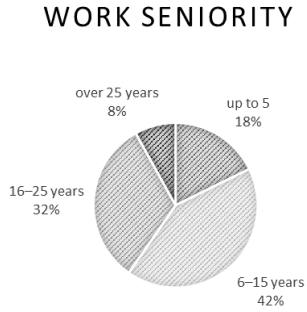


Figure 3: General characteristics for all respondents participating in the research - percentage share in relation to features: a) gender, b) age, c) education and d) work seniority.

The analysis was carried out on the basis of the form / questionnaire assigned to individual projects implemented by the enterprise. In the period in which the analysis was conducted, 31 engineering projects were started and partially implemented. In this case, a project is understood as one series of production carried out for one customer in a specific period of time. Table 2 presents numerical (statistical) results as a characteristic for all elements of the processes.

Table 2. Statistical characteristics of the obtained results

	1A	*1B*	*1C*	*1D*	*2A*	*2B*	*2C*	*2D*	*3A*	*3B*	*3C*	*3D*	*4A*	*4B*	*4C*	*4D*
Average	2.97	3.26	3.23	3.55	2.13	2.68	2.58	3.52	2.77	3.00	3.10	3.16	3.00	3.77	3.58	3.48
Standard error	0.25	0.23	0.15	0.17	0.23	0.16	0.20	0.21	0.20	0.23	0.22	0.19	0.13	0.21	0.17	0.14
Median	2	3	3	4	2	2	2	4	3	3	3	4	3	4	4	4

Standard deviation	1.40	1.26	0.84	0.93	1.26	0.87	1.12	1.18	1.09	1.26	1.22	1.07	0.73	1.18	0.92	0.77
Variance	1.97	1.60	0.71	0.86	1.58	0.76	1.25	1.39	1.18	1.60	1.49	1.14	0.53	1.38	0.85	0.59
Kurtosis	-1.42	-0.63	1.33	2.19	-0.13	0.07	0.15	-0.45	-1.34	-1.23	-1.06	-1.65	4.12	0.45	2.65	-0.21
Skewness	0.22	-0.31	-1.17	-1.10	0.92	1.03	1.08	-0.63	-0.18	0.32	0.16	0.01	-0.55	-1.11	-1.75	-0.18
Minimum	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	2
Maximum	5	5	4	5	5	5	5	5	4	5	5	5	5	5	5	5

Figure 4 shows the results for individual components of business processes. It can be noticed that an average of values above 3 (3 is the middle value) indicates numerous problems in the management of the indicated attribute in the business process.

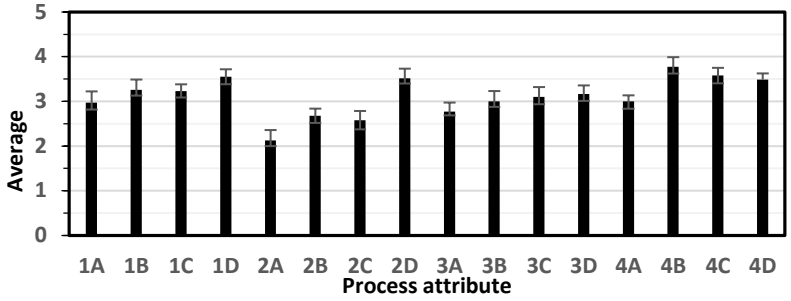


Figure 4: Comparison of average scores for individual process attributes.

It is easy to notice that as many as half (8 out of 16) of the attributes have an average value above 3 (including the error) (Table 2 and Fig. 4). That is, the effectiveness of management and the proper course of production are effected by:
-determining the requirements and technical parameters,
-valuation - project quotation,
-risk assessment of success,
-planning control activities - implementation of a quality control plan,
-effectiveness of delivering materials to the production hall,
-assessment of the quality level of products,
-timeliness of completing the order,
-distribution.
The indicated elements are information for the implementation of corrective actions in this regard. Corrective actions are understood as, inter alia, introducing norms
of behavior and an efficient management system for these areas. To complete the analysis of critical areas for the correct management of business processes, a correlation analysis was also carried out. Based on the research, a Pearson's correlation coefficients (*r*) were determined for individual components of four business processes. Table 3 presents the correlation coefficients for individual attributes of the processes.

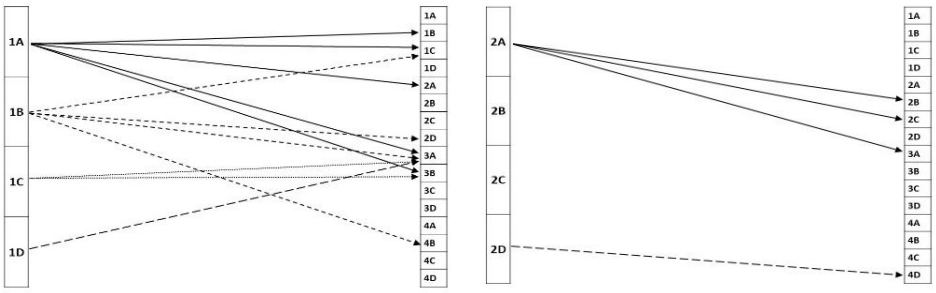
The analysis showed that the different elements of the processes are not mutually exclusive, but rather interrelated. Therefore, in order to ensure greater operational maturity in the organization, it is important to indicate the interrelationships of individual process capabilities and use them for the improvement and development of the organization.

Table 3. Corelation coefficients for the elements of four main business processes in production: (1) Launching the project implementation; (2) Scheduling and project management; (3) Management and supply of materials; (4) Production and distribution.

	1A	*1B*	*1C*	*1D*	*2A*	*2B*	*2C*	*2D*	*3A*	*3B*	*3C*	*3D*	*4A*	*4B*	*4C*	*4D*
1A	1.00															
1B	0.95	1.00														
1C	0.82	0.85	1.00													
1D	0.66	0.59	0.65	1.00												
2A	0.82	0.69	0.60	0.57	1.00											
2B	0.62	0.50	0.42	0.27	0.74	1.00										
2C	0.48	0.41	0.42	0.62	0.75	0.61	1.00									
2D	0.57	0.73	0.55	0.37	0.49	0.26	0.37	1.00								
3A	0.87	0.80	0.89	0.72	0.78	0.45	0.52	0.51	1.00							
3B	0.75	0.65	0.84	0.60	0.67	0.39	0.47	0.27	0.92	1.00						
3C	0.31	0.13	0.27	0.60	0.36	0.12	0.42	-0.11	0.54	0.50	1.00					
3D	0.47	0.26	0.36	0.51	0.48	0.13	0.28	-0.02	0.69	0.72	0.83	1.00				
4A	0.36	0.40	0.32	0.49	0.29	-0.05	0.37	0.35	0.46	0.40	0.56	0.51	1.00			
4B	0.62	0.74	0.46	0.39	0.43	0.28	0.31	0.74	0.48	0.34	0.09	0.22	0.70	1.00		
4C	0.40	0.50	0.38	0.47	0.31	0.16	0.41	0.54	0.43	0.31	0.36	0.31	0.74	0.77	1.00	
4D	0.54	0.45	0.54	0.55	0.45	0.09	0.28	0.23	0.77	0.72	0.80	0.88	0.65	0.42	0.53	1.00

On the basis of a dependency matrix that represents the interrelationships, they will strengthen a better understanding of where they need to focus on creating an action plan. Based on the data in Table 3, it can be concluded that very strong correlation ($0.7 < r < 1$) show process attributes in the layout presented in figure 5. Whilst, the strong correlation ($0.5 < r \leq 0.7$) show process attributes in the layout presented in figure 6.

a) b)



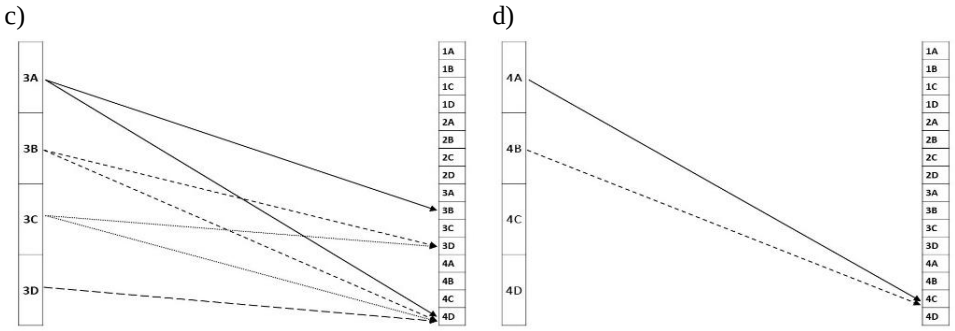
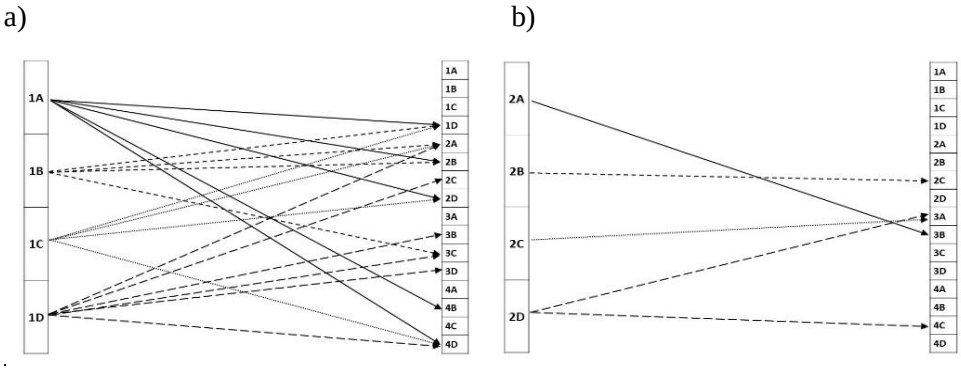


Figure 5. Very strong correlation (0.7 < *r* < 1) show process attributes in: a) Launching the project implementation; b) Scheduling and project management; c) Management and supply of materials; d) Production and distribution.

It has been noticed that the attributes from business process 1 (Launching the project implementation) and process 2 (Scheduling and project management) show a very strong correlation with the attributes in other processes. Thus, these processes can be marked as crucial for the functioning of the production system. And the high values of the average score in Figure 3 prove that the company has not yet mastered the principles of business process management in these areas. It has also been observed that all of the attributes feom proces 1 strongly interact with the attribute 3A (Identify inventory levels in relation to demand) (fig. 4a), which indicates an insufficient level of management of purchasing and supply processes. A there is a lack of data and information flow between process 1 and 3. A similar interaction can be seen between the attributes of process 3 (Management and supply of materials) and the attribute 4D (Distribution) – fig. 5c.



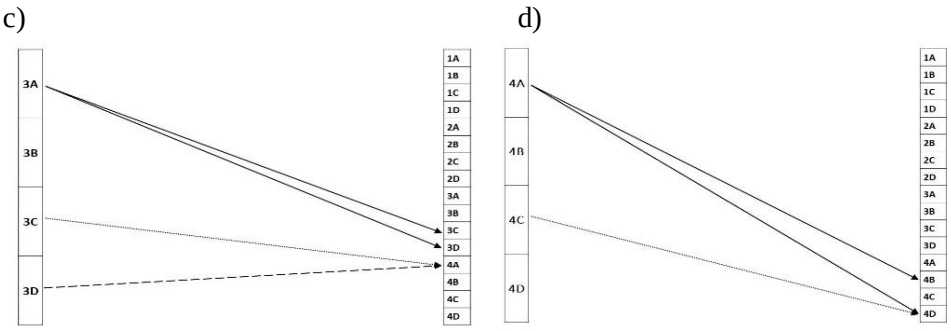


Figure 6: Strong correlation ($0.5 < r \leq 0.7$) show process attributes in: a) Launching the project implementation; b) Scheduling and project management; c) Management and supply of materials; d) Production and distribution.

Based on the data in Table 2, it can be concluded that strong correlation ($0.5 < r \leq 0.7$) show process attributes in the layout presented in figure 6. It can be seen that the attributes of process 1 (Launching the project implementation) correlate strongly with attributes in other processes, in particular with attributes in processes 2 (Scheduling and project management) and 4 (Production and distribution). The highest number of strong correlations was recorded for attribute A1 (Determining the terms of the project implementation) – fig. 6a. Attribute A1 significantly affects all attributes (in all processes) - with as many as five very strong correlations and five strong correlations, and as shown in the data in Table 2, other correlations are in the range 0.3-0.5, which means moderate correlation;. The analysis shows, as could be expected, that "Determining the terms of the project implementation" is a key element for the efficient maintenance of a stable production system. A very strong, strong and moderate correlation with elements in other processes, as well as high values of assessments proving the generation of problems, indicate the need to introduce changes in this area. Decisions made at the level of determining the conditions of the project are a critical point in the course of production. As has been shown, very often the conditions set at this stage are not feasible in other processes of this system.

Therefore, if the company, acting in accordance with the principles of BPM, it is necessary to modify the activities in this process, e.g. by improving the flow of input information, as well as the flow of information within the organization; standardization of activities, unification of possibilities in terms of project implementation.

The business process management (BPM) literature suggests (Saab et al., 2018), that more than 60% of process management efficiency improvement projects fail due to factors related to the lack of predictive control and the failure of the continuous finding of anomalies in the results over time. Qualitative anomalies

indicate extreme deviations of efficiency from expectations and quality requirements. The findings suggest that quality control in BPM is a scientific method of creating knowledge about anomalies and signaling opportunities for conscious, systematic, and continuous improvement in performance. The proposed methods of improvement are the necessary corrective actions, the implementation of which will allow the organization to develop in the field of BPM. As it results from the research, many factors in the processes in question are related, which means that improvement initiatives should not focus on an isolated problem, but on the whole perspective - at the bigger picture.
The results are limited in terms of the possibility of generalization for differently developed processes, as well as possible errors in the understanding of the evaluation of the components of the process. From point of view of practical implications - the analysis of integration and interdependence of processes provides a lens that points out places for further analysis and improvement. Empirical findings emphasize the role of the flow of information and materials throughout the manufacturing system that includes the four business processes. The paper defines the dependencies and integration of processes based on the process mapping (using VSM) and indicates the possibilities of using Lean tools in improving business processes. The questionnaire form presented in the paper can be used in production (or service) systems as a tool for the initial assessment of the business processes functioning in the enterprises.

Conclusions

On the basis of the presented results, the critical points of the information / decision flow between the coexisting business processes have been indicated. The analysis showed that the different elements of the processes are not mutually exclusive,
but rather interrelated. Therefore, in order to ensure greater operational maturity in the organization, it is important to indicate the interrelationships of individual process capabilities and use them for the improvement and development of the organization. It has been noticed that the attributes from process 1 (Launching the project implementation) and process 2 (Scheduling and project management) show a very strong and strong correlation with the attributes in other processes 3 (Management and supply of materials) and 4 (Production and distribution). Therefore, it should be concluded that the problems at the initial stages of the project implementation strongly affect its further progress:
-Problems in determining the terms of the project implementation are a signal that there may be significant problems in identifying inventory levels in relation to demand.
-Problems in determining the terms of the project implementation are also an information that they will be impossible (or very hard) to determine the requirements of project technical parameters.

-The delay or difficulties in launching the project implementation have a large impact on maintaining appropriate inventory levels in relation to demand, as well as the availability of offers for purchasing the necessary basic and auxiliary materials.
-The lack of offers for the necessary basic and auxiliary materials has a very large impact on ensuring the availability of required material stocks (or scheduling delivery), but above all on the timely completion and delivery of the order (implemented project).
An generaly, the processes in production system are strongly related and improvement initiatives should not focus on an isolated problem, but on the whole perspective.
Although there are some limits, the questionnaire form presented in the paper can be used in other production (or service) systems and as a tool for the initial assessment of the correctness and effectiveness of the business processes functioning in the enterprises. Apply it in the BPM improvement strategy would allow the indication areas requiring corrective action.

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ANALIZA I POPRAWA ZARZĄDZANIA PROCESAMI BIZNESOWYMI – W OPARCIU O MAPOWANIE STRUMIENIA WARTOŚCI (VSM) W FIRMACH PRODUKCYJNYCH

Streszczenie. Zarządzanie procesami biznesowymi jest bardzo ważnym czynnikiem w ocenie efektywności systemów produkcyjnych (całych przedsiębiorstw lub działów). I o ile planowanie i zarządzanie procesami biznesowymi jest opanowane, trudno jest tworzyć relacje między współistniejącymi procesami w ramach jednego systemu produkcyjnego. Zazwyczaj zarządzanie procesami biznesowymi odnosi się do wyodrębnionych (wyizolowanych) procesów, w tym przypadku poszukiwano relacji pomiędzy różnymi procesami. Artykuł poświęcony jest ocenie i analizie interakcji procesów biznesowych związanych z realizacją jednego projektu inżynierskiego. W artykule przedstawiono wyniki badań przeprowadzonych w odniesieniu do czterech współistniejących procesów biznesowych w przedsiębiorstwie produkcyjnym – przy założeniu, że cztery analizowane procesy biznesowe są ulokowane w ramach jednego projektu. Procesy biznesowe zostały zdefiniowane na podstawie obszarów określonych w analizie Big Picture (w analizie Mapowania Strumienia Wartości). Jako wskaźniki wpływu elementów procesu biznesowego brano pod uwagę współczynnik korelacji, którego wartość określała wpływ (lub brak wpływu) pomiędzy komponentami różnych procesów biznesowych. Zauważono, że atrybuty z procesu 1 (Uruchomienie realizacji projektu) i procesu2 (Planowanie i zarządzanie projektami) wykazują bardzo silną i silną korelację z atrybutami w innych procesach 3 (Zarządzanie i dostawa materiałów) i 4 (Produkcja i dystrybucja). Na podstawie przedstawionych wyników wskazano krytyczne punkty przepływu informacji/decyzji pomiędzy współistniejącymi procesami biznesowymi.

Słowa kluczowe: mapowanie strumienia wartości, zarządzanie procesami biznesowymi, VSM, doskonalenie procesów

业务流程管理的分析和改进——基于制造企业的价值流图 (VSM)

抽象的。业务流程管理是评估生产系统(整个企业或部门)有效性的一个非常重要的因素。虽然掌握了业务流程的规划和管理，但很难在一个生产系统内的共存流程之间建立关系。通常，业务流程管理是指提取(隔离)的流程，在这种情况下，需要查找不同流程之间的关系。本文致力于评估和分析与一个工程项目的实施相关的业务流程的交互。本文介绍了对一家制造公司的四个共存业务流程进行的研究结果——
假设所分析的四个业务流程位于一个项目中。业务流程是在大图分析(价值流图分析)中确定的领域的基础上定义的。作为业务流程要素影响的指标，考虑了相关系数，其值决定了影响(或缺乏)的影响)在各种业务流程的组件之间。已经注意到流程1(启动项目实施)和流程的属性2(调度和项目管理)与其他过程3(材料的管理和供应)和4(生产和分配)中的属性显示出非常强的相关性。根据所呈现的结果，指出了共存业务流程之间的信息/决策流的关键点。

关键词:价值流图，业务流程管理，VSM，流程改进