Using Visual Management to Improve Logistics Operations

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Abstract

The article shows the impact of visual management on performance in logistics operations. A case study was conducted at a branch of the international BMI corporation involving production of construction materials. Focus is on VM implementation in transport and storage of this firm. Active research was used to include the outlook of top management on the implementation and use of visual management. Findings from this study show that visual management is an effective way to improve performance in the studied logistics functions. This study also reveals the complex nature of the effect not only on warehouse and transport operations, but also on handling operations, improving operational planning and specializing warehouse teams. Organizational culture, work discipline and value system in the group of production and warehouse workers is of importance in implementing and efficiently using visual management resources. Using visual management is complex.

Keywords: visual management, logistics, transport, storage, case study.

1. Introduction

Visual communication (VC) is critical to continuous improvement of an organization which is a complex system sensitive to changes in its environment. Visual tools are an essential part of the communication process in factories that operate according to the lean management (LM) philosophy (Parry and Turner, 2006). Visual tools raise awareness of the importance of continuous monitoring of the organization's performance measures and indicators (Bernardez, 2007). Since its inception, visual management (VM) has been a key component of the Toyota Production System (TPS) and its derivatives like lean production (Ohno, 1988). In literature, there are different perspectives on visual management. VM is:

- an information-sharing vision that facilitates continuous improvement (Imai and Kaizen, 1997),
- a system that uses a lean approach to implementing visual management in the workplace (Schultz, 2017).

The essence of VM is the creation of a visual culture that fosters the exchange of information and knowledge at the individual and group level in the workplace with the help of available visual tools (Galsworth, 2005). At the same time, it is rather difficult to determine which of the available visual tools create the model set that affects performance to the highest extent. The issue also concerns the determination of the effectiveness of the VM technology transfer to production companies that have specific characteristics depending on the production profile (Murata and Katayama, 2010; Song et al., 2018). There are also fundamental differences in the approach to conceptualizing "the visual" in the quality research of the organization (Davison et al., 2012) and contextualizing visual management studies (Bell and Davison, 2013). Despite these problems, VM has become a powerful tool for supporting managerial and decision-making processes in organizations, providing valuable information. This allows the management to track the progress of the company's strategy and combines the implementation of processes with performance management (PM). The use of VM depends on the culture of the organization and participation deployment, which results in a difference in the assessment of its suitability in management (Jaca et al., 2014). Although literature offers explorative studies showing the impact of VM methods and techniques, among which the 5S method for performance management is a pillar, case studies providing detailed descriptions of VM implementation and development in production companies are still insufficient (Bititci et al., 2016). Eaidgah Torghabehi et al., (2016) provide one of the few studies shows interconnections between visual management, performance management and continuous improvement, proposing a practical framework to establish an Integrated Visual Management (IVM) program. Although the use of visual tools is documented in many different sectors (Bateman et al., 2016), there is a research gap in proving their suitability in the storage and transport area within complex manufacturing systems. In this context, VM research is crucial for performance management in terms of changing and implementing the operational strategies of manufacturing enterprises. This is important because VM allows to provide key information as close to the point of use as possible, constituting lean culture support (Jaca et al., 2014).

VM is one way to approach and develop use of performance improvements and key performance indicators (KPIs). There is a research gap concerning descriptions of both the implementation course and its results in the context of processes carried out in the storage and transport area. The theoretical contribution of the article is to show the link between VM and the efficiency of processes in the storage and transport area. Practical contribution consists in examining the real impact of the set of tools used on improving results in this particular case. In the provided single case study the implementation of VM affected performance and Key Performance Indicators (KPIs) in one of the factories of the international BMI group is described and analysed. This includes the decision to choose VM, in line with Eaidgah Torghabehi et al., (2016), from the perspective of the company's strategy. The case describes the timeline of the implementation VM project, from the moment of making the decision to approve the project until its closure. An important normative context of the study was the implementation of 5S as guidelines within LM in the warehouse facility. More precisely, this concerns developing managing of the storage area, the appropriate labelling of product lots and general systemic order in the warehouse.

In our study, we took a Western and Japanese look at VM, focused on many application areas beyond visual controls (Tezel et al., 2016). In this article we seek to expose the value of using VM through a practical case thereby emperically grounding VM as a LM tool. The research issues are associated with this single case study:

Regarding the overall impact on firm performance:

R1: To what extent does the implementation of VM affect the performance management in the studied production company?

Regarding issues within this studied firm:

R2: What items does the VM implementation process in the storage and transport area of a warehouse contain?

R3: How does VM perform in the storage and transport area?

In the absence of general guidelines for choosing the right set of VM methods and techniques, it is important to show the implementation context and examine whether and to what extent the project has influenced performance. The context of the implementation of VM at BMI refers to the lack of up-to-date information on results of work, KPIs, company plans, adequate communication and measurement of indicators related to the area of warehouse management and production planning, as well as all current information regarding Supply Chain (SC). The specificity of the warehousing and production area at BMI contributes to its inefficiency, extended loading time due to the lack of proper preparation of goods for shipment, long queues waiting to be loaded and failure to meet the delivery time of goods. Other issues include lack of stock inventory transparency, segregation by product group or inadequate cleanliness and order inside warehouses.

The remaining part of the article is organized as follows. Section 2 describes the theoretical background of the study and offers an in-depth discussion of the main trends in European logistics as well as factors affecting its development. Section 3 presents the methodology. Section 4 contains the description of the case. Section 5 discusses the findings, while the final segment provides general conclusions and indicates further research directions.

2. Visual management and performance

As we have already mentioned in the introduction, in literature we can find a great diversity in terms of perspective on and conceptualization of VM. This also applies to VM concept's association with other management practices. Tezel and Aziz (2017) see that visual systems often interact with each other and take roles in different managerial practices including e.g. performance management (Tezel and Aziz, 2017). However, there is still a problem with the theoretical grasp of visual management, which increases the difficulty in determining its interdependence with performance management. One of the few proposals is that put forward by Beynon-Davies and Lederman (2017) who suggest a theoretical view of VM through the use of affordance theory (Beynon-Davies and Lederman, 2017). Gibson 1977 defines affordance as 'what the environment provides or furnishes' (Gibson, 1977, 1979). The general idea relates to the perception of the possibility for employees to take action within the framework of the environment’s structure. This is particularly important in a work environment characterized by high complexity and variability, which is confirmed by the results of construction industry research (Abdelkhalek et al., 2019; Brandalise et al., 2018). However, this idea can also be used to deliberately create spatial structures that directly affect operational outcomes. Koskela et al. (2018) disapprove the use of affordance theory in the context of VM, criticizing primarily the excessive level of abstraction in the use of the term ‘affordance’, the concentration of research around collaborative devices of VM, the lack of comparability and unification of theories in the context of approaches to management as well as workplace situations and activities that may benefit from VM (Koskela et al., 2018).

Despite doubts about the possibility of including VM in theoretical frameworks, there is a widespread consensus that the use of various tools from a wide range of VC has a positive effect on performance measurement and performance management (PM) (Bititci et al., 2016). At the same time, it should be emphasized that VM is seen by managers as one of the core components of creating a visual culture within strategic management. Synergistic effects between visual management and performance management are evident in the Visual Performance Management (VPM) concept. Liff and Posey (2004) presented the general assumptions for the integration of these concepts and defined VPM as:

“visual management is a system for organizational improvement that can be used in almost any type of organization to focus attention on what is important and to improve performance across the board. It adds a new dimension to the processes, systems, and structures that make up the existing organization by utilizing strong graphic visualization techniques to heighten its focus on performance.”(ibid. p. 4)

However, literarature provides only a few examples of studies explaining how and to what extent the use of specific tools has affected performance management (van Assen and de Mast, 2019; Bernardez, 2007; Murata and Katayama, 2016). This is mainly due to the wide diversity of the environment in which operations and processes are carried out within, for example, manufacturing systems that are connected to the storage and transport systems. This is confirmed by the review and synthesis of literature relating to VM in production management, which provides practical VM tools taxonomy (Tezel et al., 2016).

3. Methodology

In our research, we conducted a single case study showing the complexity and step-by-step nature of the process of introducing VM tools at the BMI Icopal plant. Using a single case study allows for capturing multiple actors' perceptions of different VM elements as well as the relationship between these elements and results improvement, *"... depth and richness, allowing the researcher to really probe the how and why questions"* (Ellram, 1996).

This is an explorative quest that followed an iterative path in the space between theory and empirical findings. According to Eisenhardt (1989), an emergent character of research design is a common feature of case studies. From a vague initial understanding of the research problem, more specific research issue formulations are gradually evoked. This may be compared to sequential "hypothesis" formulating or simply expressing "hunches" based on empirical data that thereafter may be used to steer the research process further, which again leads to new hunches (Eisenhardt, 1989). In general, the use of case studies provides unique means of developing theory by utilizing in-depth insights into empirical phenomena and their contexts (Dubois and Gadde, 2002, 2014). Dubois and Araujo (2007) described and developed rules relating to the use of case study in the context of building a theory based on purchases and supply chain management (Dubois and Araujo, 2007). They successively refer to the following observations:

- Case studies are not purely inductive, exploratory tools
- Generalizing from case studies is an analytical (not statistical) process
- Present the case to persuade the sceptical reader
- Celebrate the flexibility of the case method and describe the casing process
- Case selection is the most important methodological decision

They demonstrate that case studies are, like quantitative methods, neutral tools for discovering new phenomena and dependencies within existing theories and, in some cases, new theories.

First, we interviewed the SC Senior Manager who is responsible for warehousing and transportation operations for the Eastern European region (16 countries). A general outlook of the BMI group headquarters on the problems found in the Polish branch was the starting point for further, more targeted interviews. This interview led to further interviews following a "snowballing" logic. This logic included abductive reasoning so that each new interview would provide new theory-related insights which again could provide guidance not only for the following interview, but also whom to interview and what to address. Moreover, in order to objectivize the opinions expressed by the interviewees, we simultaneously collected documentary data which included all data sets and information from BMI Icopal internal reporting systems, relevant in terms of the implementation of VM tools.

A total of 12 interviews were conducted with people from the organization, which provided an overview of the implementation of the project and subprojects that led to the full implementation of the VM concept (Tab.1). As interviewees, we selected persons who participated in projects in the BMI Group and directly at the BMI Icopal plant. Those persons held leading positions and thus had experience in previous implementations.

Table 1. Basic characteristics of interviewees

Location	Informant role (Number of previous VM implementations)	Lean Experience of Interview Partner	Interview topic
Zduńska Wola Plant	SC Manager A. Gil Supply Chain Director (1)	High	In charge of cały gospodarkę magazynową, logistykę, SC w zakładzie w Zduńskiej Woli
Headquarters (Luxembourg)	(3) Ali Partoazam – Regional Transport & Warehousing Manager, BMI Luxembourg – SC Senior Manager	High	In charge of warehousing and transportation operations for region Eastern Europe (16 countries)
Zduńska Wola Plant	Committee Management Member R. Jędrzejczak PhD (1)	High	In charge of the entire SC production area for all types of BMI Poland products for the entire BMI company
Zduńska Wola Plant	Team Manager	Low	In charge of acceptance of finished production products from the production area and compliance of stock in the accounting system
Zduńska Wola Plant	Warehouse Leader 1	Low	In charge of organization of production operation, storage places of products in stock and optimization of the use of storage space
Zduńska Wola Plant	Warehouse Leader 2	Low	In charge of load picking coordination and supervision of Time Slots
Zduńska Wola Plant	Warehouse Leader 3	Low	In charge of handling the production of thermal insulation products, optimization of storage of finished products
Zduńska Wola Plant	Warehouse Leader 4	Low	In charge of transaction supervision and coordination of external warehouse operations
Zduńska Wola Plant	Production Planner	High	Planning production for individual production lines in terms of market demand
Zduńska Wola Plant	Plant manager	High	Coordination of the entire production process at the Zduńska Wola plant
Zduńska Wola Plant	Production Manager of the polystyrene line	High	Supervision over polystyrene production according to the production schedule
Zduńska Wola Plant	Production Manager of the bituminous shingles line	High	Supervision over bituminous shingles production according to the production schedule
Zduńska Wola Plant	Production Manager of waterproofing materials	High	Supervision over waterproofing materials production according to the production schedule
Zduńska Wola Plant	Supply Chain Manager	High	Supply chain area BMI Icopal Logistics of planning the supply of goods and semi-finished products from all foreign branches of the BMI Group

The main interviews were conducted before the commencement of the project, during the implementation of sub-projects and then after the completion of the entire project in order to capture the continuity of the changes taking place in the organization and to assess the effects in the form of improved results in the area of warehouse and transport logistics. Before semi-structured interviews were conducted, a list of questions about the most important insights related to the implementation of VM in the organization was submitted. Most of the responses were submitted via email by people who were interviewed 1 to 2 weeks afterwards. Then, semi-structured interviews which lasted from 20 to 60 minutes were conducted. They usually took place at the headquarters of the main BMI Icopal plant, in the workplace of the person providing the information. Some interviews with people from outside Poland were conducted in the form of videoconferences due to the lack of direct contact during the implementation of the subsequent VM stages. Interviews were recorded and then transcribed. Additional interviews were conducted until deciding that a potential following informant involved in the studies' professional network was not expected to provide further substantially fruitful insights into the research issue.

4. Case description

3.1 The company description

BMI Icopal sp. z o.o. (previously Icopal Sp. z o.o. Zduńska Wola, Icopal SA Zduńska Wola, Izolacja SA Zduńska Wola) belongs to the international BMI Group, a world leader in the market of roofing and waterproofing materials in the construction industry. The company has 38 production plants and 97 sales offices in 30 countries of the world and employs 3,900 employees. Since 1999, Icopal has been represented in Poland by the Polish BMI ICOPAL Group. Its production, technological and financial potential as well as strong support of the consortium allows it to take full advantage of the latest technological advances and adapt the company's offer to the growing needs of the clients. BMI ICOPAL sp. z o.o. is the precursor of pro-quality activities on the Polish construction materials market. It is a very important area of activity of BMI Group which develops its activities in the European, African and Asian markets.

a. Implementation

VM was implemented at the BMI Icopal production plant in Zduńska Wola in 2 external warehouses (600 and 601), one raw material warehouse (100) and 3 loading areas (Figure x). The layout of the warehouses includes a 1,600 m2 of high-bay warehouse area using high-storage racks for finished and commercial goods.

Figure 1. BMI Icopal warehouse locations

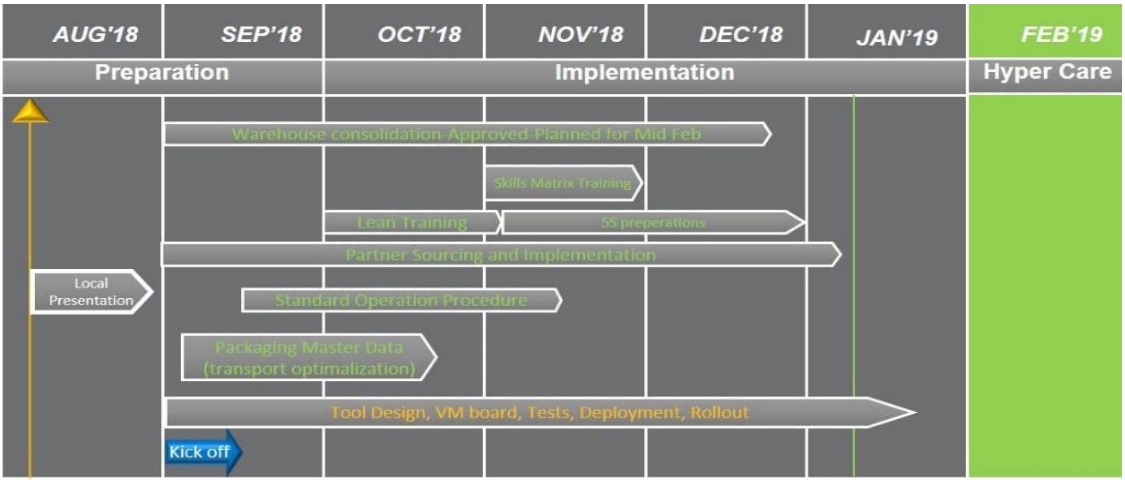
The implementation of VM at BMI Icopal was part of the Multichannel Transport & Warehousing Project which was implemented from September 2018 to March 2020 (Figure x). It began in September 2018 with a preliminary analysis of the situation in the company. In December 2018, project and sub-project objectives were set and training for employees was planned. In 2019, sub-projects were implemented and tasks carried out. The final phase of the project, its conclusion, took place in March 2020. The SC Senior Manager, experienced in the implementation of VM in this area, was a strong support in the process of project execution. At the same time, companies specializing in projects were not used. The project received support from the Management from Luxembourg which is responsible for Transport & Warehousing in BMI Group.

The project aimed to improve storage area productivity at BMI Icopal. The general goal involved the setting of specific objectives which mainly covered the area of warehouse and transport logistics. The idea was to implement work planning in the area of picking and loading and production process, improve the efficiency of work in warehouses in the areas of preparation and picking, and reduce loading time.

Another goal was to change the transport service system by introducing one leading logistics operator and making customer service more efficient. It involved the establishment and implementation of measures of basic processes in the warehousing and transport area, and the development and monitoring of KPIs. Consequently, it was envisaged to optimize the use of cargo space of means of transport and introduce additional tools to help optimize the timeliness and quality of deliveries to the customer. The final specific objectives of the project included the implementation of Time Slots and training in lean 101 and 5S systems.

The detailed process of introducing VM at BMI Icopal took place in stages and covered the presentation of the implementation project assumptions together with the implementation schedule. Then key project leaders received training, the implementation team was set up and the project manager was appointed. In the next stage, staff training was carried out and the plan of changes and assumptions for the reorganization of the areas covered by the project was presented. Project sub-teams, their leaders and specific tasks to be completed were identified. Implementation was supervised, analyzed and the required actions were corrected. In the final stage, the project's objectives were summarized and reviewed and process measures (KPIs) were identified for the continuous measurement and discussion of the implemented processes and changes to maintain the standard achieved. In the last phase, the project elements were visualized and presented in an appropriate graphical form and place in the storage area.

Figure 2. Project time periods



3.2. VM implementation elements at BMI Icopal

VM implementation process at BMI Icopal consisted of 6 elements: Standard Work Instructions, Skill Matrix, Transport Operation Manual, Quality KPIs, Safety KPIs, 5S Method.

For Standard Work Instructions, the first step was to identify all standard operations performed in the warehouses. Warehouse operations form a part of an on-the-job training. They can also be performed in another position or warehouse. Each warehouse operation consists of activities that are performed as part of that operation, and it also includes:

- the time necessary to perform a given action and operation,
- information about the application of the required security measures,
- information about the machines, equipment or tools necessary for the operation,
- illustrative images which help understand the purpose and scope of a given operation.

Standard operating instructions are also a very good material for the induction and training of new employees and should be available to all employees.

Skills Matrix informs the recipient in a simple and transparent manner about the scope and quantity of standard warehouse operations performed, while taking into account the participation or level of employee involvement in the process. The basis for creating such a matrix are standard operating instructions along with the assignation of groups of people who perform certain roles in the warehouse (leader, warehouser, issuer). The skills matrix is also a very good element of the visualization board, informing people from outside the warehouse about the scope of work performed in the warehouses (Figure 3).

Figure 3. Skills matrix at BMI Icopal Sp. z o.o.

SKILLS MATRIX

Skills module / Operations — Function	Leader	Delivery	Warehouse Worker
Manual loading of goods	✗	✓	✓
Loading of goods with a side-lift truck	✗	✓	✓
Loading of goods with a forklift from the ramp	✗	✓	✓
Service of polystyrene products production	✓	✓	✓
Part-pallet shipment picking / courier	✗	✓	✓
Servicing the documentation of deliveries and releases of goods	✓	✓	✗
Side unloading of goods in a warehouse	✓	✓	✓
Unloading the goods from the ramp in the warehouse	✓	✓	✓
Operation of forklift trucks and tractors	✗	✗	✓
Making additional securing of pallets	✓	✗	✓
Paper products production service	✓	✗	✓
Shingle production service	✓	✗	✓
Replacement of gas cylinders in forklift trucks	✓	✓	✓
Moving goods between warehouses	✓	✗	✓
Fuelling of tractors and forklifts	✓	✗	✓

Transport Operation Manual (TOM) describes the processes, requirements and information necessary to ensure the correct execution of transport orders, starting with the creation of the order through loading and delivery to delivery to the recipient. TOM also contains the necessary information about warehouse work, how goods are loaded and secured and the location of loading places. It is not only an indispensable element of standardization of warehouse processes, but also an instruction on how to proceed for those involved in the entire process of planning and delivery in transport. TOM is a universal document that facilitates work with any carrier while complying with the procedures, processes and requirements assigned to a given company or plant.

KPI in the area of Quality (*correct loading indicator*) is one of the measures determining the level of quality of the work performed in the warehouse. It is represented graphically in the form of a bar-line chart, where the continuous line shows the percentage of mistakes relative to the total number of loadings performed. At the same time, it clearly shows the trend in the number of mistakes on a monthly basis. In some respects, it is also a part of the rivalry between two warehouse crews and translates into greater staff mobilization and increased work efficiency.

KPI in the area of Safety *(work safety indicator)* is an indicator of vital importance which informs the crew about incidents and accidents at work. At BMI, the level of safety at work is defined through the following components:

- LTI (lost time injury) is an accident at work resulting in the loss of working time and absence of the employee at the workstation,
- MI (medical injury) is an incident resulting in medical trauma,
- FAI (first aid injury) is an incident resulting in the use of the first aid kit.
- In addition, the number of days without an accident in the warehouses is shown through an appropriate visualization to encourage a positive perception of this aspect of warehouse work by employees.

5S Method is regarded at BMI Icopal as *part of the lean process*. This is a method introduced to make the most of storage space and maintain order. The method consists of 5 stages which at BMI Icopal are:

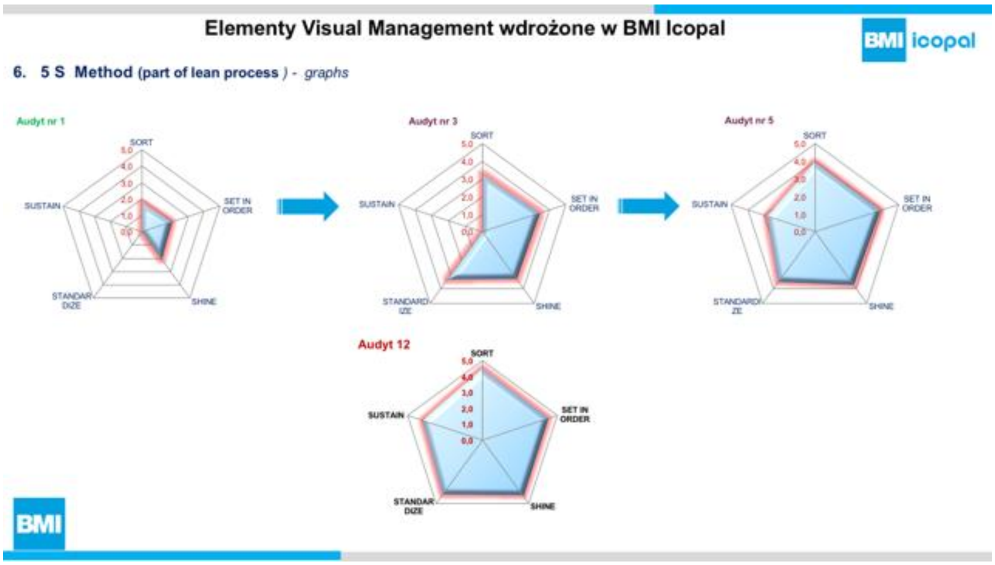
- *SORT* (*sorting*) – removal of unnecessary, damaged items from the workstation and warehouse area.
- *SET IN ORDER* (*ordering*) – after removing useless elements, sorting and marking the remaining elements so they can be quickly identified. Each element should have a properly marked place at the workstation or in a given area.
- *SHINE* (*cleaning, tidying up*) – a workstation or area should be cleaned regularly. BMI Icopal has created lists of persons responsible for maintaining cleanliness in given areas.
- *STANDARDIZE* (*unification*) – after the previous 5S method stages have been achieved, it can be considered that a certain level of standardization has been introduced, where each employee is aware of what action should be taken during

each operation performed in order to maintain the 5S method threshold reached so far.

- *SUSTAIN* (*maintenance*) – the most difficult step in the 5S method consisting in maintaining the high standard achieved. In order to maintain the high standard of the 5S method, regular audits should be carried out in all areas subject to its implementation.

At BMI Icopal, audits are carried out on a monthly basis. Each audit is attended by warehouse leaders and the SC Manager, whereas one in three audits also includes the SC Director. Each audit results in the creation of a list of areas requiring improvement, which is verified during the next audit. BMI Icopal introduced a score, visualized on the board as a radar chart showing the result achieved after the subsequent audit. The 1-5 scale adopted refers to the results of activities to be identified and determined in given areas. The scoring principle introduced at BMI Icopal allows to award a score of 5 only after 4.5 score has been achieved in six consecutive audits. The results of consecutive 5S audits are presented in each warehouse separately, which again has an additional positive effect through inciting rivalry between warehouse crews and thus improving efficiency (Figure 4).

Figure 4. 5S Method as part of lean process



The implementation of VM at BMI was carried out to improve warehouse management efficiency, dimension (estimate) KPIs in the warehouse area, implement a daily work planning system, familiarize employees with the results of their work and the scope of their duties, and link the warehouse work organization to the collection of products from production. VM has also been implemented to analyze daily reports with a plan to assign specific storage sites to gain knowledge of what operations are performed in warehouses for optimal work planning.

VM meetings are held daily, divided into two operational groups. The group responsible for preparing and securing shipments receives 3 reports per day of the planned number of cars to be loaded in a given time slot. On its basis, a daily plan coordinated by one person is determined. The second group handles production and also receives a daily plan of availability and location of products in the warehouse. Plans, schedules, reports are available and updated on the VM board. Monthly cyclical meetings are held with all employees, where the SC Director discusses the results achieved for the designated KPIs. The analysis of the results is carried out on an ongoing basis by the manager and, if necessary, meetings aimed at correcting actions are organized more frequently. At BMI Icopal VM is placed on magnetic boards where all measured targets, plans and other significant data relative to warehouse operation are displayed.

3.3. Project challenges

The management process in the field of warehouse logistics at BMI Icopal faced numerous problems before the implementation of VM. The main issues to be resolved were the lack of KPI process measures and the lack of daily plans in the area of goods preparation and production service. Time and number of loadings could not be defined either. Another important problem was waiting for the arrival of the vehicle without a prior plan to make the cars ready for loading and the inefficient 16-hour working time of the warehouses. The results of the work were not visualized for the warehouse operation staff and there were gaps in the information about the operation of the warehouses. There was also no system for preparing shipments and picking before loading. Too much time was spent on multi-freight forwarding routes and transportation service. Another problem was the waste of time and inefficiency of work due to the lack of an effective management process of the storage area in terms of maintaining order, sorting and cargo labeling. The last issue that reduced productivity was the lack of operational instructions to optimize processes and warehouse operations.

5. Findings

The study has shown that VM has made it possible to show the results achieved by the warehouse crews within the entire storage and transport area. The results of established KPIs (processes) are updated on a monthly basis and discussed each time with the Supply Chain Manager and warehouse workers. It constitutes the basis for drawing conclusions and making possible adjustments for individual actions. Each warehouse worker is aware of the work of the entire warehouse and effectively participates in the work of designated teams. He/she also has the opportunity to present ideas in order to rectify inefficient processes.

In the case under study, all analyses and process results are assigned to individual warehouses, which allows for positive rivalry in order to achieve better and better results according to the principle of “rising up to the competition". The basis for the functioning of VM and its processes is to maintain a continuous, high level (status) of work organization and set further goals as a result of building better standards. To achieve this, all instructions and additional materials have been placed in a single designated place, freely available to all employees. There was also a consolidation of 2 warehouses, resulting in better work organization opportunities, the elimination of one additional loading place and the optimization of staff costs by 3 posts.

The implementation of Time Slots allowed to change the work organization in the warehouse and precisely determine its areas: picking and securing of goods and loadings. Cooperation between these areas is continuous and coordinated by means of daily reports of planned loadings. Such a system of operation allowed to cut loading times by half and better organize and plan loadings. On arrival at work, each warehouse worker receives a work plan for the day along with an hourly schedule. The process of scheduling warehouse workers takes place in a 2-day rotation system, which means that the schedule for the next day is also available.VM has also led to linking the storage area and the production area by planning the collection and storage of finished products at designated locations.

As a result of the VM implementation, three groups of warehouse workers were created: production handling team, team responsible for the security and preparation of ready-to-ship products and loading handling team.

As part of Skills Matrix, teams change and warehouse workers are swapped. The basis for the development of Skills Matrix is: identification of all warehouse operations, inclusion of employees in the operation process, identification of the main workstations in the warehouse and assignment of given warehouse operations to them, and the creation of Standard Operations Procedures (SOP).

Time Slots project resulted not only in the increased efficiency of warehouse work and transport logistics, but also the determination of precise times of delivery to the customer. The General Terms of Delivery (GTD) document is associated with this. The introduction of Time Slots allowed to analyze loading times and modes of transport, which in the future will result in adjusting the required actions to achieve even better results. A very important element of the correct functioning of Time Slots is the proper and close cooperation between the areas of transport logistics, loading planning, security (entry into the production plant) and forwarding.

The appropriate assignment of a worker to specific activities or operations results from his or her job position and responsibilities. The implementation of Time Slots resulted in the creation of a system identifying employees who pick and load goods. The system also increases the awareness of the work performed. It is possible to identify and track mistakes when picking or loading all shipments. Currently, the share of mistakes is 0.2% of all shipments.

The project led to the optimization of transport through cooperation in the field of warehouse management in terms of handling finished products with a large international forwarding company CH Robinson (the main global transport operator). It allowed to visualize transport orders by analyzing and eliminating ineffective actions. This led to a 33% increase in loadings within the required time frame. In addition, by implementing further tools to support the transport planning process, efficiency in the use of cargo space has increased by 15%, which in turn reduced unit transport costs. The implementation of Time Slots also resulted in the reduction of storage spaces due to the designation of additional sites for picking and securing of goods before loading. At the same time, considering safety standards in the area of loading, the implementation of Time Slots contributed to the reduction of storage places in the warehouse area due to the need to designate special zones for drivers to secure the loaded goods. The driver cannot block the loading dock after loading due to the strict schedule. Summing up the results of the VM implementation, the following improvements have been achieved:

KPIs in the storage area:

1. Quality – quality of loadings (number of mistakes in relation to the number of loading orders) – target 2020 < = 0.2 %
2. Loading Time – average loading time in the accepted loading time frame of the implemented Time Slots system – target 2020 <= 60 min / 1 loading
3. 5 S – target in the adopted model management system for 2020 < = 4.3 – average of 5 areas.

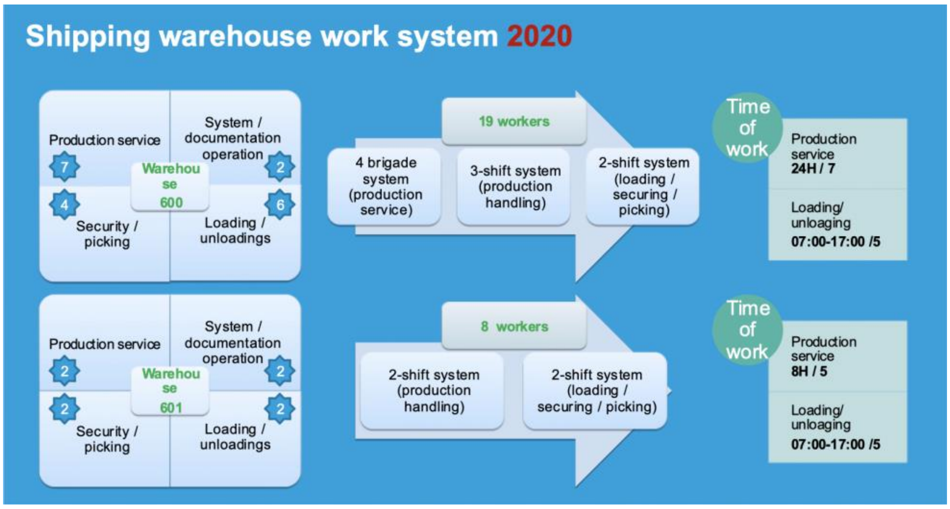
KPIs in the transport area:

1. Delivery on Time – target 2020 >= 97% of all transport orders
2. Pickup on Time – target 2020 >= 97% of all transport orders
3. Damages in transport – < = 1% of all transport orders

The implementation of VM allowed for the development of daily loading and production plans, so that every warehouse worker has information for current and next day and knows what tasks to perform without wasting time on “looking for work" or instructions from the supervisor. All work plans are available and updated up to several times a day on VM boards. There have been changes in the organizational structure of warehouses, such as consolidation, and warehouse working time has been reduced to 10 hours a day. Three teams of warehouse workers have been created with divided, specific activities assigned for higher efficiency and productivity. It is important that the same high level of execution of loading orders and production handling has been maintained. Visualization of work results was achieved through fixed and measured KPI targets in the storage and transport areas. The presentation of KPI results is made in a clear and encouraging way for employees to analyze. Another significant issue is the introduction of a monthly update and discussion of the results with the entire warehouse crew. This is also when the goals for subsequent periods are presented.

The implementation of the TS forced a change in the organization of warehouse work and transport logistics by creating a new system of picking and preparation of shipments within a 2019-2020. (Figure 5).

Figure 5. Shipping warehouse system 2020



In addition, a loading schedule was established and introduced, which minimized waiting for the car's positioning for loading and thus significantly reduced inefficient work in the warehouse.

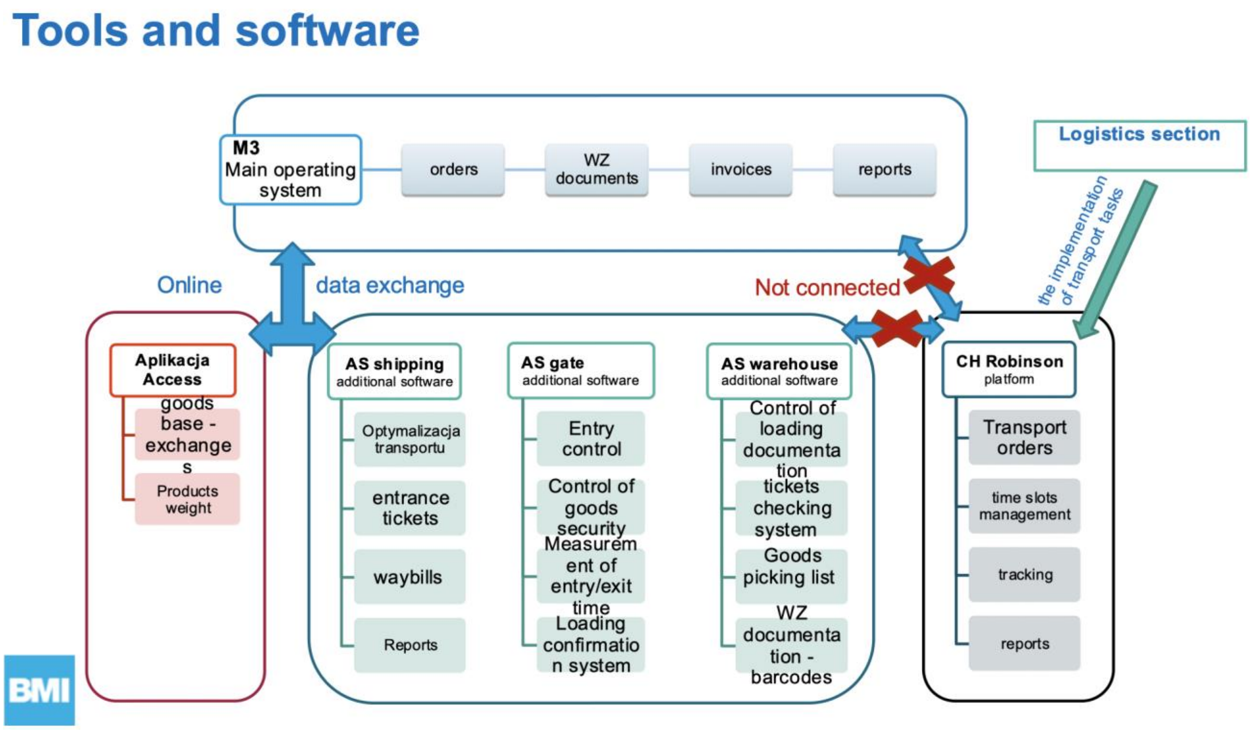
The implementation of the 5S system and the systematic audits by management forced employees to maintain order, properly sort and label goods, which in turn contributed to greater productivity without unnecessary, ineffective actions.

The development and implementation of additional IT applications and tools allowed for a 15% increase in the use of the car's loading space.

Changing the transport cooperation system and switching to one large operator resulted in a 33% better lead time for transport orders.

In addition, the introduction of the high-tech logistics platform NAVISPHERE by the system supplier CH Robinson to support the TS, led to obtaining data facilitating the analysis of loading times and daily reports. Figure x shows the interdependence between the IT systems used at BMI Icopal.

Figure 6. BMI Icopal system tools



VM has also improved work culture, commitment and relations among employees. Naturally, there was also rivalry among warehouse crews arising after the presentation and discussion of the results of their work.

Consolidating and reorganizing warehouse working time has reduced employment by 10% while maintaining serviceability and work efficiency at least at the same level as prior to the changes, setting new targets for achieving a higher standard.

It can be concluded that a solid foundation has been laid to start introducing higher work standards, bringing the organization closer to the level of work in modern warehouses regarded as a benchmark. Interviewees were asked about understanding VM in the context of implementations carried out at BMI Icopal. Due to the specificity of the production plant, the authors wanted to know whether the context of implementation affects the understanding of the concept.

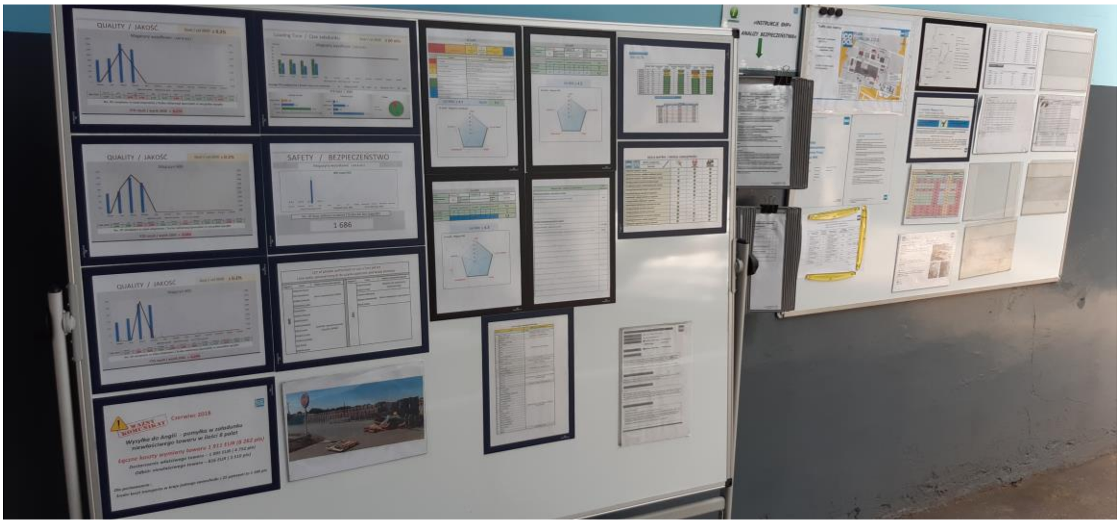
The responses of the interviewees revolve around two approaches to VM. The first one treats it as an effective way to transfer knowledge to warehouse and production workers (Figure 7). The second approach emphasizes the importance of technology in improving the efficiency of warehouse processes. Some statements from the informts in the case study include:

I see the Visual Management concept as a good way to pass on knowledge and results to the warehouse crew. The most important elements are the establishment of real KPIs, warehouse work plans (production support, pickings) and their proper presentation on the Visual Board. In one place, on one or several boards with divisions into task groups/areas, you can manage the work of the entire subordinate area in such a way as to encourage each employee to independently observe the results and plans [Adam Gil, 24 years at BMI Icopal as the SC Manager].

VM is combination of technology, design and tools to support and improve the efficiency and accuracy in warehouse operations [Ali Pertozan, SC Senior Manager].

Figure 7. KPIs Scoreboard / 5S / SWI /Skills Matrix / Work Plan Implementation Q1 2019

Take in figure x here.



5. Discussion and conclusions

Our research has revealed that the implementation of VM in the storage and transport area has contributed to improving the organization of work and systematic collection of data from the area of warehouse management. The use of the IT system has allowed for a comprehensive analysis and weekly reporting of operating results. VM has partially changed organizational culture, especially for production workers involved in warehouse and transport operations. We have noticed a degree of improvement in the quality of work discipline, which is consistent with the concept of CI (Continuous Improvement). We have identified and designated operations zones in the warehouses and the teams handling individual processes in the warehouse and production have been adjusted to them. VM has helped to closely link transport planning processes to warehouse work and it has raised stock accuracy.

The approach to the implementation of VM in the studied company includes 6 elements: Standard Work Instructions, Skill Matrix, Transport Operation Manual, Quality KPIs, Safety KPIs, 5S Method. Our research confirms that the elements introduced within VM allow for a real improvement in results in the storage and transport area. In the implementation process, it is important to verify and re-check the project tools in accordance with the PDCA principle.

VM in the storage and transport area directly reduces employment, increases productivity and shortens the time of loading and unloading operations. Indirectly, VM improves the process of operational planning and preparation of items for shipment to customers. It also affects the specialization of warehouse teams.

The study has shown that the implementation of VM at BMI Icopal Sp. z o.o. has directly contributed to increasing the efficiency of the activities and processes carried out in the storage and transport area. The problems that have been solved through the implementation of VM relate mainly to the operational sphere of management, but also change the management philosophy towards the Lean Management approach. The study revealed that the following problems experienced by the company before the project were solved:

- Waste of time and inefficiency due to the lack of an effective management process in the storage area in terms of maintaining order, sorting and cargo labeling
- Lack of process measures (KPIs)
- Lack of daily plans in the area of goods preparation, production service and time and quantity of loadings
- Waiting for the arrival of the car without a prior plan to make the cars ready for loading
- Inefficient 16-hour working time of the warehouses
- Lack of information and visualization of work results for warehouse service
- No system for preparing shipments and picking before loading
- Spending too much time on multi-freight transport routes and their handling
- Lack of operational instructions to optimize processes and perform warehouse operations.

BMI Icopal has a loading and unloading monitoring system that has an indirect effect on the correct and swift handling of complaints. However, the lack of a WMS system does not allow for higher work efficiency that would result from the systematic identification of goods from production. This is crucial when managing inventory, its location zones, which in turn improves the handling of possible complaints.

Research revealed that VM was implemented along with the new KPIs and the organizational changes introduced in the work of the warehouses. Displaying additional, relevant data and the graphic design of the VM board was also important for the VM development.

The introduction of the first board with warehouse results and work plans by group produced a very positive effect among all employees. Of course, not everyone was happy with the changes made, thinking along the lines of "*I've been doing things the same way for so long and it's been good, so why change it*?". However, over time and noting visible positive changes in the system of their work, skeptics have also grew to appreciate the new standard. In the interviews conducted among employees none of them stated that VM adversely affected their organization and productivity. Employees approach the boards on their own initiative and check the results and work plans for the coming days on an ongoing basis. Each of them has an up-to-date information on what tasks are to be performed and what the results of their work are, which motivates them even more to work efficiently and safely.

Studies have shown that the management of the VM implementation process is staggered over time and step-by-step. The first step is the assessment of the current status of operations. Next step is to evaluate and clearly define improvement areas and process design, and to determine what and how should be improved. The it is time to define the project plan, milestones and resource allocations. What follows is the development and submission of the business case. Once the business case is approved, the project can be implemented.

Specific challenges and barriers during the implementation of projects refer to the statement that a project looks easy on paper, but proves challenging when implemented, as challenges may arise at every stage. The most common challenge is underestimating timing, lack of resource allocation and/or commitment, or coming with a predefined, standard design. In the case of underestimating the challenges, the project may fail. Very good assessment of challenges, good process design or redesign and commitment from all involved people and stakeholders is a key to success. It is not advisable to commence a project with a preconception of how it should unfold, but to understand the business and the current process. Only then can the project plan be built. The prerequisites for a successful VM implementation are: assessment and audit, cooperation with local teams and the right process design.

Our research shows that the implementation of VM has led to a change in management behavior at BMI Icopal. WMS implementation will bring transparency and clarity to operations and will support changes based on facts and figures and the real-time availability of data. It also has a positive impact on finance, sales or customer service. After some time, the real value of WMS was clearly visible: operations became more efficient and people were content with the WMS rollout. At the same time, the most significant barriers and key success factors for the VM implementation are the correct evaluation of the project, resource allocation and people's commitment. This is also associated with the VM change in the course of digitalization/industry 4.0 initiatives. We see more and more fully automated warehouses, IOT, digitalization, robotics, AI, blockchain. They will fundamentally change the way that we control and manage warehouse operations in the coming years. Our research indicates that we are at the beginning of the change in the area of VM practices.

Limitations of this study incklude that it was a single case study carried out in a particular industrial setting, the construction industry. This limits transferability to ther firms and other industrial settings given industrial particularities. Although the research was carried out in the Polish branch of a global corporation, the level of operations in storage and transport processes is the same as in other branches in the world. Hence our observations do relate to a broader spectrum of similar organizations operating in the construction sector. Our future research will focus on creating a theoretical framework for the efficient implementation of VM in other areas of activity outside the storage and transport area, such as procurement and production. We will also strive to understand the implementation process of 101 lean warehousing. Due to cultural differences in different countries and the increased level of generality of inference, we plan to conduct a cross-country study within the construction sector. Future reseach may involve similar studies on evaluating the economic effects of VM in other cases in the construction industry as well as in in empirical settings in other industires. The approach may aslo be used in service sectors such as health-care and logistics service provison which already to a high degree use VM tools.

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