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**DOCTORAL SCHOOL IN LETTERS, HUMANISTIC AND APPLIED SCIENCES
FIELD : INGINERIE / MANAGEMENT**

**EXCELLENCE IN OPERATIONS BY APPLYING THE
CONCEPT OF PRODUCTION MANAGEMENT IN THE
AUTOMOTIVE INDUSTRY**

SUMMARY

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1. INTRODUCTION

Organizational performance is often measured too little or inefficiently in many cases, and many organizations end up going bankrupt not because of their field of activity or market challenges, but due to an inefficiently applied management system that is not aligned with the factors and resources of an organization operating in the industrial sector. The doctoral research and implicitly the doctoral thesis will contribute to defining a new methodology and a Production Management System through which a production organization can be transformed into a high-performing company through an improvement program.

The various improvement methods already existing in the market and applied in the automotive industry, understanding them as individual methods, their efficiency, and their interaction during implementation, make defining a Production Management System highly challenging. Thus, the 'mix of methods,' the selection, and adaptation of improvement methods for each company must be different and specific.

The doctoral research and implicitly the doctoral thesis will contribute to:

- The practical, unique, and adapted interpretation of methods, including the calculation of benefits and the contribution rate of each element to the efficiency of the Production Management System;
- The definition of a new efficient Production Management System (PMS) model;
- The creation of a production evaluation model based on the proposed Production Management System model, with the possibility of proposing an improvement program.

The research objectives are:

- The study of knowledge regarding existing methods and systems;
- Practical and specific testing of selected improvement methods in the PMS model in the automotive industry;
- Calculation of benefits within the pilot company in the automotive industry for the applied improvement methods;
- Calculation of the contribution rate of each method for the optimization of the proposed PMS model;
- Identification and definition of the relationships between PMS elements.
- The research methodology within the doctoral research includes the following tools and methods:
- Statistical methods applied in the applied research of idea management;

- Data analysis collected in case studies, such as the application of the 5S Method, stratified audits, equipment maintenance, Single Minute Exchange of Die (SMED), the Kanban System, and Idea Management;
- Case study, 14 studies applied within two companies, Hirschmann Automotive TM and Takata Romania;
- 'Before & After,' a comparison method applied especially in the case of improvement ideas and the application of the 5S method;
- Pareto, applied in applied research for practical problem-solving methods and in the case of the 5S Method application;
- Quantitative methods for analyzing the relationship between PMS elements and company performance.

The research structure is represented by 14 methods, analyzed in specific case studies for each one. By practically applying each method and complementing with specific innovative elements, the collection and analysis of data provide a clearer and more in-depth picture of the impact on the company's results.

The practical application of the 5S method is studied through the creation of a 5S workshop and the evaluation of final results. Practical problem-solving methods are highlighted through the practical application of the 7-step method. Stratified audits are applied at different levels within the organization. The application of autonomous maintenance of equipment, an element of Total Productive Maintenance (TPM), is examined. The organizational strategic planning tool is applied in the applied research for defining the company's strategy. The optimization method for product change, 'Single Minute Exchange of Die' (SMED), is applied and monitored for its impact on production performance. The implementation of the Kanban system in the production supply flow with raw materials is studied. The application of the process mapping method is examined in a case study. The implementation of the piece-by-piece production concept is studied through the application of defined implementation steps. The application of standardization in production through the implementation of 10 specific colors for standard documents is analyzed. The idea collection system for improvements is studied using statistical methods. Personnel development is studied through the application of several practical tools.

In each analyzed method, we find various innovative elements introduced by this research study, such as in the case of:

- The 5S method, the interpretation of the level of understanding of the method within an organization,
- Stratified audits, the graphical representation of the necessity for stratified audits,
- Communication, the structure of meetings within the studied organization, and the graphical reporting of performance indicators,
- Personnel development, the concept of personnel development including the six steps, including the element described in the 'Employee Development Pathway',
- Leadership, the creation of the tool applied within the Personal Balanced Scorecard (constituting a management system and a personal strategic planning tool),
- Operational Balanced Scorecard (constituting a management system and a personal strategic planning tool), the tool for developing the company's strategy,
- Idea management, the entire flow of idea management and rewarding,
- The matrix of relationships among the studied methods.

The motivation for choosing this subject comes from my extensive practical experience in applying these methods in various organizations and due to the identification of a 'gap' in the existing literature, especially in how improvement methods influence company results and the necessary preconditions before implementing each method.

2. CURRENT STATE OF KNOWLEDGE

2.1. INTRODUCTION AND THEORETICAL CONCEPTS

Regarding the term "production systems," there is no consensus on a universally accepted definition. According to the Encyclopedia Britannica, a production system is "any method used in industry to create goods and services from various resources" (Encyclopedia Britannica).

A comprehensive definition of the production system is provided by Bösenberg and Metzen (1992) as 'the recognition of the inherent complexity of a production system by relating the term to intellectual, political, and corporate laws, an approach that therefore defines the term production system as a complex system concerning organizational structure with human beings at its center.'

Boyer and Freyssenet suggest and emphasize that the development of the production system is: "a process of making the technical organization, economic practices, and internal systems of firms coherent and viable externally, with the aim of reducing uncertainties related to markets and labor, and capable of revealing general principles applicable to a variety of geographical spaces and ensuring a certain level

of predictability in the evolution of the firm over time, to the point of leading to a series of macroeconomic and social configurations" (Boyer; Freyssenet, 2002).

Skinner (1985) defines in a more tangible way, distinguishing between the components of the production system as "hardware" elements and the organizational elements as "infrastructure."

2.2. ESTABLISHED / CLASSIC METHODS IN THE AUTOMOTIVE INDUSTRY

2.2.1. Toyota Production System

In every major company within the automotive industry, top management defines a production management system. In this chapter, we will analyze the Toyota Production System, the most widely applied system in the automotive industry.

2.2.2. Lean Manufacturing System Ford

The Toyota Production System is fundamentally based on the evolution of the production line concept developed by the renowned production engineer Henry Ford. Ford's production systems trace their roots to the American Armony System, also known as the functional workshop..

2.2.3. Mercedes Benz Production System

The Mercedes Benz Production System (MPS) describes the basic structure of an organization's production and the methods used by the Mercedes Car Group. Standardizing processes, tools, and production equipment ensures the prevention of production issues and guarantees product quality, all while reducing employee efforts.

2.2.4. Value-added Production System BMW

The BMW Production System, known as the Value Production System (VPS), represents BMW's application of Lean principles, methods, and mindset. Qualified Lean employees have the opportunity to participate in training programs within the VPS concept, established in 2012. The goal of this academy in Munich is to develop the skills of managers and Lean experts. Since 2015, training has also been offered to suppliers (Lewin, 2022). To achieve the Kaizen mindset, the VPS center aims not only to achieve qualification objectives but also goals related to continuous improvement, Lean methods, and tools, which will be applied later.

3. LEAN METHODS PRESENT IN PRODUCTION MANAGEMENT SYSTEMS AND USED IN APPLIED RESEARCH

3.1. 5S METHOD

As a tool for improving modern business operations, the Lean method brings advanced management ideas and business processes to companies (Klein, 2020).

Lean Management (LM) was developed based on the Toyota Production System and has become essential not only in the automotive industry but also in various other sectors such as information technology, government, retail, construction, and procurement, among others, due to its numerous benefits (Honarpour, 2017; Veres et al., 2021).

Recently, Lean methodologies linked to approaches of "innovation" and "sustainability" have been developed. It is no coincidence that organizations need to implement solutions to minimize potential risks posed by the industrial, economic, political, and business environment in all its complexity in order to maintain sustainable business operations (Overbee, 2021). Since the external environment cannot be significantly influenced by a company's activities, a flexible internal approach is the solution for managers and entrepreneurs (Willis, 2017).

Sustainability and Lean methods are interdependent elements:

1. On one hand, through Lean actions and solutions, organizational sustainability is ensured.
2. On the other hand, sustainability provides the necessary context for further Lean actions and improvements (Caldera, 2017), establishing a positive relationship between the two concepts.

Recent research has conducted multiple analyses linking Lean Management (LM), Industry 4.0, and the circular economy (Varela, 2019; Nadeem, 2019).

Because Lean is based on the continuous identification and elimination of waste, companies remain efficient and adaptable to external environments over the long term (Nayak, 2022). Manufacturers have seen increases in profitability and customer satisfaction through reduced lead times, improved product quality, and waste elimination (Resetarits, 2012).

3.2. PRACTICAL METHODS FOR PROBLEM SOLVING

In a Lean company, operators are capable of performing multiple tasks within various processes. One fundamental aspect of Lean production is that any operator, in case of issues or deviations, has the authority to stop the production process. This right is crucial for implementing Lean production principles. By integrating quality control into the production system, we aim to minimize defects and eliminate the need for inspectors, creating a natural environment where quality control is intrinsic. The

core concept is to monitor, prevent problems from occurring, and prevent their effects from leaving the workplace (Rawlins, 2008).

3.3. LAYERED PROCESS AUDITS - LPA

Layered Process Audits (LPA) are a technical quality practice focused on observing and validating how a product is manufactured. LPA is a systematic approach to quality management that involves conducting regular audits at various levels of a production or business process (Stamatis, 2021). These audits are necessary to verify that work is being performed according to established standards and to identify opportunities for continuous improvement (AIAG, 2014).

3.4. COMMUNICATION IN ORGANIZATIONS

Groups and teams are the backbone of modern organizations and the driving force behind innovation. Employees come together to pool their efforts, unite their strengths, develop creative ideas, and make decisions in a key social context: the workplace meeting (Meinecke et al., 2020; Danskin, 2014). Meetings can be either in-person or virtual, with the latter becoming increasingly popular post-pandemic. In situations where the number of participants is high or the distance between participants is significant, virtual meetings provide a simple solution, enabling participants to voice their opinions and generate ideas, solutions, and agreements that propel the entire group forward, regardless of size.

3.5. STANDARDIZATION

There are several concepts that intersect with the concept of "standard," as outlined by Jakobs (2019): internal standards, policies, or regulations within an organization, external certifications that verify compliance with specific quality or performance standards, product standardization (especially in lean management) to ensure consistency and efficiency in production processes, and interface standards (technical specifications) that define how different components or systems interact with each other.

3.6. EMPLOYEE DEVELOPMENT

International competition and technological advancement are the elements driving continuous change at an enormous pace. As the speed of transformation accelerates, organizations must be flexible, innovative, and creative, capable of addressing new challenges and reshaping industries (Fitzgerald et al., 2011; O'Toole, 2011).

3.7. “LEADERSHIP”

The role of a leader within a team is crucial and can significantly impact the team's performance and cohesion (Tucker, 2008).

The dynamics of teams and group processes involving people have been extensively studied, often involving high costs. Nowadays, there is much more knowledge about how successful teams can be formed. Brian Tracy (2010) states that "Just as there are recipes for preparing a meal, there is also a specific and functional recipe for forming an autonomous and high-performing work team. By applying this recipe - with ideas and principles, until it becomes automatic, a habit, much better results can be obtained from people than one might imagine."

3.8. OPERATIONAL BALANCED SCORE CARD OBSC

In many current organizations, there is often a mismatch between personal goals and company objectives, requiring managerial approaches to synchronize and align goals from the macro level (mission, vision) of the company down to the individual employee level (Rampersad, 2002). The Total Performance Scorecard (TPS) provides organizations and individuals with a tool to achieve personal and business performance goals (Olve et al., 2000).

3.9. IDEA MANAGEMENT SYSTEM

In today's business context, innovation has evolved into a strategic necessity for all companies. Organizations can gain a significant competitive advantage by creating relevant innovations in products and/or services (Bagherzadeh et al., 2020). Among the various stages of the innovation process, preparing for product development stands out as one of the most challenging tasks (Lower et al., 2014; Kim et al., 2002). But how can organizations efficiently identify the most promising product ideas or improvements? Recognizing the essential role of employees in the improvement and development efforts of a company is crucial (Liker & Franz, 2019). To advance toward corporate objectives, a viable approach involves implementing a systematic process for idea selection (Stevanovic et al., 2016b).

An employee suggestion system represents a valuable path, empowering staff members to actively engage in improving processes and activities within the company. Such participation not only contributes to increasing employee satisfaction and engagement but also has the potential to generate significant financial benefits for both the company and its workforce. A well-designed suggestion system has the ability to reward employees and the organization with substantial financial gains. Moreover, it

fosters high morale and collaboration among employees, regardless of the type of company activity (Stefan, 2018; Koji et al., 2010).

3.10.“ONE PIECE FLOW” METHOD

Lean thinking allows industries to optimize production, engage customers to reduce waste, and stimulate business growth (Lermen et al., 2023; Lakshmanan et al., 2023). The "one piece flow" (OPF) method, also known as single-piece flow or piece-by-piece flow, is an approach in production and process management aimed at eliminating waste and improving efficiency.

3.11.KANBAN SYSTEM

The Just-In-Time (JIT) production management system has gained significant global interest, particularly when Japanese companies achieved success during the 1970s and 1980s (Quesado Pinto et al., 2018). A key operational element in JIT is the Kanban control system, which was initially implemented in many Japanese companies during the 1970s. Subsequently, companies outside Japan also adopted the Kanban system to improve control over material flow in production (Krieg, 2005; Kaynak, 2011).

3.12.PROCESS MAPPING)

Value Stream Mapping (VSM) is a valuable tool that helps a company visually represent and map production, material, and information flows to gain a better understanding of its processes, stages, inputs, and outputs. Essential steps of the process and key figures such as lead time are visualized on a value stream map, which encourages understanding of the current process as it is and provides a communication environment (Réquillard, 2020b). VSM is a Lean method for analyzing the transformation flow, aiding in identifying issues and optimizing the entire production flow. This contributes to increasing added value. VSM is not something applied sporadically; it becomes a natural part of a company where there is a culture of continuous improvement (Martin et al., 2014).

3.13.SINGLE MINUTE EXCHANGE OF DIE (SMED

SMED, or Single-Minute Exchange of Die, refers to a theory and technique aimed at reducing the time required to change a die or product within a maximum interval of 10 minutes.

The SMED method was introduced by Mr. Shingo in the 1950s in Japan. The concept and method became available to other companies and countries starting from 1974 in West Germany and Switzerland, and from 1976 onwards in the rest of Europe and America (Bendre, 2015; Shingo, 2018). The changeover time can be defined as the time required to switch tools from producing one product to another, or as the time required to change from one set of dies to another set (Poiger, 2022).

3.14.TOTAL PRODUCTIVE MAINTENANCE TPM

Maintenance encompasses all technical and organizational activities aimed at maintaining or restoring technical equipment to a state where it can perform its specific function (Ionut, Vasile, 2003).

Maintenance activities are typically categorized into two types: Preventive (planned) maintenance and corrective (unplanned) maintenance. In recurring cases, maintenance is often confused with equipment maintenance. Maintenance involves only two types of actions: repairs and troubleshooting of defects. Modern maintenance includes elements such as defect tracking and statistical analysis, diagnostics, quality assurance, and computerization (Shirose, 1992).

PERSONAL CONTRIBUTION

4. RESEARCH METHODOLOGY

The current doctoral research aims to design an efficient production management system by selecting effective management and improvement methods tailored for the automotive industry.

The proposed Production Management System (PMS) model is a novel integrated concept built upon over 18 years of professional experience in the automotive industry, including 5 years as director and administrator of one of Romania's largest automotive firms. The proposed concept comprises seven elements: KPI's tree, Problem-solving methods, Line Management, Layered Process Audit (LPA), 5S Method, Communication: escalation procedure, and Communication: Meeting structure.

The goal of this doctoral research is to determine the necessary and essential elements of PMS through the implementation, testing, and application of the proposed model, followed by measuring its effects on the organization. Calculating the benefits for each component of this innovative system demonstrates its level and degree of influence on organizational outcomes.

4.1. The objectives of the doctoral research are:

1. Investigating the specialized literature related to existing methods and systems for which published results already exist, in order to identify the "gap" in the literature, specific to the automotive industry.
2. Designing a proprietary SMP model for testing based on findings from the specialized literature.
3. Practical and specific testing of selected improvement methods within the proposed SMP model for the automotive industry.
4. Calculating the benefits for pilot companies in the automotive industry from the applied improvement methods.
5. Calculating the weighting contribution of each method to the efficiency of the proposed SMP model.
6. Identifying and defining the relationships between elements of the proposed SMP model.
7. Formulating conclusions and recommendations based on the results observed in the applied research in the automotive industry.

4.2. Research Hypotheses

The general hypotheses of the applied research within the 14 case studies are as follows:

Efficient management of elements such as labor, machinery / production equipment, materials, work method, and work environment through the application of management and improvement methods will determine the performance of operational processes.

The effectiveness of implementing Lean management tools / methods is determined by the sequence of their implementation, with each tool having different prerequisites regarding the existence of other tools within the organization.

Each case study is accompanied by specific hypotheses for each applied method, which are mentioned within each subchapter.

4.3. Data and variables used in research

The data and variables used in this research will be tailored to the specific objectives and methodology of the study, and examples may include the following:

- Employee demographic data: This includes information such as age, industry experience, educational level, job roles, etc. These details help understand workforce characteristics and assess the impact of various management methods on different employee groups.
- Operational performance metrics: Data on operational performance are crucial for evaluating the effectiveness and efficiency of production processes. This may encompass metrics like productivity, equipment uptime, downtime, production defects, etc.
- Employee feedback: Gathering employee feedback on the implementation of different management methods provides valuable insights into their perceptions and experiences. This feedback could include satisfaction levels, improvement suggestions, change resistance, etc.
- Financial data: Financial data plays a critical role in assessing the impact of implementing various management strategies and methodologies. This could involve production costs, profitability, revenues, expenses associated with implementing and operating new systems and processes, etc.

These types of data will be collected or generated during the study to address research questions and achieve desired outcomes.

Variables represent the characteristics, traits, or factors that can be measured, observed, or manipulated in a study to investigate relationships, effects, or desired phenomena. They are essential in formulating hypotheses, designing the study, collecting, and analyzing data. Here are some important aspects about variables in research:

- Methodology implementation variables: These may include variables related to the implementation of methodologies such as 5S, Kanban, TPM, etc. Examples include adoption level, compliance with standards, impact on operational efficiency, etc.
- Operational performance variables: These include variables that measure the operational performance of the company before and after implementing various management methods. For instance, productivity, downtime, production costs, etc.
- Employee feedback variables: These can encompass variables that assess employee satisfaction levels, engagement in continuous improvement processes, resistance to change, etc.
- Financial variables: These may include financial variables that evaluate the impact of implementing different management methods on production costs, revenues, profitability, etc.

These data and variables will be collected and appropriately analyzed in the research to draw conclusions and provide recommendations in line with the established objectives.

4.4. Methods applied

In the context of the doctoral research, the following tools and methods were employed:

- Statistical methods were used for data analysis in the applied research on idea management, including descriptive statistics, Pearson correlation coefficients, inferential statistical testing, one-way ANOVA, Kruskal-Wallis independent samples test, and multiple linear regression using the Enter method with collinearity diagnostics.
- Data analysis was conducted using data collected from organizations in the case studies, focusing on the application of the 5S Method, Layered Process Audits, Equipment Maintenance, Single Minute Exchange of Die (SMED), Kanban System, and Idea Management.
- Case study methodology was applied, with 14 case studies developed within two companies, Hirschmann Automotive TM and Joyson Safety Systems.
- The "Before & After" method was used for comparative analysis, particularly for improvement ideas and the implementation of the 5S Method.
- The Pareto method was applied in applied research for practical problem-solving methods and in the application of the 5S Method.
- Quantitative methods were employed to analyze the relationship between SMP elements and company performance.

5. APPLIED RESEARCH IN THE AUTOMOTIVE INDUSTRY

5.1. 5S METHOD

The purpose of this research is to describe the stages of implementing the 5S methodology, highlighting the real impact that Lean tools can have on an automotive company and the method for economically measuring these impacts.

5.2. Practical Problem-Solving Methods: Implementation and Results in the Automotive Industry

Quality is strictly regulated in any industry, but extra attention is paid to the automotive field. Thus, quality control is necessary to keep costs down, to identify problems before a part or product is shipped.

In this applied research we present the application in the automotive industry of the combined approach of both quality circles and the 7-step methodology to reduce the number of defects and improve quality, emphasizing the importance of establishing the quality circle in production plants and the effects implementation. A systemic perspective and appropriate involvement support the company's continuous improvement efforts.

5.3. LAYERED PROCESS AUDITS – LPA

Any modification, change or improvement, most of the time, is transposed in an organization by changing written rules, work instructions, procedures, methods or work standards, meaning that in a proportion of over 90%, the improvements made in an organization are sustainable and lasting, only if the employee respects the new work procedures systematically.

5.4. COMMUNICATION TOOL FROM SMPSMP

In order to carry out activities in a standard and efficient way in a large and/or very large organization, it is necessary for information to circulate in a fast, clear and accurate way, so that any deviation, problem or stoppage of activity be taken over by the responsible employees, depending on the degree of complexity and the type of problem, so that the problem is solved efficiently and as quickly as possible.

5.5. Standardization as a method in SMP for the automotive industry.

In companies, the application of standardization brings a major impact, consisting in the direct contribution to business results (Nils, 2002). Standardization reduces product and service costs

(Münstermann, 2014). Meeting or not meeting standards can make the difference between success and failure within the company (Vries, 2013). The application of standardization includes the following goals: reducing the increased variety of products, making communication more efficient, contributing to the safety and security of employees, protecting consumers and reducing environmental impact.

5.6. PEOPLE DEVELOPMENT

The People Development Concept (PDC) has a systematic and permanent approach that successfully assesses, defines, monitors and develops the level of competence within the entire organization. This case study presents the application in the automotive industry, of the concept of employee development, in a proprietary approach adapted to the company's needs. A systemic perspective and appropriate involvement support the company's continuous improvement efforts. Own approach to the concept of employee development, presenting in parallel, the evolution of implementation in a company in the field of the automotive industry.

It was observed that, by defining the "People Development Path", i.e. by designing the package of trainings that must be received as a basis, specific for each individual position throughout the evolution, of the career, the employee has the perspective of the trainings that he will receive receive in the future. This program also ensures delivery of specific core training package to all employees. Otherwise, in many other companies, development programs can be identified that focus only on the lacks of employees, on filling an existing gap, and not on consolidating already existing knowledge or perfecting skills. This concept of "People Development Path" is like a recipe for success specific to each position in the organization, containing the training package necessary to achieve the best results.

5.7. “ LEADERSHIP” THE TOOL FOR SMP IN THE AUTO INDUSTRY

The concept of leadership is necessary to support any business development initiative or drive any organization to successful achievements, ensuring employee commitment and involvement.

This applied research presents a case study from the automotive industry, applying the concept of leadership, through an own approach, adapted and according to the needs of the company. A systemic perspective and appropriate involvement support the company's continuous improvement efforts. The applied research aims to apply the tools from the leadership concept made by the PhD student (own conception).

5.8. Operational balanced score card

We often encounter within organizations the existence of a mismatch between individual objectives and company objectives, requiring a synchronization through a managerial method that harmonizes and transposes the objectives from the macro level (mission, vision) of the company to the objective level of each individual/ employee (Rampersad, 2005).

5.9. The economic effects of the idea management system in the automotive industry

In the dynamic landscape of the automotive industry, innovation is the key driver of success. For companies that actively engage in idea generation and have effective ideas, existing management systems often gain a competitive advantage. This applied research explores the importance and necessity of idea generation in the context of the Romanian automotive industry, shedding light on the economic effects it can have. Based on a review of the scientific literature, the papers add value by filling a gap in the process of continuous improvement and idea management, by describing in detail how the idea management system can be introduced, and by performing a quantitative analysis, using complex statistical methods and machine learning on big data collected to observe the effects of idea management. Using the system on the results and level of employee engagement and finding a predictor of potential savings for the car company. Very few academic works consider the economic effect of the Idea Management System, especially for company performance (KPI), focusing rather on metric performance for idea management.

5.10. One pieces flow

The main objectives pursued in the applied research were:

- increasing the productivity of direct personnel, i.e. decreasing variable costs;
- optimizing the production space, freeing up space for new projects, thus increasing the number of production hours.

The research methodology demonstrates the relevance of OPF flow and layout optimization in an automotive company. It provides a practical perspective from an organizational point of view, applying practically the different theoretical formula of the OPF balancing calculation. There is always a concern about improving or reducing overall production costs. Therefore, the present research highlights the relevance of production flow, interphase inventory level, time, production line structure, production cell balancing and resource management. The research demonstrates a new concept for implementing One Pieces Flow, the steps needed to have a successful production line optimization. Major findings relate

to reducing costs, reducing work in progress, improving quality, the benefits of teamwork and freeing up space so that the company has room for additional projects.

5.11.KANBAN SYSTEM

The advantage of the Kanban system over other inventory management systems is its simplicity and ease of use. This applied research presents a case study from the automotive industry, of the implementation of the Kanban System, through a proprietary approach adapted to the needs of the company. A systemic perspective and appropriate involvement support the company's continuous improvement efforts.

The purpose of this research is to define the way, the concept of the implementation of the Kanban system, based on the regulation of the calculation method for the sizing of the system in an organization in the automotive industry. This will be done by observing the effects on the results and observing how the concept is applied.

5.12.Process mapping

Process mapping is a key methodology to successfully analyze and understand any process in an organization by creating a visual representation of the workflow with the aim of streamlining processes, optimizing resource utilization and reducing waste. Due to its proven effects, Process Mapping is widely used in the automotive field and is recommended to be applied in any other industry.

5.13.Single minute exchange of die - SMED

The concept of SMED emerged in the late 1950s and early 1960s, being developed by Shiego Shingo together with Mazda, Mitsubishi and Toyota. The need to implement a fast and efficient changeover method came from the analysis of the injection/pressing process of automotive components, the critical point in this regard being the long changeover of molds, which generates large batches in production.

GENERAL CONCLUSIONS

Efficiency in operational management represents a high interest among production companies, due to increasingly high competitiveness in the private sector.

The elements of novelty and own contribution within the applied doctoral research consists in the application of a number of 14 methods, directly within the production plants of the automotive industry, the way of relating the methods, observing and measuring the effects on the performance results obtained by the organizations being another contribution of this doctoral thesis.

The 14 methods studied and applied in real conditions during the research were allocated in a conceptual structure of their own that concludes and synthesizes the results of the 14 case studies, concept presented in figure 1.

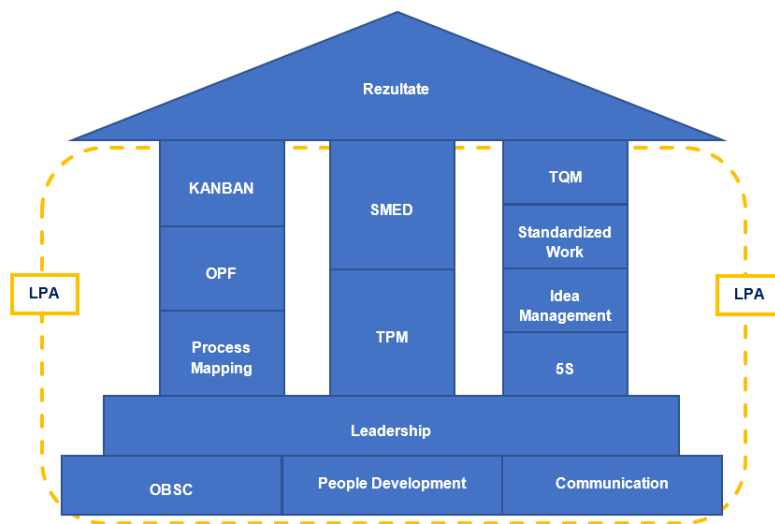


Figure 1: Operational management system, presentation of the management methods of the 5 elements (source: author's own conception).

One of the most valuable resources within a company is the "human resource", due to this fact the methods that ensure the development, involvement and collaboration between employees have been assigned to the basis of the system, being the foundation of the entire SMC, for example: OBSC, Personnel Development and Communication .

The creation of the relationship matrix was designed based on the conclusions obtained following the observation of the implementation, the results of the case studies carried out in this doctoral research, concept presented in figure 2.

Matrice Implementare a metodelor. Prezența altor metode în faza de implementare ca și precondiții	OBSC	Dezvoltarea Personalului	Comunicarea	Leadership	KANBAN	OPF	Maparea procesului	SMED	TPM	TQM	Standardizarea	Managementul ideilor	5S	LPA	Numar de preconditii pentru implementare
OBSC		x	x	x											3
Dezvoltarea Personalului			x	x							x				3
Comunicarea	x	x		x											3
Leadership	x	x	x									x			4
KANBAN	x	x	x	x			x				x		x	x	8
OPF		x	x	x	x		x	x	x		x	x	x	x	11
Maparea procesului			x	x							x				3
SMED		x	x	x			x				x		x	x	7
TPM		x	x	x							x	x	x	x	7
TQM		x	x	x							x	x	x	x	7
Standardizarea		x	x	x									x	x	5
Managementul ideilor		x	x	x							x			x	5
5S		x	x	x							x	x		x	6
LPA		x	x	x							x				4
Cele mai solicitate ca si preconditie	3	12	13	13	1	0	3	1	1	0	10	5	6	8	

Figure 2: Relationship matrix

(source: author's own conception)

We can thus conclude, after creating the matrix, that we have a different degree of demand on the methods as a precondition, thus we find among the most requested methods as a precondition: leadership, communication, staff development but also the least requested methods respectively: Kanban, One Piece Flow, TQM (Total Quality Management).

ORIGINALITY OF THE THESIS / PERSONAL CONTRIBUTIONS

The doctoral research is relevant and innovative in the field of engineering and management, because it is the first study with this complex approach, with the aim of identifying the methods necessary for an effective operational management system, also completed by identifying the relationship between these methods and by highlighting the preconditions and/or prioritization in implementation.

Future research directions

Since the doctoral research referred to the identification and definition of suitable resource management methods within manufacturing companies to ensure an effective operational management system, it can be extended and improved through post-doctoral research / research programs, with objectives related to:

- Identifying the financial impact as a share of the total cost reductions and efficiency;
- Realization of a "scanning" tool of the organization, by evaluating the methods applied in the operational management system and how to calculate the potential for improvement through the implementation of the operational management system;
- Development of new improvement methods necessary for the operational management system;
- Applied research of alternative methods for efficient management of available resources in production companies;
- Experimental study on the application of the operational management system in other industries, other than that of motor vehicle construction.

Limits of research

- We could not use company KPIs in all studies to show the impact of the methods on overall company results due to data confidentiality.
- Another limitation is related to the presentation of data on a three-four year basis; thus, the analysis focused on the medium-term impact. A long-term analysis and follow-up would significantly enrich the value of my research.
- The studies are based on data from two companies, which may limit the generalizability of its findings to other industries or organizations with different contexts and culture.

During my doctoral research, I had the privilege of contributing to the advancement of knowledge in my field of expertise by publishing a total of nine scientific articles. Of these, I had the honor of being first author on seven articles. These publications are the result of my intense research efforts, dedication and collaboration with academic colleagues and mentors. Each article reflects not only my individual work, but also my passion and commitment to the development and advancement of my field of study:

- 1 ISI article with Fi:1, yellow background - Journal of Knowledge Economy,
- 1 ESCI article with Fi - Acta Technica Napocensis,
- 2 ISI conference - INTER-ENG 2021,
- 2 BDI articles – AMSET, NEJM 2023,
- 2 Springer chapter – INTER-ENG conference 2023,

- 1 national conference - Challenges of the Knowledge Society 2021.1 conferință națională - Challenges of the Knowledge Society 2021.

BIBLIOGRAPHY

The bibliography is an essential part of the work, reflecting the breadth and depth of the research. The bibliography includes 451 sources/books, suggesting meticulous research and in-depth study of the subject. Here are some important aspects related to the studied bibliography:

We have consulted a wide range of sources, including theoretical works, case studies, scientific articles and reference works, to ensure a comprehensive understanding of the subject;

We ensured knowledge of the latest discoveries and theories in the field including recent sources, alongside the classic works;

The study includes recognized and cited works in the field of study, published by respected authors and publishing houses;

The studied bibliography demonstrates that the thesis is based on a solid theoretical foundation and a critical analysis of the existing literature.