

**HOW TO BECOME A WORLD CLASS MANUFACTURING PLANT:
OPERATIONAL EFFICIENCY, EMPLOYEE PRODUCTIVITY AND STRONG
ORGANIZATIONAL CULTURE IN A COMPETITIVE ENVIRONMENT**

PhD Thesis – Summary

to obtain the scientific title Doctor of Philosophy (Ph.D.) at the
Politehnica University Timișoara
in the PhD field of Engineering and Management

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month 09 year 2017

Chapter 1 presents a short overview of the automotive industry on several levels in order to provide a complete setting upon the issues and importance of the companies which are part of this complex and very competitive supply chain.

The chapter provides relevant data about production, sales and the main worldwide car manufacturers from the automotive industry, as well as the dynamics of the industry in recent years, along with the most important challenges faced by the carmakers in today's interconnected environment.

This data is then continued with the most important features of the automotive industry from Romania, where the importance of the automotive business is underlined through data from the macroeconomic environment (GDP, exports and number of associated jobs in the economy) as well as the extent of the national supply chain which is driven by the main carmakers which have manufacturing plants in the country, Dacia in Mioveni and Ford in Craiova.

The chapter also includes a well-focused overview upon the country's western region concentration of important automotive suppliers (Continental Automotive, Johnson Controls, Delphi, Valeo or TRW being within the top 10 worldwide automotive suppliers) and the main competitive advantages and assets of this part of the country for attracting foreign investments in the automotive industry: best-cost country, geographical position, high quality infrastructure, technological center, highly qualified and skilled employees, high concentration of universities in the region and very good motivation from the workforce towards performing well at their jobs.

The last part of the chapter underlines the importance of the support for the automotive industry provided by road infrastructure improvement and motorway network enlargement for enabling a sustainable long-term development in Romania in view of the concentration of the competition from neighboring countries: Czech Republic, Slovakia, Poland and Hungary and also provides some data upon the growth dynamics of the automotive industry within recent years and its development perspectives.

Chapter 2 presents some of the most important performance assets in automotive industry, as well as their strategic and operational implications.

The first subchapter highlights the importance of competitive advantage, which can be attained by the companies either through best cost or differentiation advantages in order to gain an important position on the automotive market.

In order to be able to reach such a position the company has to understand the importance of the value chain and its main features. The value chain is basically a set of interlinked activities which are composed of primary functions as are logistics, production and

marketing which are supported by auxiliary features in order to provide value to the customer. To be able to do this, the company must design processes and activities which mainly add value to its products and services and have a very good perceived value by the customers for which they are willing to pay.

The value chain approach for assessing competitive advantage and customer value is then highlighted, showing the necessary steps that should be taken in order to obtain highly effective processes and efficient results within the manufacturing activity of the plant. These steps include internal cost analysis, internal differentiation analysis, vertical linkage analysis as well as organizational and managerial challenges of the value chain analysis. The value chain analysis approach requires proper strategic thinking, deep understanding of all processes and interlinked activities, as well as constant awareness in order to be able to continuously adapt to an improved workplace structure while maintaining the process flow and having high operational performance supported by the associated performance indicators (KPIs).

The following subchapter presents the different organizational structures that companies can employ in order to help support their management of all the processes and activities, their main features and characteristics, advantages and disadvantages as well as the situations where they would be best suited for in order to provide maximum outputs and high efficiency.

The last subchapter features the importance of layout effectiveness and value chain improvement strategy. The first part of this subchapter presents the gains obtained through layout effectiveness during a 3-year timespan at a manufacturing plant in the western region of Romania by improving productivity and work efficiency in a documented manner, by showing the steps and transformations done to several of the plant's most important production, logistics and other dedicated areas and their respective constraints and desired characteristics. The follow-up of the plant's operational performance is ensured by employing visual management, which helps to monitor performance, by assessing the most important and relevant KPIs and the planned and effective output levels. Results have also been obtained at others levels as well, as is the case with operational efficiency: reducing waste, adding value and improving effectiveness has been done throughout almost all of the plant's significant areas in order to achieve the best possible performance and have provided important time and cost savings.

Chapter 3 emphasizes the current challenges and assets in automotive industry production that car manufacturers are facing and are trying to adapt to in order to gain a more competitive position on the globalized car market.

Automotive industry production's main goal is to provide best quality products at the best possible cost in order to enhance market share and volumes and be able to continue development and improve profitability indicators in the long-term. The extent to which this goal is achieved affects the pricing strategy and is the main driver of all managerial and organizational efforts within the manufacturing plant, where machine and labor flexibility issues have to be solved as well as modification, mix and new product flexibility schedules integrated within the operational scheduling of the manufacturing facility.

The issues and challenges thus associated with agile manufacturing in automotive industry production are presented in the next subchapter, where alternative assembly layout configurations are discussed as well as an emphasis upon the continuous improvement process within the lean management philosophy through the most important principles: Just in Time (JIT), Total Quality Management (TQM), Total Preventive Maintenance (TPM) and Human Resource Management (HRM).

The efforts to attain agile manufacturing within a production plant are mainly due to the importance of customer focus and a value-oriented approach from the manufacturers

which is being supported by using the proper tools, such as value stream mapping (VSM) in order to source the most effective processes and to try to improve productivity and the added value ratio within all the processes in the plant.

The next subchapter deals with the changes and challenges in automotive industry today, which are every-day issues and which shape the competitive nature and the development of the industry throughout recent years. The main challenges refer to cost pressures, shorter product life cycles, the increased use of electronic equipment which has also prompted many consumer electronics companies to enter the automotive market and have added to the complexity of the supply chain as well as to the range of electronic and software products available on modern cars.

Production flow principles and systems in automotive industry have to thus meet the needs of the company and the global challenges as well therefore there is a big emphasis upon productivity and efficiency. The subchapter dedicated to this topic discusses the main tools used by the plant to achieve its results: the concept of flow, no inventory in the line, clear visualization of all the process deviations, improving material flow and plant layout and no buffers or bottlenecks, all principles applied simultaneously having a big contribution to rendering the plant highly effective and supporting it to achieve best results.

The Six Sigma principle and its utility is also discussed in the following subchapter, where the DMAIC concept (an acronym for Define, Measure, Analyze, Improve, Control) is explained as part of the quality process in order to improve existing processes, to stabilize certain processes and their designs within the plant. For creating new product or process designs the DMADV (an acronym for Define, Measure, Analyze, Design, Verify) project methodology is employed as part of the same quality procedure.

The challenges of cultural differences and features of the Romanian work culture are equally important to understand when working within a specific environment, because by properly understanding the characteristics of the workforce, through the right techniques the potential to achieve best results can be highly increased in order to motivate, empower and inspire the people to do their best and bring results to the plant's operational performance, which is at the base of creating added value, providing high customer value and enables the company to gain a very strong competitive position on the automotive market.

Chapter 4 presents a consistent part of the main challenges related to managing production in automotive industry, as well as many practical issues related to operational effectiveness.

The first subchapter of this section provides a more overall view of the industry and its complexity which is mainly due to globalization and its associated opportunities, every-day challenges, issues and constraints.

The increasing competitiveness in the automotive industry in which not only car manufacturers are involved, has also been extended to their suppliers' network, meaning the working in the industry is becoming more and more demanding in terms of quality, cost control and meeting deadlines. The required level of motivation and mindset alignment in organizational culture is thus utterly important for a plant to deliver high performance and achieve its objectives by providing high customer value. This part shows the principles on which this level of motivation and mindset alignment is based and how they apply in real examples at different plants in automotive industry with the associated obtained results.

Logistics and supply chain integration is one of the fundamentals for a successful collaboration in the automotive industry and has to also bear the constant pressure in cost reduction for this part of the manufacturing process and plays an important role for its degree of effectiveness.

The harsh challenges associated with building a reputation of best quality over time are also described in the next subchapter, where the importance of working together as a team

is emphasized by the need to create added value, which can only be done by properly combining the skills and assets of people, processes and practice. Plant effectiveness helps the facility to develop added value and bring value to its customers by focusing on process flow by skilled people, with experience and motivation which support the delivery of high productivity rates and competitive advantage for the manufacturing plant.

Another important success factor for manufacturing plants is outlined in the next subchapter, as improving effectiveness can only be done through proper synchronization of all processes and activities within the manufacturing facility. The subchapter explains why is it important to pass from partial to global optimization and achieve a high rate of performance for inputs, outputs and most important, for the linkages of a production system.

The next subchapter presents the results of the improvement process for automotive electronic production in a best-cost country production plant, along with some automotive industry competitive characteristics and production plant challenges, how the WCM principle was applied in an approach to achieve effective organization within a best-cost country production plant and how the implementation of the correct organization principles brought very impressive results within a best-cost country production plant from western Romania.

The last part of this chapter is dedicated to explaining the world class concept for a manufacturing plant which is mainly focused upon operational performance, productivity and its adding value capability. This part highlights the importance of designing an effective workplace with a clear focus on operational performance and reliability, outlines how workplace effectiveness is the result of employee productivity and a performance-based mindset and why when implementing the world class concept best results are only possible with the total implication and hard work of the best people.

Chapter 5 presents how measuring the degree of value added activities within a company is a means for continuous improvement towards world class manufacturing (WCM).

This chapter outlines some very important aspects that are very important and relevant within any production facility, as are standard times and their key role in a manufacturing plant. The desired average values are best approximated and simulated by using some mathematical tools as are the linear interpolation method, which are then refined through Rolle's theorem, cosine interpolation and polynomial interpolation in order to provide more accurate qualitative and quantitative results for these calculations.

The following section is dedicated to the added value productive time and the associated operational indicators, where the Added Value Productive Time of an operator's work time (AVPT), of a machine's work time (MAVPT) and their deviation from target levels are analyzed and compared within 10 randomly selected processes from the plant's operational processes and machine indicators. Results are then expressed graphically for better understanding of the values and their differences and they are further refined by using the Euler method for a more fine and accurate representation.

Providing a tool for the comparison of the performance level of manufacturing plants is then one of the most important parts of the thesis as the logistic function is a source for the effectiveness improvement chart proposed by the author in this section. The mathematical graph and dynamics interpretation of the logistic function are then completed by the sigmoid function and the associated mathematical relations, a variation of the growth rate through the Gompertz curve which source the effectiveness improvement chart (EIC) as a measuring tool of the performance state of the company, its progress and dynamics and its potential to grow further in the future.

The last part of the chapter is dedicated to formalizing the effectiveness of the systems thinking process and emphasizing the Macro approach, to achieve world class manufacturing competitiveness, and the Micro approach, to source organizational culture and operational effectiveness, as they commonly support the plant's global approach to become a world class

manufacturing plant.

Chapter 6 presents the personal contributions of the author within the thesis:

1. making a synthesis on the key events that have shaped the automotive industry throughout recent years both worldwide as well as in Romania, with relevant data from the key industry players and highlighting the automotive industry's contribution and importance within the economy
2. conducting a comparative analysis upon the competitive nature of the automotive industry sector in the western region of Romania, with the main suppliers working within the automotive supply chain and the main competitive advantages of the region which attract these companies to build and extend their plants in this part of the country
3. summarizing the main figures of the Romanian automotive industry as well as those from neighboring Central and Eastern European countries (CEE) in order to outline the growth evolution, development perspectives and high competitive nature of the Romanian automotive industry (Chapter 1)
4. presenting a synthesis with the main features and characteristics of the value chain and competitive advantage, along with some examples from the automotive industry in order to outline the importance of these concepts in understanding how to provide high customer value and being successful as a manufacturing plant
5. compiling an outline with the differences of the organizational structures that companies can employ in order to help support their management of all the processes and activities, their main characteristics, as well as the situations where they would be best suited for in order to provide maximum outputs and high efficiency rates
6. conducting an extensive case study upon the layout effectiveness of a plant by improving its productivity and work efficiency and showing the steps and transformations done to several of the plant's most important areas (production, logistics, other dedicated areas) and their associated constraints and desired functional characteristics
7. presenting the benefits of visual management within a manufacturing plant: monitoring performance, assessing planned and achieved output levels, analyzing other relevant KPIs and its influence upon operational efficiency: reducing waste, adding value and improving effectiveness, as means to achieve the best possible performance
8. summarizing the main changes and improvements in operational efficiency: production line and process changes, operational changes in the workplace, improving layout and space utilization, ergonomic changes, common space and logistics improvements, employee careers and development perspectives, as important means for increased productivity and plant performance (Chapter 2)
9. outlining the main issues within an automotive industry plant: high quality, low costs, meeting strict deadlines, the challenges of flexible and agile manufacturing, providing customer value, as well as renowned management techniques from the industry, presented with references from relevant research literature
10. presenting some of the most toughest challenges an automotive supplier is facing in its every-day activity and long-term planning strategy, with its practical implications as well as with relevant research literature references
11. explaining the effectiveness of simplification within the production process and its benefits by applying some innovative techniques in a specific manner to improve production flow and how these concepts can source important results to the manufacturing plant

12. providing an overview upon the complexity and the linkages between brand ownership in automotive industry as well as a short synthesis upon the main collaborations and evolution within the industry in last couple of years
13. elaborating an innovative approach to explain the challenges of cultural differences and features of the Romanian work culture, the characteristics of the workforce from the western region and how to use the right techniques to achieve best results in operational performance and enable the plant to gain a very strong competitive position on the automotive market (Chapter 3)
14. presenting a synthesis of production management issues in automotive industry and how globalization, motivation and mindset in organizational culture, logistics and supply chain integration affect operational effectiveness and plant performance
15. summarizing the most important features of an effective synchronization process and how to successfully pass from partial to global optimization to increase performance and results
16. conducting a case study upon a production plant and applying the world class manufacturing (WCM) principle in adapted manner and aligned with the company's organizational culture principles in order to improve overall performance
17. designing an approach for an effective workplace with a clear focus upon improving and maximizing its operational performance and reliability on short-, medium- and long-term
18. emphasizing and highlighting the most important elements that drive employee productivity and a performance-based mindset in order to build the best possible team that will provide the best possible results for the plant and source high customer value (Chapter 4)
19. compiling an outline of the most relevant aspects that provide the standard times within any production facility and the mathematical tools used to improve approximation and refine accuracy of the obtained results
20. elaborating the factor of added value improvement (FAVI) formula as a result of a case study upon the added value productive time of the operators' and machines' work time and their deviation from target levels within randomly selected processes from the plant's operational processes
21. designing the effectiveness improvement chart (EIC) as a performance measuring tool of the plant, its progress and dynamics and its potential to grow further in the future
22. developing a global approach to become a world class manufacturing plant by formalizing the effectiveness of the systems thinking process through world class manufacturing competitiveness principles (the Macro approach) and organizational culture and operational effectiveness concepts (the Micro approach) and combining their features for an integrated outlook (Chapter 5)

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