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## LOGISTIC AND SUPPLY CHAIN IN PLANNING AND MANUFACTURING

**Abstract:** In this paper, importance of logistic and TPS methods in manufacturing are considered. Proposed method is based on sample of car factory in Kragujevac. Sample given is appropriate for further improvement after detailed analyses.

**Keywords:** Toyota Production System, Supply Chain, Computerized Systems

### 1. INTRODUCTION

Throughout its history, the word logistics has had various stages of development and understanding. Even in times of old Byzantium, the term logistics began to be used as one of the important factors in warfare win big winner [1].

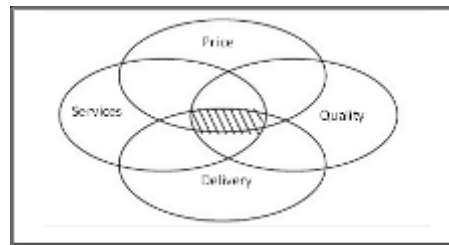
Logistics of a company is a function of business management, which aims to already traditional values such as the type of product, quality, price etc., add new values, the most important feature highlights the availability of the required goods at the place and moment in which is manifested needs of consumers for these goods.

Business goal of logistics:

- **efficiency:** meeting the needs of the client for the required goods at a particular place at a particular time,
- **effectiveness:** the satisfaction of customer needs for the required goods with minimal total cost of needs realization.

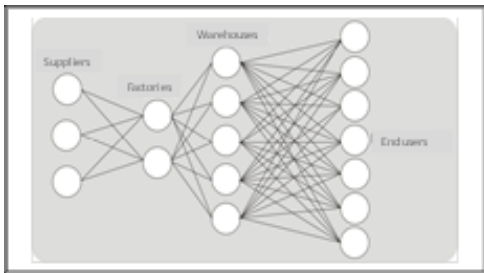
In the early decades of the auto industry, automotive manufacturers produced all required parts and components mainly in their own factories. Today, in terms of specialization, that program is left

to other manufacturers. They are classified as: manufacturers of materials and components, sub-assembly manufacturers, system manufacturers, system integrators and finalists. Supply chain, therefore, has 5 levels. Each manufacturer tends to depend only on one (low) level of the supplier, where the supplier selection are classified according to several parameters (Figure 1). The world's leading suppliers of today are so advanced that they have acquired the status of OEM (Original Equipment Manufacturer).



**Figure 1 – Evaluation and assessment of suppliers**

Continuous improvements in many companies allows ability to design, manufacturing and marketing worldwide. Moreover, new products must be delivered quickly and efficiently [2] to new markets (Figure 2).



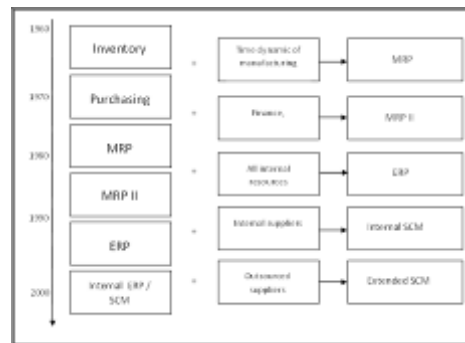
**Figure 2 – Logistic system: planning, implementation and control of material flow**

Therefore, the importance of internal and external logistics have a major impact on the development of new products and the emphasis on planning factory rightly placed on these parameters. Illustrated example in these situations are present factories operating in the automotive industry, where just logistics and its planning is an important factor in the organization and future reorganization of business processes. Best practices for now to the world has shown the Toyota Production System (TPS) with its "push-pull" method and standardization of business processes.

## 2. COMPUTERIZED SYSTEMS

With activities of the supply chain was managed through paper-based transactions, which can be very inefficient. The first software programs were supported by the short segments of the supply chain [3, 4]. Typical examples are systems for inventory management, scheduling and billing. The objectives were cost reduction, fast processing and errors reduce. It is clear that some activities in the supply chain are interdependent. Production planning is associated with inventory management and purchasing plans. More sixties was invented model of planning material requirements. This model integrates production, purchasing and inventory

management of interrelated products (Figure 3). Although the MRP packages have been helpful in many cases, helping to reduce inventory levels and streamline parts of the supply chain, they have also the same number of cases where failed. One reason for this failure is the knowledge that the operations and inventory planning related to financial resources and manpower. This finding has led to enhanced MRP methodology called resource planning production (MRPII), which enters the MRP needs of the workforce and financial planning. Then came the increasing integration of functional information systems. This development continued, leading to the concept of Enterprise Resource Planning (ERP), which integrates transaction processing activities of all functional parts of the whole enterprise. ERP was later extended to annexed external suppliers and customers in the extended ERP / SCM software (Enterprise Resource Planning / Supply Chain Management) [5].

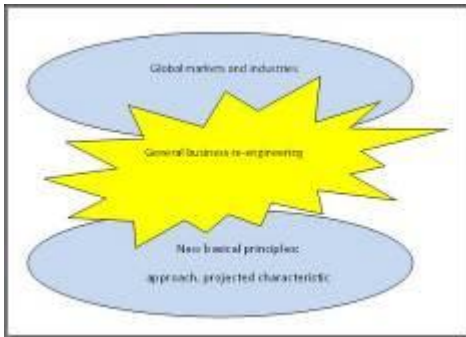


**Figure 3 – Evolution of integrated systems**

## 3. LOGISTICAL ORIENTED APPROACH IN FACTORY PLANNING AND PRODUCTION SYSTEM IN AUTOMOTIVE INDUSTRY

As result of total globalization of market and industry, as well as constant turbulence of market, SMEs are forced to

constantly analyze structures inside factory and adapt them fastly in order to adapt into situation of market when it is needed [6]. This factors influences on develop of new products, production methods, machines, facilities as well as new forms of policies of business and organization (Figure 4).



**Figure 4 – Extreme changes that affects on industry**

One of the goals of competitiveness and gain competitive ability, especially in the automotive industry, aims to integrate the logistics approach on the relationship between producer-client, so that the demands of the market, or the client, install threw the production and supply of raw materials. Also on production companies, these principles can be implemented by restructuring in order of independence and self-organization of parts of the company. These production units are working efficiently and cost-effectively, frequently in line with the Toyota production system, and JIT (just-in-time) deliveries.

### 3.1 Logistical oriented planning of new factories

Planning of new production plants by analytical approach or Tailor’s method is part of the past. Now the planning of logistic is main point in joined decisioning. Importance of making logistic optimized “lay-outs” is constantly increasing: from internal material flow inside the facility, threw connection with current logistical infrastructure.

In the production oriented parts of the plant, the production flow of materials is directly linked with preassembly / underassembly cells that are synchronized with the main production line manufacturing process, and waiting of parts (buffer) is reduced to a minimum. Due to limited space of logistics zone, assembly zone at the main production facility, the flow of information and materials is held as short as possible. Assembling the chassis is the main manufacturing operation, and this is the main area when designing the layout and planning of factory structures, considerate external suppliers [7]. Thus, the flow of parts focuses on specific places where they will be mounted.

### 3.2 Reorganization based on Toyota production system

Successful implementation of the elements of production systems, which are based on the TPS, depends solely on the proper understood relationship between the individual elements. Incomplete implementation is often a source of unsatisfactory results with respect before the expected productivity, reduced storage of materials within the plant, and product quality. Also, traditional business practices must be changed, and suspicious attitudes of part of manufacturing workers and management must be overcome. Under the basic analysis, the different effects of the elements of the production system involved, and proposed is gradual approach to implementation in a production system.

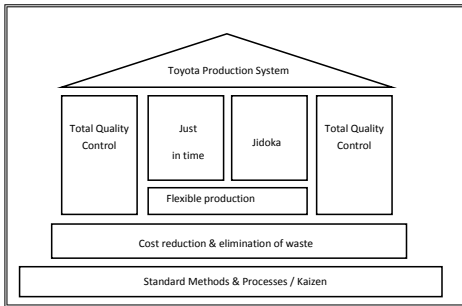
### 3.3 Elements of Toyota Production System

The philosophy of products producing with a 100% quality (Zero Defects Quality) in parallel with minimal inter-process delay is based on five main elements of Toyota Manufacturing System (TPS), based on independent systems (Figure 5).

The main pillars of TPS are Just-In-Time, Jidoka and Total Quality Control

(TQC), including a flexible production and minimize costs by reducing waste.

TPS is maintained using standard methods and processes as well as continuous improvement, known as Kaizen, supported by training on work places.



**Figure 5 – Main elements of Toyota Production System**

Toyota's targets can be summarized in supplying of society with:

- Motor vehicles with highest possible quality,
- Lowest possible cost,
- Shortest possible time of delivery.

In basics of this corporate targets, direct influences of TPS philosophy are:

- 1) Cost reduction by eliminating all shapes of waste during production process,
- 2) Connectionning of processes in order to get permanent quality of products, and
- 3) Creation of work environment that can be easily adopt to changes in processes, products and clients, and at the same time satisfy individual needs of employees.

In order to achieve these seemingly contradictory goals, it is important to agree on standards that guarantee your safety and simplicity of assembly process [8].

### 3.4 Standardization of work processes

At Toyota, standadrization with Kaizen, provides the basis for the Toyota Production System and its various elements

[9]. For the purpose of standardization, each individual operation in the process of production in the automotive industry must be described in detail.

At Toyota, standardization is required to define the guidelines for the three important elements in the description of the operations: tackt time, work speed and standard interprocess stock.

Tackt time is the period of time provided for assembly on workstations and calculated the total production time and production volume. Cycle time is the sum of all the operations carried out on a single workstation. The goal is to align most of the tackt with the cycle time. Reminder is known as "taktausgleich" (time compensation) and results mainly due to a lack of standardization, which leaves room for interpretation and mixing product lines that have not been optimized.

### 3.5 Step by step implementation of TPS

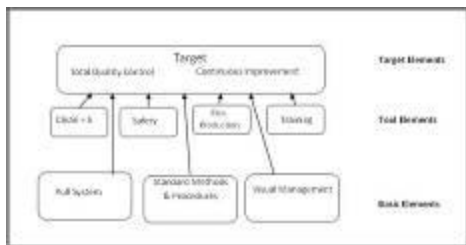
For successful implementation of TPS in existing production plants, recommended are procedures that will go in steps (slowly): this approach is often necessary because of the large number of workers involved in the process and avoid the costs of reorganization.

In the tests, starting from the basics and gradually introducing the production system is desirable: the reason that first began with the presentation of the basic elements, then followed tools and of course at the end of the target elements (Figure 6).

Standard methods and procedures, visual management, and "pull" system consists of so-called basic elements. Using their primary functions, these elements contribute to the creation of a safe working environment that meets basic needs and provides the motivation for the introduction of an integrated production system.

Description and standardizing core activities are properly documented and provided to employees; these actions provide a basis for reproduction quality and apparent discrepancies in the

manufacturing plant. Visual management contributes to the rapid observation of deviations from the standard norms; the state of the manufacturing plant can be raised to perfection, but the problem has to be addressed directly. "Pull" system that is oriented toward the acquisition of materials, gradually reducing the amount of "flow" of material [9, 10]. Problems with manufacturing processes, which are frequently hidden with materials buffers in manufacturing plants, become visible and it also solved gradually.



**Figure 6 – Importance of basic TPS elements**

Despite the gradual introduction of these elements, as implemented in Kaizen projects in Mercedes Benz factories in Brazil, can be recommend the selection of a limited part of the factory in order to rapidly, introducing the total production system with exemplary features. In direct comparison with the rest of the "traditional" organized parts of the company, the advantages of the production system and the staff and management can quickly become clearly observed. Prerequisites of this approach are a young, flexible staff as well as plans for a restructuring of production in any case, for example when to introduce new equipment to launch a new product.

#### **4. REALIZATION OF EXTERNAL LOGISTIC ACTIVITIES IN FAS PLANT**

"FIAT" company in 2009. took a

majority part in the former factory "Zastava Automobili", and together with the state of Serbia established a joint factory FAS - Fiat Automobiles Serbia. Initially, the factory started in assembling the model of "Fiat Punto" getting component mainly from suppliers in Italy.

During this time, intensive have been worked on developing of the plan for future production models. Arrival to Kragujevac from side of FIAT subcontractors opened the possibility to improve the supply chain, bearing on mind the location that the suppliers had. Currently in Kragujevac, located inside the factory and in Grošnica, FAS has seven subcontractors:

- Magneti Marelli Ecxhaust System,
- Magneti Marelli Bumper,
- Johnson Controls Magneti Marelli,
- Johnson Controls,
- Sigit,
- PMC,
- HTL.

First 3 suppliers placed their facilities inside the circle of FAS factory, while rest of them are placed on few kilometers far location Grošnica. Bearing on mind that "FAS" inside its facility installed the modernist equipment, it was expected that the supply chain will be developed to highest level.

From the beginning of new 500 L model, factory started JIS (*Just in Sequence*) production principle. This significantly reduced buffering inside factory of parts which are shipped by primary suppliers. Every car by determined plan/sequence had certain specification:

- vehicle model,
- engine model,
- color,
- level of equipment.

Suppliers within the plant have developed a system of communication with the based FAS production via the

licensed software intended procurement. When inside the FAS base on going is car with a certain specification (sequence), label data is immediately sent to suppliers within the plant. Printer "launch" label, and operators performing installation of demanded part, quality control and storage of the zone for delivery. After some time, the internal logistics of FAS takes stored parts with movable shelves, and transports them into production.

Layout image of the entire FAS company is shown in Figure 7. Figure 8 shows the layout of separate sites of other companies located in the factory.

This model made the company FAS savings in time, space, just as in their speeches stated from Toyota colleagues.



Figure 7 – Layout of FAS plant

For the factory, the internal logistics of the every 45 - 60 minutes with the purchase order goes "in round" to suppliers, providing FAS everything necessary for uninterrupted production. Upon entering the factory, parts with complete racks are transported directly to the assembly line, and the operator easy

based on the sequence of vehicles, in a certain moment can take the parts that will be installed.

However, despite this, there are situations with suppliers that aren't located in Kragujevac, or around the factory. One of them is the "Magna Slovteca" from Nove Mesto nad Vahom, Slovakia. Supplier for FAS produces all kinds of mirrors (for all models) and the covers of the mirrors in all colors. FAS worker on the assembly receives a sequence of vehicles with all parameters, and takes a certain cover from stock, analyze it and get back to the client if he explicitly demand.



Figure 8 – Layout of FAS suppliers in Kragujevac, "Grošnica" location

In particular, the operator in charge for collecting of "cosmetic" parts inside the unit of assembly, performs installation of covers that corresponding mirror. Such things FAS wants to move out of their factory, as it aims assembling of complete made mirrors within suppliers, and the mirrors depending on the needs of car



models and options send to FAS in finished state [11]. By this company carries out reduction of jobs, and shift the responsibility of the entire procurement and installation to the supplier "Magna Mirrors". Also one of the biggest gains is saving space within the production process, which will be used primarily for the purpose of emergency situations and draw attention to the developed supply chain, which in this case is easily visible by the management.

## 5. CONCLUSION

Changing circumstances of market developments, followed by variations and adaptations of the paradigm of business, gave rise to the necessity of designing a variety of techniques and philosophy of management that will be used to keep the business stable and prosperous. Over time, some initially introduced branches of management are changing, and even are the trigger for the development of new fields and areas of interest. Whenever a change occurs, whether it is incremental or revolutionary, or a story about an important business philosophy, professional public usually has divided opinions on whether this philosophy is

absolutely new, or maybe upgrade something that already exists. It thus begins the story of the relation between logistics management - supply chain management.

Modern business conditions as "a must" impose the constancy of change and the adoption of the spirit of innovation as a business orientation of all market participants. Consequently, there is an improvement of many philosophies and also to create completely new, that its elements are trying to respond to the challenges and obstacles turbulent environment. Just as such a philosophy, logistics management and logistics planning and operation of the factory occupies equal attention to professional public and practice.

Logistics management is a relatively young business philosophy, which is being developed over the past thirty years. Numerous concepts created under the auspices of this philosophy, have a positive impact on the value creation chain, that can be realized under their application. The subject of this work is just to prove the importance of selected concepts and strategies in creating and adding value to supply chains, and their comparative analysis for their successful future application.

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