IMPROVEMENT OF THE FLOW OF INFORMATION BETWEEN THE PRODUCTION LINE AND THE LOGISTICAL SYSTEM WITHIN THE MANUFACTURING PLANT

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Abstract

Logistical systems are capable of generating considerable savings for the enterprise, but in many cases, if inappropriately managed may generate financial losses. It should be noted that the functioning of the logistical systems is determined by their recipients. They are limited by supply, warehousing and transport sources. The ability to forecast makes it possible to collect necessary stocks in advance and transfer goods so as to locate goods in the appropriate place and time.

The aim of article is to presents the possibilities and the way to improve the flow of information from the production line by creating a real file importing data into the computer system in the logistic unit (quantity of items produced, number of defective items, production capacity and production time).

Keywords: Manufacturing logistics, RFID, Barcode

1. MANUFACTURING LOGISTICS

Manufacturing logistics covers all of the processes linked with equipping manufacturing process with appropriate goods (auxiliary materials, resources, intermediate goods, consumables and parts of their purchase) and transferring intermediate goods and finished goods to the inventory warehouse and, immediately, to the client taking into account the satisfaction of the client [1].

The production logistics may be defined as a system based on an integrated concept of separated materials flows at proper time to proper place in proper amount and quality in order to optimise completion of tasks and production processes. The development of the production logistics created specialised methods (Kanban, Just in Time, FMEA), systems (MRP, MRP II), ideas (Lean Production) which allow an effective logistical management in production [2 - 3] .

An important factor for the manufacturing enterprise to function is a methodological approach concerning the improvement of the flow of information, taking into account the broadly understood phenomenon of risk assessment [2].

Well organized manufacturing logistics allows [3-5]:

- access to all materials, components and parts of a given product at the time of the commencement of a given order,
- rhythm and continuity of the commenced manufacturing process,
- favourable conditions to apply advanced internal transport,
- adequate stocks of finished goods within the supply area,
- possibility to shorten and improve the manufacturing cycles,
- selection of packages (bulk and individual) for logistical units in order to improve the effectiveness of transport and warehousing,
- possibility to apply automatic identification (**Figure 1**).

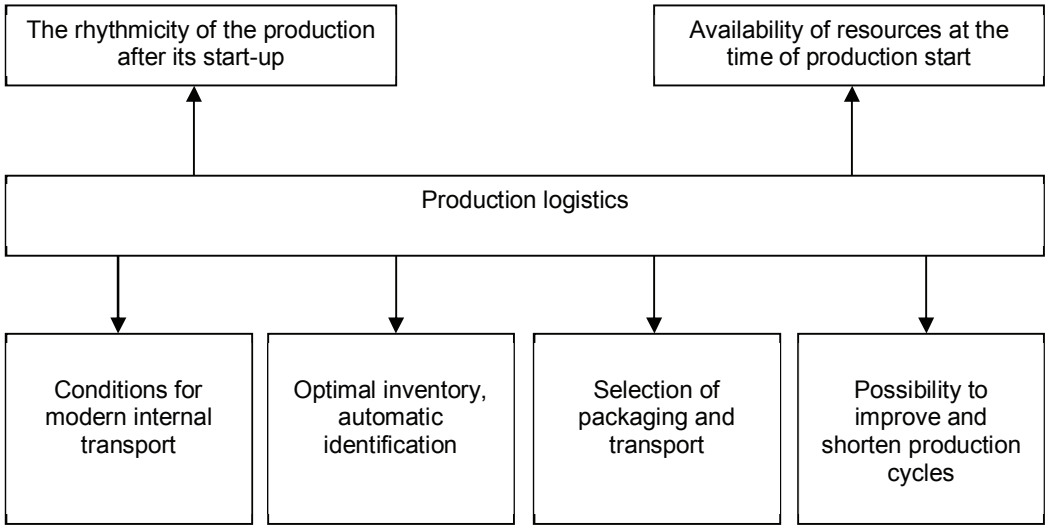

Figure 1 The aim of manufacturing logistics [3]

Aims of manufacturing logistics may be achieved by applying the appropriate tools and instruments, such as: proper policy, research, modern management methods supported by information technology. There are the following sub-systems in the manufacturing logistics [1, 3]:

- management - operations and practical knowledge linked with planning and steering (this is expected to achieve the client's satisfaction, appropriate level of effectiveness, level of costs and profit),
- manufacturing - the production of goods (components, parts, intermediate goods, assemblies, and final products), this notion refers to the physical operations necessary to manufacture goods,
- warehousing - group of actions related to temporary acceptance, storage, warehousing, relocation, collecting, registration, maintenance and issuance of material goods,
- resource manipulation - physical functions in the manufacturing logistics cover changes in the placement of materials, from the moment of their acceptance up to the issuance in the specific object zone. Manipulation covers acceptance, storage, internal transport, packaging, division and issuance.
- flow of materials - path and direction of the transport of materials along with the order of their placement in the production line,
- steering - a consolidated set of procedures, reports and data used to regulate and plan the supply of the production line,
- control - covers the control of the assumed quantity of products with the order and the control of the compliance with the specification (accompanying document),
- diagnostics and management of materials - the assessment of their efficient management (the note is made on the basis of material consumption production coefficient which presents the effectiveness of holding of materials: energy, fuel, lubricant, dynamics and the level of material stocks, growth in stocks, unit resource consumption, rhythm, level of productive material consumption,
- waste treatment - removal, post-mining, production and post-consumer substance management as well as firm texture and liquid materials (not being sewage) not intended to be managed in certain place and time, not usable in the manufacturing site and removed post-consumer products,
- flow of tools,
- supplying the production area with utilities - all necessary utilities during the manufacturing process, namely: electricity, gas, water, liquid fuels, etc.,
- post-sale service (assembly, service, transport, treatment),

- information - set of all elements and dependencies between them that have an important role in the process of information flow within manufacturing logistics sector.

During the decision making process related to the manufacturing, solutions within the flow of information and goods appropriate to the created conditions and needs are shaped and include, among other: demand forecasting, product planning, placement of devices, project design, aggregated planning, productive capacity management and warehouse management. For that purpose, different devices facilitating the flow and identification of details within supply chain are applied [3 - 8].

2. AUTOMATIC IDENTIFICATION SYSTEMS

For many years, flow of large amount of goods within the supply chain has caused difficulties in the monitoring and identification. For this reason, automatic data identification was one of the first application of computing in the manufacturing logistics [4]. A close link between automatic identification systems and logistical process steering system makes it possible to optimize information system influencing development of physical flows [5]. Automatic identification systems are understood as devices and programs which allow warehousing, reading, processing and printing data represented by different carriers (e.g. barcode, RFID transponders,) [6]. Their essence is to directly introduce data to IT systems. Mostly, the following solutions are applied: optical (barcode), electromagnetic (radio wave), magnetic (magnetic tapes), biometric (differentiate voice) [5 - 9].

Most frequently applied techniques in the manufacturing logistics are the following:

1. Barcode - is the cheapest and the easiest method applied to optimize logistical management. To date, few hundred barcodes were created, among others, linear codes, reduced codes, composite codes, two dimensional codes, composite codes, but only several are commonly applied [7]. In the barcode system the reading is based on "the analysis of the signal generated by the laser beam which moves and reflects on the background with depicted code pattern. Reflected beam, via optical system of the scanner, is moved to the photoresistors battery and generates the flow of current within the electronic system of the scanner" [8]. This signal, in the form of partially flattened and irregular sinusoid, is amplified and then processed into the incrementally variable signal. Then, the signal is subject to subsequent processing by dividing into parts with the base time length similar to the length of the code module, namely the thinnest bar in the code [8].
2. RFID - (Radio Frequency Identification) is very promising for all types of enterprises [7]. RFID tags - tags or transponders, in the case of EPC product stickers, electronic product codes - occur in two types: active and passive. Active transponders are supplied from separate power sources. Their range varies between few dozen up to few hundred meters. Active tags are applied in various economic sectors. Passive tags are applied in industrial logistics. The aim of transponders is to transfer energy and information via radio transmission. The operation of passive transponder is based on the transformer operation. Station antenna and transponder antenna constitute air transponder. Radio waves (are electromagnetic waves) transfer energy. Then, this energy is processed and collected in tag capacitor. When the appropriate state of charge has been reached, in the second phase, the transmission system of sent data by the transponder antenna towards the station antenna is commenced. Commonly applied transponders operate on the basis of this system. The flow of data between the transponder and the system is based on the radio wave modulation, namely - keying. We may point out several ways of modulation: phase, amplitude, frequency. Thanks to the application of the co called digital farmer it is possible to achieve string of binary signs at the end of the process [8 - 13].

3. IMPROVEMENT OF THE FLOW OF INFORMATION WITHIN THE MANUFACTURING PLANT - CASE STUDY

This article uses data from a company that manufactures brake systems. The basic product manufactured by the examined unit is a ventilated dual disk brake for passenger cars. Depending on the car model, the brake

discs are ventilated, drill ventilated or ground ventilated. Each of the brake discs is manufactured on one of the six production centers. Because of the limited ability to publish the data in the study, details have been omitted to identify the surveyed enterprise.

In the enterprise each of the six production centers has planned capacity over a period of time (e.g. day, month). Capacity is calculated as a real quantity of manufactured items compared to the planned quantity. Capacity determines the manufacturing profitability. When all necessary operations related to brake disc processing are finished, the item is transferred to the special marking machine - DMC. DMC marking machine is responsible for Data Matrix code laser engraving and generating markings on the disc fits - product code, serial number, client and company sign as well as minimal thickness of the TH raceway.

DMC marking machine is responsible for proper marking of the finished brake disc. Proper marking is extremely important for the client and the manufacturer.

In the studied enterprise the proper course of Data Matrix Code engraving along with markings is performed by specially designed software produced by the manufacturer of the machine. Dishi DM-Fori is a machine steering program addressing mechanical properties. Evlaser program - SAMLight is responsible for proper code engraving along with the description. The third program is Simatic MV440 SR which, in a real time, presents actual camera readings (Data Matrix code) mounted inside the machine. The above mentioned programs are mutually linked and the activation of one of them results in the activation of the rest of the integrated software. Marking machine software is based on the operational system Windows 7 which, thanks to the wireless connection, (Netgear router) is able to connect with the internal server of the plant. Dishi DM-Fori program, in its catalogue, have a "Logs" folder in which only files in .Log format are located. These files are in .txt format and their name is composed of a calendar date. Commonly referred "Logs" are saved automatically in a real time. Each separate file contains a database which gives the history of a machine manufacturing process from the last 24 hours.

Table 1 Advantages of the import file with Barcode, RFID systems [6]

ADVANTAGES	
IMPORT FILE	**BARCODE, RFID**
• clear, easy to use, • less expensive than Barcode and RFID • identical precision in the flow of information from the production line, • universal technology, possibility to import information from a given place, • possibility to change the file operation thanks to simple VBA code modification. • short time of the flow of information.	• possibility to apply in all sectors of the enterprise operation, • accurate information on the quantity of the manufactured items and the possibility to transfer information on the product path to the client. • fast flow of information (40 tags per second), • tags serve as reading/recording devices • RFID ensures a high level of security. Data may be encrypted, secured by a password or set with the activation of "kill" function to remove fixed data. • after creating the system it can be activated with a minimal human contribution.

The company noted that full usefulness of the file for logistics purposes requires the addition of the manufacturing selection option for a given production line. Thanks to the above, the user may intuitively select the list from the preferred line without the need to open different files in .xlsm format. Affordable solution for creating one file which optionally opens the selected production line is also file in .xlsm format referring to six earlier created files automatically importing data from marking machines. At the beginning it is necessary to create the file in .xlsm format automatically importing data from files in .Log format - each separate file is a separate production line. The construction of files is identical with macro scheme presented above, except for

the change of the socket number (file 1 - BLT1, file 2 - BLT2, etc.) at the end of the reference path:sPath=\\dabrowashare01\Bu_staff\MACHINING\TECHNOLOGY\EXTERNAL\DataMatrixMachines\BLTs\LOGS\BLT(socket number from 1 to 6)\. The next step is to create a new file which will be available for the user. Thanks to Visual Basic for Applications it is possible to create a simple form which will be available when the file is open. Then, it is important to assign references thanks to which when the given button is pressed, the file will open created files importing actual data and present them to the user. **Table 1** presents advantages of the import file with Barcode and RFID systems.

4. CONCLUSIONS

In the turbulently changing environment enterprises are forced to search for the most effective methods of process optimization [14]. The logistics in an enterprise plays the key role [15]. Introduction of new management methods and concepts is a response to the changing surrounding and increasing expectations of customers. Enterprises who fail to react to these signals cannot face the competition.

The manufacturing logistics resulting from progressing changeability of the surroundings is a point of interest for many enterprises. It is a process of significant transformation for the organisation, which transformation is most frequently connected with the need for the enterprise to fit in the ever-changing environment.

Based on the research conducted in the company it was found that automatic data identification systems are necessary industry logistics tools in each manufacturing plant. Alternative solutions for professional logistical systems (among others, Barcode or RFID) which demand considerable financial resources are the creation of own solution based on the existing enterprise resources. The creation and implementation of the project is based on the commonly applied software, minimizing costs of execution. Prepared files in .xlsm format presents actual manufacturing data from all production lines. Xlsm format makes it possible to freely execute further operations on the basis of prepared list. It is possible to extend the file operation to other production lines in the enterprise. The creation of the presented project minimizes costs related to the implementation of the advanced subcontractor's system. The time of the flow of information between the machine and the logistical unit takes only a few seconds (depending on the quantity and the size of files and clock speed of the processor).

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