

IMPROVING A PLASTICS INJECTION PROCESS BY USING AN EFFICIENT PRODUCTION MANAGEMENT SYSTEM

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Rezumat. *In contextul actual, dominat de schimbările bruște și oscilațiile comenzilor, nesiguranța în procesul de aprovizionare a componentelor și materiei prime, toate companiile sunt în permanentă căutare de soluții și instrumente care să ajute la creșterea productivității și eficientizarea procesului de producție. Lucrarea descrie modul de eficientizare a unui proces de injecție mase plastice prin implementarea unui Sistem de Gestionare Eficientă a Producției (MES), care folosește informații on-line pentru a gestiona resursele curente de producție: oameni, echipamente și timp. Sistemele MES oferă o serie de beneficii pe termen lung și scurt, precum și beneficii strategice și tactice, inclusiv timp redus, volume de producție mai mari, randamente îmbunătățite, costuri de operare mai mici, conformitate sporită.*

Abstract. *In the actual context, with sudden changes and fluctuations in orders, insecurity in the supply of components and raw materials, all companies are constantly looking for solutions and tools to help increase productivity and improve the production process. The paper describes how to streamline a plastics injection process by implementing the MES (Manufacturing Execution System) which uses online information to manage the current application of production resources: people, equipment and time. MES Systems offer a number of long-term and short-term benefits, as well as strategic and tactical benefits, including reduced time, higher production volumes, improved yields, lower operating costs, increased compliance.*

Keywords: Plastic products, Injection process improvement; MES, ERP.

1. Introduction

The paper describes the concept of optimizing a plastic injection process by implementing an efficient production management and control system [1]. Starting from the injection process and the need for optimization to adapt to current market requirements, I have identified several management and control systems that can be implemented to achieve a productive process. The paper details the implementation of the production execution system (MES-Manufacturing Execution System) for the described process and the contribution for the process improvement [2], [3], [4], [5].

From the stock of raw materials to the management of delivery times for products, all companies are constantly looking for solutions and tools to help increase productivity and improving the production process. This implies the

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existence of a permanent link between the activities in the manufacturing line and those of the management.

The application of information technology to assist in the execution of production, through online management of process activities, has been a rapidly growing trend in recent years. Several planning and control systems have emerged, under a variety of headings, including: Material Requirements Planning (MRP), Enterprise Requirements Planning (ERP).

There are also modern control systems that manage or control the functions of a machine, such as Programmable Logic Controller (PLC) used to run machine tools. The Manufacturing Execution System (MES) bridges the gap between the planning system and the control system using online information to manage the current application of production resources: people, equipment and time.

2. Plastics - areas of application

In recent years, plastics have undergone a quick evolution in many industrial areas. Due to its processability, plastic is used in different areas such as alimentation, medicine, electronics and electrical engineering, civil and industrial construction, the machine building industry and many other areas of activity. Plastic processing methods are injection, extrusion and blowing. The most common and used method of making plastic objects is by injection.

Injection molding is the most popular and used process in making plastic parts. This involves melting the granules of material and injecting the molten plastic into the mold, where it solidified, in order to obtain parts in specific shapes. Plastic parts have successfully replaced products made of iron, steel, glass or other materials. The main advantages of using this material are related to the fact that it is easy to process and making parts of high complexity and with innovative design in a short time and with low costs [6], ..., [9].

The automotive industry is constantly evolving and improving which means better and better quality of the products used. Plastics are used to make car components because they help reduce the weight of the car and, consequently, reduce fuel consumption. Parts made of this type of material help to absorb shocks in the event of an impact, are durable and can be recycled after life.

There are a lot of reasons for which car manufacturers have implemented more plastic in car design, such as: longer vehicle life, little corrosion, low weight, the possibility to design parts in different shapes and textures, greater innovation potential, more versatility in component integration, consistency and flexibility, greater safety and increased comfort.

The relationship between plastics and the car industry is very close, in the same way that component manufacturers and car companies coexist in the market.

3. Optimization of the production process through automation and efficient management

Optimizing the production process is an essential aspect for any company. The processes are becoming more and more complex, the requirements are more and more varied and in order to fulfill them, it is necessary to improve each stage of the process.

Automatic control and continuous monitoring of the process allow access to the essential data that must be analyzed in order to obtain favorable results and to streamline production. The analysis of the data from the process leads to a clear image of the aspects that need to be improved.

Actually, most production processes are automatically controlled and monitored, which helps to identify inefficient or repetitive processes and the correct analysis of the process components in order to find the best optimization solutions.

All companies are focused on maximizing the productivity, limiting losses, creating quality finished products and, most importantly, successfully meeting customer requirements.

In order to meet the requirements of the profile market, it is necessary to use the latest and most advanced planning and management technologies. Using this technology is possible to achieve a permanent monitoring of the production, an efficient management of the supply time, production, stationary and delivery of the products through the efficient data collection and management.

The need of one production management systems is also justified by the increasing of customer requirements: reducing the number of delays in delivery, minimizing costs by reducing indirect production times and blockages of any type, improving the quality of parts delivered. Increased competition in this area, which will result in lower prices for new projects, requires strict management of all activities, especially production, in order to compete at a low cost for new projects.

4. Management and Control of the systems for production improvement

In recent years, complex management and planning systems (Fig. 1) have appeared:

- MES- Manufacturing Execution System
 - ERP- Enterprise Resources Planning
 - MRP- Manufacturing Resources Planning
 - MCS- Manufacturing Control Systems
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- HRM- Human Resource Management
- CRM- Customer Relationship Management
- QMS- Quality Management System
- WMS- Warehouse Management System
- CMMS- Computerized Maintenance Management System
- SCADA- Supervisory Control and Data Acquisition



Fig. 1. The structure of the production execution system.

Some companies use multiple software systems to manage the different departments in the process. However, this solution is not financially and operationally reliable. An efficient option involves operating the entire process through a single system that is based on the particular needs of the organization. Such a system is: Manufacturing Execution System (MES).

Such a system adapted to the specific requirements of the injection molding industry is TIG Authentig, which provides a vertical integration of important data down to the level of individual cavities [10]. The software helps to make the best use of the available capacity of a machine or to correlate the productivity data with the economic objectives. The system has a modular structure and can be precisely adapted to the individual requirements of the process.

This software has direct electronic connections to the planning system and control systems, collects and provides information and direction in production activities, thus proving to be an innovative industrial solution in the field.

All processes are integrated in a single flow, which helps to optimize and streamline the process in terms of production costs, operational efficiency, cycle times, thus leading to productive planning.

Main advantages that this system offers:

- possibility to schedule production and maintenance orders and follow the schedule
 - declaration and registration of scrap as well as reasons for production downtime
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- correct calculation of the main performance indicators (OEE, machines in production, cycle time deviation, stationary index, etc.)
- monitoring the condition of the equipment
- monitoring compliance with quality requirements for manufactured products
- provides information on unforeseen events.

The system provides real-time information about the status of each order, what equipment is working, at what stage in the production process, about the parameters of the machines or about the indicators of availability, performance, productivity and quality.

The program has modern technology, adapted to the production environment. The data collection is done by using professional tablets from where the production data, information about the condition of the machines, the number of finished products, the registered scraps and data on the control performed on the products are entered in the control system.

This solution helps to collect, measure and analyze the most important production performance indicators in a factory, to generate reports for efficiency analysis, at any time during the production process.

4.1. The relationship between Manufacturing Execution System (MES) and Enterprise Resources Planning (ERP) system.

A frequently debated question between Manufacturing Execution System (MES) and Enterprise Resources Planning (ERP) system is whether to purchase an MES system or an ERP system.

Nowadays there is a better understanding of MES and ERP and its specific role. ERP systems are rooted in planning material requirements and focus on helping to manage all relevant enterprise resources. MES started as a class of systems developed specifically for managing, tracking, controlling, documenting and creating the ongoing activity of a factory or workshop, in real time. Gradually, some additional functions have been added to the MES system to also manage stocks and resources, such as equipment and personnel. At the same time, ERP systems have evolved and started to offer functions of management and monitoring of manufacturing processes.

Modern MES and ERP are much more open and interconnected than before, through the API. An open Application Programming Interface (API) is a powerful software solution for connecting two software systems together and for requesting, exchanging, and sending data in real time. One system can notify another system that a task or process has been completed and that new data is available. The other system will take over this data and trigger its internal processes and activate to further process the data.

The ERP role is to initiate, process and complete business-level transactions, while MES is used to operate in real time on the production floor to manage and measure production processes and equipment. The use of ERP and MES in this way results in a clearer and more symbiotic relationship between MES and ERP (Fig. 2) [11].



Fig. 2. The symbiotic relationship between MES and ERP.

5. Production Execution System (MES) modules and their contribution to efficient production management.

The production execution system has several modules that cover all stages of the manufacturing process [12],..., [20].

The monitoring module helps to track in real time the entire production process, the status of the machines and allows decisions to be made at the push of a button. Through it you can track the progress of orders and productivity.

The process quality module provides an overview of all process values of the machines. Through this module it is possible to analyze the observance of the requirements and process parameters. The module also helps to track the sources that are causing problems in the production process, reducing waste. The system can generate reports on shifts, days, cars and downtime.

The quality-measurement module helps to create and manage inspection programs, manage all inspection results, generate quality certificates and inspection. Control reports are predefined to easily and quickly record verified dimensions and issues. The module offers the possibility to compare and analyze key data in the process.

The Configuration / Setup module provides the correct data, at the right time, for the correct machine. It is the central management tool for machine configuration data. In this module you can save, store and compare all production factors. It provides a complete hierarchy of changes to production configuration data.

The scheduling module is one of the most important because it helps to plan the whole process at the touch of a button. The system can plan the entire production chain, on several levels: machine, mold, staff and this can help to use the machines at full capacity to optimize the production.

The maintenance module is an essential tool in preventive maintenance planning, scheduling periodic maintenance by performing a maintenance schedule with detailed perspectives on the results and maintenance return. This module helps maintain the production quality.

The production monitoring provides manufacturing transparency, production status information, order progress and productivity, downtime, and restarts.

The consoles, which are connected to each injection machine, provide easy and practical information for operators. They are used to start, stop and divide the production, enter downtime and scrap, record data on dimensional and appearance checks of products.

The analysis module is the main actor in the management and optimization process. Through it you can compare the key data of the process, you can make informative reports and quick analyzes of all components. This module is a tool for decision making.

The observation and information module provides real-time information on critical process values. In this module you can establish your own values, adapted to the process and you can compare the correlations, verifying the fulfillment of the quality conditions.

The power module helps to divide the energy consumption on the machine, order, each injection, to optimize and save energy in production. Reduces energy costs through energy-optimized planning, makes energy consumption visible, helps schedule start-up and heating processes.

6. The influence of MES system implementation on the production process.

Production Execution Systems (MES) offer a number of long-term and short-term benefits, as well as strategic and tactical benefits, including reduced time, higher production volumes, improved performance, lower operating costs, increased conformity of the products.

Other benefits include eliminating value-added activities, proactively and systematically standardizing and enforcing processes, streamlining problem analysis, diagnosing and resolving the root cause, and continuously improving the quality of products and services.

7. Conclusions

One of the most important benefits of the optimization process is the reduction of production costs. Optimization is also an opportunity to gain better or more control over the manufacturing process, to reduce the number of defective products, and to make more efficient use of the production potential.

Process optimization is becoming a necessity for all companies that are constantly evolving and adapting to current requirements.

During the plastics injection process, the management system becomes the support for the activities of scheduling and monitoring of production. Gain by implementing this system addresses the need for immediate, current, online information that allows users to make the best informed decisions about optimizing the entire process.

Manufacturing optimization is the result of an in-depth analysis of the entire process, an analysis that can only be done using clear, real and quantifiable data. This data can be collected using production control and management systems. This interactive tool helps the management to act promptly and efficiently in case of any situation encountered in production. The resources are used at full capacity, processes are accelerated, the elimination of downtime or manufacturing downtime is favored. Monitoring is easy and permanent on the entire process, from supply to delivery of products. Process optimization leads to cost optimization and increased process performance.

Reducing costs by optimizing resources is a requirement that modern production companies must now face in order to better survive in a world in the process of digitalization. Production systems has a key role in the factory of the future.

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