THE CHALLENGES OF THE PRODUCTION PLANNING PROCESS IN HUNGARY

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Abstract

The results of the research highlight that the automation of production planning can significantly increase the efficiency and competitiveness of enterprises. However, it is worth every manufacturing company to clearly define which processes they automate, which processes are left to human resources. If human resources are used for certain activities, it is advisable to assign these tasks to appropriate job titles. Another important pillar of development is the accuracy of the information flow between production planning software and ERP systems. When designing new systems, it is essential to prioritise integration to ensure a smooth flow of data between systems. A critical aspect of production planning is assigning production orders to capacities. The condition for preparing an appropriate plan is the adaptation of products with different workloads and production equipment capacity to the norm. It is extremely important to take human capacity into account here. In a modern production planning system, such considerations must be seamlessly integrated. During the research, a fundamental need was identified for data visualization. Over the decades, many solutions have been developed to visualize production planning, offering opportunities to significantly streamline and improve planning processes. Another important element in increasing efficiency is the creation of the right ratio of flexibility and control, i.e. excessive control processes reduce the competitiveness of production. The main bottleneck in most developments and automation is the underdevelopment of IT systems in manufacturing companies. Intervention and support are needed here as soon as possible, as domestic manufacturing companies will only be effective if their IT systems are modern and competitive.

Keywords: *flexibility, transparency, simplicity, capacity planning, parameterizability, speed, integration, customizability, raw material handling, automation*

Introduction

The basic condition for the development of Hungarian manufacturing companies is the existence of an appropriate information database related to production and warehousing and the logistics processes before and after that, and their integration into ERP systems (Bareith – Csonka, 2019). Since the 2020s, the domestic manufacturing industry has faced great challenges. Covid-19 has significantly changed the way supply chains work, and previously predictable purchasing and distribution systems have become completely unproven. It was necessary to redesign logistics processes. In the previous period, logistical methods (JIT, JIS, ABC procurement strategies based on analysis) that were characteristic of the industry and helped Lean manufacturing, reduce inventory levels and deliver on time were well suited to their use, their efficiency decreased due to the changing economic environment.

Literature review

The importance of logistics performance – quantified in terms of delivery time, inventory levels, capacity utilisation or lead time – is becoming increasingly important for sustainable business success. (Wiendahl& Wiendahl, 2019)

Production planning and management (PPC) coordinates all relevant logistics activities along the entire order processing chain and thus contributes significantly to the economical implementation of the production program and the achievement of the desired logistics performance. (Schuh, 2014)

In addition, the complexity of planning is influenced by external factors due to fluctuations in supply and demand. The Covid-19 pandemic and the resulting crisis are new, but have evolved in recent decades and are expected to continue in the future. (Wilhelm et al., 2024)

The production plan resulting from the operational planning process forms the basis for the allocation of orders and resources (Pénzes et al., 2014,. The reliability of the plan is in the best interest of companies to ensure efficiency and timely delivery. (Lukas et al., 2023)

The term robustness is used several times in connection with production planning. This term is increasingly discussed in the literature and leads to a controversial interpretation. As a measure of robustness, differences are often used. For example, the robustness of a timetable can be interpreted as the maximum absolute deviation of the worst-case scenario from the optimal solution. (Daniels et al.)

Bongaerts et al. (1999) define robustness under the concept of predictability. This is a metric that determines what is known in advance. It refers to the stochastic distribution of a value and thus indicates the degree with which a variable can take a certain value or be located in a certain range.

One approach to determining robustness is a measure that is the variability of the value of an objective function that can be interpreted as a function of variability. Consequently, a schedule is considered robust if the variability is less. (Mignon et al., 1995)

The emergence of Industry 4.0 and related intelligent technologies is expected to have a significant impact on the production planning and management process (PPC). However, some recent studies show that many companies face challenges in their efforts to adopt smart technologies and implement smart technologies by implementing PPC (Bean & Davenport, 2019; Oluyisola, 2021).

Many of these challenges relate to the characteristics of the design environment (Oluyisola et al., 2020), and understanding these characteristics is therefore important to identify needs and opportunities.

Production planning and management encompasses design-related decision-making processes and policies (estimation, route planning, scheduling, and resource charging) and management (dispatching, accelerating, controlling, evaluating, and taking corrective action) production processes and resources. (Slack et al., 2013)

Many enterprise systems have emerged to support PPC, from material requirement planning (MRP) and manufacturing resource planning (MRPII) systems to more advanced enterprise resource planning (ERP) systems. Later, manufacturing execution systems (MES) and advanced planning and scheduling systems (APS) appeared to overcome some of the limitations of ERP systems.

However, they also have their limitations, including being oversimplified and rigid, limited ability to adapt schedules to real-time or near real-time data, and very expensive, in many cases requiring human resources, in many cases requiring employees with specific skills (Oluyisola, 2021). In addition, such systems are still based on periodic planning, even though demand is continuous. (Oluyisola, 2021)

Materials and methods

In this article, we examined the challenges associated with production planning solutions, the problems of the support process, and the required properties.

For the research, 150 participants were involved, all of whom work in industrial environments and are directly involved in the application or support of production planning solutions. Participants came from a variety of industries and professional backgrounds to provide diversity in research. Participants participated in the research through an online questionnaire. The questionnaire consisted of two parts: in the first part, demographic data was collected, while in the second part, text answers were asked about their experiences, challenges and expectations regarding production planning solutions.

The data was subjected to thematic analysis, during which common topics, patterns and correlations were identified in participants' responses. When interpreting the results of the research, we combined aggregated data and the results of qualitative analysis to get a comprehensive picture of the challenges and expectations associated with production planning solutions. This methodological approach allowed us to thoroughly examine the goals of the research and obtain meaningful results on current trends and challenges in the field of production planning.

Results

The challenges of production planning solutions

The main challenges related to the capabilities of production planning solutions often revolved around the degree of automation or lack thereof. Modern production planning solutions offer advantages over less advanced systems by automating many tasks and utilizing the computer's ability to quickly execute algorithmic processes. In the specification phase, it is important to clearly define which tasks need to be performed by humans and which are automated. It is usually simple to determine which category a task falls into. However, there may be cases where a program cannot perform certain inherently algorithmic tasks. In such cases, it is essential to assess whether the right device has been selected or whether it is appropriate to develop or purchase additional features. It is also important to consider the consequences of relying on human resources to perform tasks that can be automated. While choosing manual intervention may seem like a good choice, it can significantly compromise the reliability of your data. If human resources are used for such activities, it is advisable to assign these tasks to appropriate job titles. For example, using a well-trained production planner as a typist would not be an optimal allocation of resources.

Degree and lack of automation
The problem of interfaces
Improper handling of raw materials
Management of capacities
Lack of flexibility
Keeping data up to date
Data visualisation
Managing multiple production phases

Figure 1. Gaps in the capabilities of production planning solutions

Many respondents found the interfaces problematic, especially between production planning software and ERP systems, which do not always operate from the same database. This lack of connectivity not only makes production planning difficult, but can also make it impossible, as plans must be based on real-time data to be feasible and efficient. In addition, plans are expected to be prepared efficiently and in a timely manner, which further underlines the importance of data accuracy and integration. Addressing the issue of fit is crucial in the short term, as plans cannot be implemented effectively without reliable data. When designing new systems, it is essential to prioritise integration to ensure a smooth flow of data between systems. Furthermore, the issue of real-time data is closely related to this. While some systems may consider data updates within a few days or weeks acceptable, this is generally not appropriate for production planning where real-time data is essential. If data updates are infrequent in the ERP system, this indicates that processes need to be reviewed and improved to ensure timely and accurate availability of data. It is clear that seemingly disparate problems are intricately interlinked, which underlines the importance of comprehensively addressing integration and data availability issues.

Inadequate handling of raw materials was also mentioned by several people. This problem may arise from a discrepancy between systems where the supply of raw materials has to be controlled in another system. Obviously, due to the volume of production orders or the complexity of the bill of materials (BOM), manual checks may not be practical, especially when you consider that repeated checks are required each time the plan is modified. Some respondents even noted that their production planning solution calculates the material requirement for only one product, leaving the multiplication task to the production planner. In addition, managing potential alternative material lists can be a significant burden for the production planner if done manually. Therefore, a good production planning solution must handle the calculation of material requirements and provide real-time visibility into material availability.

For some respondents, capacity management was another major challenge. This is a critical aspect of production planning, as assigning production orders to capacities is essential to creating a feasible plan. However, if capacities are not mapped accurately, a number of problems can arise. For example, if an installation has the same capacity norm for products with significantly different workloads, if capacity is assumed to be infinite, or if the program does not take into account planned downtime and production losses, it becomes impossible to make a proper plan. One respondent specifically highlighted the importance of taking human capacity into account through a skills matrix. In a modern production planning system, such considerations must be seamlessly integrated.

In addition, the lack of flexibility was mentioned as another challenge. We will explore this further in the last question.

As with the previous question, the topic of data was raised. The main mention was that keeping the data up to date is the problem. Very often this is due to a fitting problem. After all, if the data is produced somewhere, an integrated system can use it. If the new data is not produced, then we are talking about a process problem and it must be remedied accordingly.

Another common expectation is the need to visualize data. Over the decades, many solutions have been developed to visualize production planning, offering opportunities to significantly streamline and improve planning processes. Visualization stands out as one of the most important features of a production planning module or program. If a solution lacks visuals, it probably won't meet your needs effectively.

Many respondents mentioned the challenges of managing multiple production phases within their programme. While this may not be a problem, if scheduling one production phase is sufficient and other phases can be addressed through a pulling system or alternative approach, if scheduling multiple phases is required, these concerns should definitely be addressed. Although lean principles encourage scheduling production at some point, many manufacturing companies do not yet adopt this practice or do not consider it feasible. Those who need to schedule multiple production phases should have their solution prepared to handle such complexity. Changes in the planning or scheduling of one phase should have an appropriate impact on the other phases. Even if scheduling separate phases is not beneficial, the material requirements of all phases must be taken into account.

The challenges of support

The most frequently cited challenge with support for the production planning solution was lead time. Some respondents referred to this problem as a lack of capacity, referring to IT as the bottleneck. To resolve this situation, the expected lead time must be incorporated into the grant agreement. It is important to recognize that lead times do not necessarily correlate with the size of the provider. Unfortunately, there may be delays in processing requests in both small firms and large companies, which often take months to resolve.

Even worse are those who say that there is little support, almost no support and no support at all. This is also problematic because as the production system and the expectations of customers, owners and managers develop, the production planning system should be improved. Some say that the system is outdated and therefore cannot be called subsidy, while others highlight the cost of aid. Although it is easy to see that since the subsidy creates value and generates costs, someone has to pay at some point, of course there are models that charge the cost of the subsidy not occasionally, but on a flat-rate basis, or a major support package is already included in the price of the product.

Lead time
Support is low
Lack of native language support
Lack of system knowledge
Lack of competence of the supporting company

Figure 2. Key challenges of manufacturing planning solution support

The lack of native language support and knowledge of the system is a major challenge. If communication is hindered due to language barriers and lack of knowledge of the system, solving problems becomes increasingly difficult. Although English language proficiency is widespread, effective communication can be compromised when people from different linguistic and technical backgrounds discuss complex production planning issues. Moreover, knowledge of the system goes beyond basic understanding and includes the complexity of a customized system implemented within the company, which may have changed several times over time. When the original developer of the system is no longer available, navigating such complex issues becomes even more daunting.

In the end, the lack of competence of the sponsoring company remained, because according to many – and costs are not mentioned here – the sponsoring company is unable to develop the system that would work as expected. Of course, there are highly complex systems that can be difficult to model in such a way that the resulting model represents reality in the best possible way while remaining usable. In such cases, it is also worth thinking about how the system could be simplified. Not necessarily just because of modelability, but also because these systems very often involve much more losses and are difficult to understand for managers. But you have to accept that the model will never be "perfect" unless you operate a single-machine system on which you produce only one product.

Expected characteristics

Respondents highlighted flexibility as the most emphasized feature, indicating that flexibility is paramount for a good production planning solution. While some respondents mentioned flexibility without elaborating, others highlighted specific aspects such as the ability to adapt to user needs and changes in production. This emphasis on flexibility underlines the dynamic nature of modern manufacturing environments where adaptability is essential for success.

Interestingly, some respondents also noted the need to strike a balance between flexibility and control, suggesting that excessive flexibility can also have disadvantages. This nuanced perspective recognises that while flexibility is key, it must be mitigated by an appropriate level of control to ensure the stability and efficiency of production operations. Overall, the consensus on the importance of flexibility reflects the recognition that rigid or inflexible systems struggle to keep pace with the changing demands of the manufacturing environment.

Flexibility
Transparency and simplicity
Capacity planning
Parameterizability
Speed
Integration
Customization
Raw material handling
Automation

Figure 3. Features expected from a production planning solution

Combining transparency and simplicity into a single category makes sense, since they are closely related. Both features are essential for efficient production planning solutions as they contribute to ease of use, clarity and accessibility. Simplifying user interactions through simple data entry and output processes, and ensuring that important features are available with minimal effort, improves the overall user experience. By prioritizing transparency and simplicity, organizations can facilitate smoother operations and decision-making within production planning processes.

Indeed, capacity planning is a critical aspect of production planning, and its prominence among respondents' priorities underlines its importance throughout the process. Efficient capacity planning ensures that production orders are distributed among available resources in a way that maximizes efficiency and minimizes bottlenecks. By considering strategic, tactical and operational time horizons, organizations can manage both immediate and long-term capacity needs, whether it's purchasing machinery, recruiting human resources, or optimizing existing resources. It is worth noting that some solutions on the market may lack robust capacity planning capabilities, which can lead to inefficient resource allocation and potentially increased lead times and inventory levels. This underlines the importance of choosing a production planning solution that can effectively manage capacity planning across different timeframes and resource types, taking into account factors such as supplier readiness and inventory levels to achieve optimal results.

Tied with capacity planning is the fourth place in parameterizability. The answers show that many parameters of a good production planning system are accessible to users and can be easily modified. No matter how much it seems that certain parameters never change, it is not advisable to "burn" them into the system either, because there may be a business need at any time to change the static parameters of the system that has been working well for years. For example, the lead time between two production phases, which we have been approaching by 3 days for years. What prevents us from including this as a parameter in the settings. Perhaps not even as a general parameter, but by product group. That is, there will be 10 parameters in the settings, which are currently set to 3 days, but the system can change at any time so that for one of the product groups it will no longer be 3 days, but only 2. By designing a production planning solution with this approach, we can be sure that we have done everything possible to best serve changing needs.

Speed is critical to the usability and efficiency of a production planning solution. Users expect fast response times and smooth performance, especially for features they frequently use in their daily tasks. A system that responds quickly to user actions increases productivity and minimizes workflow interruptions. Features that are used more frequently should have shorter response times to ensure a seamless user experience. This approach is consistent with the principle of optimizing system performance for real-time decision-making and operational agility. A production planning solution that works with speeds and responsiveness similar to high-bandwidth browsing on the Internet can significantly increase user satisfaction and overall usability of the system. It allows users to focus on their core tasks without being hampered by software delays or inefficiencies. Ultimately, speed contributes to the efficiency of production planning processes and supports the organization in achieving its operational goals.

Integration is key to a production planning solution as it ensures seamless communication and data exchange between different systems and modules within an organization. By centralizing shared data in a common place accessible to all relevant applications, organizations can avoid redundancy, data inconsistencies, and unnecessary manual work. The example of data stored in the product body within an ERP system illustrates the importance of avoiding double data entry and maintaining data consistency across systems. By integrating production planning software with an ERP system, organizations can leverage existing product data without redundant storage. Changes made in one system can be automatically reflected in others, reducing the risk of data discrepancies and streamlining data management processes. Furthermore, the integration of a production planning solution with other departments, such as controlling, ensures that relevant stakeholders have access to the data they need for decision-making and analysis. This facilitates collaboration and enables informed decision-making based on real-time information. Overall, integration increases efficiency, data accuracy, and collaboration across the organization, contributing to better performance and results in production planning processes.

Customizability is essential to ensure that your production planning solution closely aligns with each organization's unique needs and workflows. The distinction between parameterizability and customizability highlights two important aspects of adaptability of software solutions. Parameterizability emphasizes the ability to modify certain parameters or settings within the system in response to changes in the production process. This ensures flexible response to changing requirements without the need for comprehensive changes to the underlying software architecture. On the other hand, customizability focuses on the broader ability to tailor the solution to your organization's specific workflows, preferences, and business processes. This includes more extensive modifications or configurations of the software to adapt to the unique requirements and operating procedures of the organization. If a production planning solution lacks sufficient customizability, organizations may face challenges in fully integrating software into existing workflows. They may encounter resistance from users who find that the system imposes rigid limits that do not fit their best practices or preferences. By prioritizing customizability, organizations can ensure that a production planning solution effectively supports their operations and empowers users to work more efficiently and effectively. This may include working closely with software vendors or developers to implement customized solutions that meet your organization's unique needs, while also leveraging the core functionality of the software.

In ninth place, there was a three-way tie. As with capacity planning, raw material management should not be an issue when choosing a solution. Production orders for capacities can be generated when the necessary raw materials (auxiliary materials, semi-finished products) are available. When checking the availability of raw materials, it is important to have the appropriate BOM list, which, in addition to production planning, is also the basis for calculation, therefore, in principle, it should not be missing. We also need to have up-to-date information on stock developments. If there is currently no IT solution for worst-case daily mapping of inventory information, it is a good idea to address this issue before implementing a production planning program. Checking the availability of raw materials can be complicated by the fact that materials exist in different warehouses (e.g. internal warehouse, supplier warehouse), in different statuses (e.g. released, unreleased) and as traveling inventory before arrival at the warehouse. These different inventories must be managed physically and IT-wise, so that the production planner can use the inventories as quickly as possible, while avoiding an inventory shortage situation due to incorrect information.

Automatism is one of the most important aspects expected from a production planning solution. Customers rightly expect routine tasks that can be efficiently algorithmized and do not require human intervention to be performed automatically by the software. Surprisingly, optimization capability moved lower in the rankings, dropping to 20th place, with significantly fewer mentions compared to automation. This indicates that many respondents would like the program not to replace the production planner in optimization tasks, as this is not always feasible. The role of a production planner is to provide insights and make decisions based on nuanced information that can exceed the processing capabilities of the program. It is important to acknowledge that due to modelling limitations, many optimization solutions cannot match the expertise of an experienced production planner using a highly automated program with the aforementioned features.

These were the most important qualities that could be expected. The other properties mentioned more than once are only listed due to space constraints. They do not represent the opinion of the vast majority, but it is worth learning from them regardless. The remaining characteristics are: easy development, accuracy, generation of reports, management of plan variants, decision support, good data management, traceability, efficiency, cost planning, optimization, dynamism, reliability, online, real-time, change tracking.

Conclusions

The respondents represented companies of various sizes, industries, and production systems. While the survey is not representative, we believe that a larger study would yield similar findings. The analysis was conducted on the entire sample, as any subset would have been too small to provide reliable conclusions.

Among the challenges of production planning solutions, automation, interfaces, improper handling of raw materials, capacity management, lack of flexibility, data visualization, and managing multiple production phases were mentioned the most. Only a few things were mentioned more than once in the challenges of support. These were lead time, low support, lack of native language support and system knowledge, as well as lack of competence of the supporting company. The most important requirements for the production planning solution were: flexibility, transparency, simplicity, capacity planning, parameterizability, speed, integration, customizability, raw material management, automation.

The survey evaluation clearly indicated that there is potential for improvement and development in nearly all aspects of production planning in Hungary.

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