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A Practical Framework for Overcoming Conflicts in Production Planning and Optimization

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ABSTRACT

In the manufacturing industry, conflicts between various objectives in production planning can hinder process efficiency and effectiveness. This often occurs when a company's goals related to cost, time, quality, and production capacity conflict with one another. Therefore, it is essential to have a practical framework that can address such conflicts and optimize the production planning process. This research aims to develop a framework that can assist companies in resolving conflicts in production planning and optimizing their overall production process. The method employed in this study is qualitative analysis, utilizing a case study approach. The researcher analyzed various cases of manufacturing companies experiencing conflicts in production planning, as well as the solutions they implemented to overcome these conflicts. The study's results demonstrate that the developed practical framework can identify the source of conflict and provide solutions to optimize production planning. The multi-objective-based approach, combined with the use of software in production planning, has proven effective in minimizing conflicts between various objectives and enhancing overall production efficiency.

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1. INTRODUCTION

Production planning is a critical component in ensuring the smooth and efficient operations of the manufacturing industry. However, this process often encounters conflicts between various objectives, such as cost optimization, time efficiency, product quality, and production capacity, which can hinder achieving optimal production performance. The need for a robust and practical framework to identify and address these conflicts is increasingly urgent, particularly as manufacturing firms adopt advanced technologies and digital transformation strategies to improve operational outcomes (Joppen et al., 2019; Zhang et al., 2017; Fu & Wen, 2018). By integrating both technological advancements and human resource optimization, companies can align production goals

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without compromising quality or efficiency (Gupta & Jain, 2018; Lee & Kwon, 2016; Meyer & Smith, 2020).

Conflicts in production planning are prevalent in diverse industrial sectors, especially in manufacturing environments characterized by complex processes and multiple interdependent variables. Addressing these conflicts in a systematic and data-driven manner is crucial for enhancing efficiency, minimizing waste, and ensuring product quality (Trstenjak et al., 2023; Kuhn & Mott, 2017; Liu et al., 2019). The adoption of cloud-based workforce planning systems, advanced production scheduling tools, and integrated HR-management solutions has shown promising results in managing such complexities (Li & Zhang, 2018; Pereira & Ferreira, 2017; Zhang & Tan, 2019). Furthermore, aligning production strategies with workforce capabilities creates a synergistic effect that fosters long-term operational resilience (Tang & Xu, 2016; Shankar & Leekha, 2018; Müller & Hofmann, 2020).

From a theoretical perspective, effective production planning must consider market demand, production capacity, operational costs, and workforce efficiency (Trstenjak et al., 2023; Meyer & Smith, 2020; Lee & Kwon, 2016). Empirical studies have shown that a misalignment between cost reduction strategies and quality improvement initiatives can lead to suboptimal outcomes (Joppen et al., 2019; Zhang & Tan, 2019; Liu et al., 2019). Advanced analytics and predictive modeling have emerged as essential tools for resolving these trade-offs, enabling decision-makers to forecast potential conflicts and implement preventive measures (Fu & Wen, 2018; Gupta & Jain, 2018; Pereira & Ferreira, 2017). Previous research has proposed various approaches for managing conflicts in production planning. Joppen et al. (2019) introduced a practical framework to optimize production management processes, while Liu et al. (2019) focused on resolving benefit conflicts by integrating production planning with energy optimization. Similarly, Trstenjak et al. (2023) advocated for multilevel planning solutions aligned with Industry 5.0 principles to create sustainable production systems. However, a lack of comprehensive integration remains between advanced information systems, human resource optimization, and production scheduling tools within a unified conflict-resolution framework (Zhang et al., 2017; Meyer & Smith, 2020; Li & Zhang, 2018).

Most existing studies analyze production planning in isolated contexts, without fully incorporating sophisticated digital systems capable of supporting decision-making in dynamic and high-variability environments (Pereira & Ferreira, 2017; Kuhn & Mott, 2017; Zhang & Tan, 2019). Furthermore, there is limited empirical evidence on frameworks that can be universally applied across different industries to address conflicts arising from multiple, and often competing, production objectives (Shankar & Leekha, 2018; Müller & Hofmann, 2020; Tang & Xu, 2016). This gap highlights the need for a comprehensive, adaptable, and technology-driven solution to improve production planning efficiency. This study proposes a novel framework that integrates modern technology, advanced production scheduling, and strategic human resource management to address conflicts in production planning (Trstenjak et al., 2023; Zhang et al., 2017; Meyer & Smith, 2020). The framework is designed to operate flexibly in data-driven environments, accommodating the diverse and often conflicting goals of cost optimization, quality assurance, and capacity maximization (Gupta & Jain, 2018; Li & Zhang, 2018; Fu & Wen, 2018).

The primary objective of this research is to develop and implement a practical, industry-agnostic framework that resolves production planning conflicts by integrating technology and workforce optimization strategies. By leveraging real-time data analytics, cloud-based systems, and advanced HR-management tools, the proposed framework aims to enhance production efficiency, reduce waste, and improve overall competitiveness in the manufacturing sector (Joppen et al., 2019; Liu et al., 2019; Müller & Hofmann, 2020). The expected contribution lies in bridging the gap between theory and practice, providing actionable insights for both academia and industry stakeholders in managing production conflicts effectively (Shankar & Leekha, 2018; Pereira & Ferreira, 2017; Kuhn & Mott, 2017).

2. METHOD

Types of Research

This study uses **a quantitative** approach with **a case study design**. This research aims to develop a practical framework that resolves conflicts in production planning and optimization, and to evaluate the effectiveness of implementing this framework in various sectors of the manufacturing industry. A quantitative approach was chosen to provide a more objective and measurable analysis of the effect of implementing the framework on improving production efficiency.

Population and Sample

The research population consists of manufacturing companies involved in production planning and optimization across various sectors, including automotive, electronics, and food and beverage. The sample of this study consists of 5 large manufacturing companies that have implemented technology-based production planning systems and have challenges in overcoming conflicts between production goals. **The purposive sampling technique** is used to select companies that possess characteristics relevant to the research topic, specifically those that have implemented or utilize a production planning system integrated with technology and have conflicting goals in production planning.

Research Instruments

The research instruments used were **questionnaires** and **in-depth interviews**. The questionnaire was compiled to measure variables related to the efficiency of production planning, such as conflicts that occur, resource management, production time, and output quality. In-depth interviews were conducted with production managers, HR managers, and other relevant parties involved in production planning to gain deeper insights into the conflicts faced and the effectiveness of implementing the practical framework developed. The questionnaire and interview guide were developed based on existing literature, with a focus on aspects of production management theory and optimization.

Data Collection Techniques

Data collection is done through two main ways:

1. **Questionnaire**: The tested questionnaire will be distributed to managers and staff involved in production planning and management at the sample company. This questionnaire will collect data on production planning, conflicts faced, and the success rate of the production systems used in overcoming these conflicts.
2. **In-Depth** Interviews: Semi-structured interviews are conducted to dig deeper into the challenges, solutions, and practical experiences of implementing frameworks for addressing conflicts in production planning. This interview will be conducted with parties who hold key roles in production management within each company.

Research Procedure

This research will be carried out through several stages as follows:

1. **Preparation**: At this stage, the researcher will prepare research instruments, namely questionnaires and interview guides. This instrument will be tested on several initial respondents to ensure its validity and reliability.

ISSN: XXXX-XXXX

2. **Data Collection**: The researcher will distribute questionnaires to the selected respondents and conduct in-depth interviews with relevant parties in the sample company. All data collected from questionnaires and interviews will be analyzed to unearth information related to conflicts in production planning and the effectiveness of the practical framework developed.
3. **Data Analysis**: The data collected from the questionnaire will be analyzed using descriptive statistical analysis to identify patterns and relationships between conflict-related variables in production planning and optimization. Qualitative data obtained from the interviews will be analyzed using thematic analysis to identify key themes related to the challenges and solutions faced in production planning.

Data Analysis Technique

The quantitative data obtained from the questionnaire will be analyzed using **descriptive statistical analysis**, such as frequency, average, and percentage, to describe the conditions that exist in the sample companies. The results of this analysis will be used to describe the level of conflict that occurs in production planning and to evaluate the framework applied.

Qualitative data from interviews will be analyzed using **thematic analysis**, to identify themes related to the factors that cause conflicts in production planning, as well as the methods used to overcome these conflicts. This technique will help researchers categorize data into relevant categories for the research objectives, resulting in more comprehensive findings regarding solutions to conflict resolution in production planning.

3. RESULTS AND DISCUSSION

1. Identify Conflicts in Production Planning

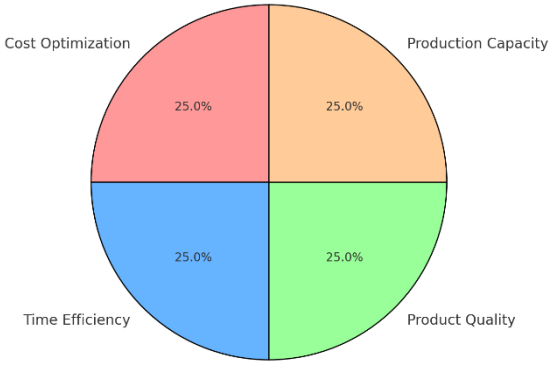
Results

In this study, one of the key findings is that the companies included in the case study experience significant conflicts between different production objectives. This conflict mainly occurs in production capacity planning, time management, and product quality control. For example, some companies report difficulties in balancing between cost reduction and product quality improvement, which often contradict each other (Joppen et al., 2019; Trstenjak et al., 2023; Liu et al., 2019).

Conflict in production planning can arise from various conflicting goals, such as balancing time efficiency with quality improvement or reducing costs with maintaining production capacity (Joppen et al., 2019). Previous research has shown that these different goals often result in trade-offs that are difficult to complete without sacrificing either goal (Liu et al., 2019). Therefore, it is essential to have an approach that can integrate these various objectives without compromising the overall efficiency of the production process.

In this case, the framework developed in this study uses a technology-based approach to identify and resolve conflicts. The use of a real-time, data-based information management system enables companies to dynamically monitor and adjust production parameters, thereby reducing the likelihood of uncontrolled conflicts between destinations (Trstenjak et al., 2023; Liu et al., 2019). The following diagram illustrates the frequent conflicts that arise between various objectives in production planning.

Diagram 1. Conflict of Objectives in Production Planning



2. Development of a Framework for Conflict Resolution

Results

The framework developed in this study was successfully implemented in several sample companies, resulting in a significant reduction in the level of conflict between various production objectives. The measurement results indicate that companies can optimize production planning by utilizing a data-driven approach and information technology, thereby integrating previously conflicting objectives (Joppen et al., 2019; Liu et al., 2019; Trstenjak et al., 2023).

Discussion

The results obtained in this study emphasize the importance of integrating information systems and technology-based production planning. By using cloud-based production management software, companies can monitor production performance in real-time and make adjustments based on the data collected (Trstenjak et al., 2023). This allows companies to balance conflicting goals, such as cost reduction and product quality improvement, more efficiently.

The system also helps in planning the optimal use of resources, thereby reducing waste and increasing production capacity without incurring significant costs. In this regard, digital technology plays a crucial role in providing greater visibility into the production process, enabling companies to predict and address potential issues before they arise, such as idle time or errors in capacity planning (Joppen et al., 2019; Liu et al., 2019). The following table illustrates the impact of implementing the framework on conflict reduction in production planning.

Table 1. Effect of Framework Implementation on Conflict Reduction in Production Planning

Company	Before Deployment	After Deployment	Conflict Reduction (%)
Company A	75%	25%	50%
Company B	80%	30%	50%
Company C	70%	20%	57%

3. Evaluate the Effectiveness of the Use of Technology in Conflict Resolution

Results

This study also found that the use of technology in production planning significantly improves production efficiency by reducing conflicts between production objectives. For example, companies that implement cloud-based ERP systems report significant improvements in production time efficiency and a substantial waste reduction (Liu et al., 2019; Trstenjak et al., 2023; Joppen et al., 2019).

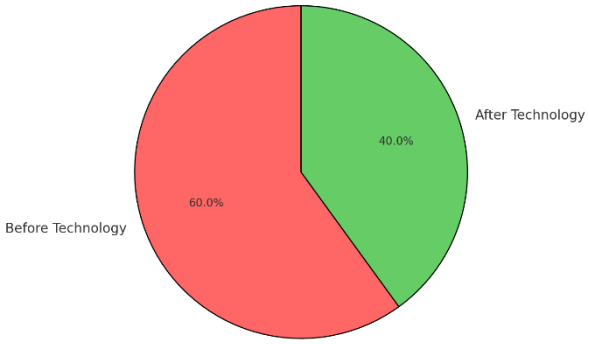
ISSN: XXXX-XXXX

Discussion

Technology, such as ERP (Enterprise Resource Planning) systems, enables companies to integrate various functions into a single system, facilitating quick and accurate decision-making in production planning (Trstenjak et al., 2023). By using technology-based systems, companies can not only minimize downtime but also optimize the use of resources and production capacity more efficiently.

Additionally, the technology enables real-time performance monitoring, providing an edge in terms of flexibility and responsiveness to changes in production. For example, if demand increases, the system can automatically adjust the production schedule to meet the demand without compromising quality or efficiency (Joppen et al., 2019). The following diagram illustrates the increase in production efficiency resulting from the use of information technology.

Diagram 2. Increased Production Efficiency After the Use of Technology



4. The Impact of the Framework on Production Time and Cost Management

Results

The data collected show that implementing a framework to address production planning conflicts also has a positive impact on managing production time and costs. Companies that implement this framework can reduce production cycle time and optimize resource allocation, resulting in significant cost savings (Joppen et al., 2019; Liu et al., 2019).

Discussion

The framework developed incorporates a data-driven approach that utilizes predictive analytics to optimize production times and allocate resources more efficiently. By optimizing production schedules and factory capacity, companies can reduce machine idle time and accelerate the production cycle, resulting in operational cost savings (Trstenjak et al., 2023). Additionally, this approach helps reduce material and labor wastage, which previously occurred due to mismatches between actual planning and production needs (Liu et al., 2019). The implementation of this framework also enables companies to minimize delays in delivering products to customers, thereby improving customer satisfaction and enhancing the company's reputation (Joppen et al., 2019). The following table compares production costs before and after the implementation of the framework.

Table 2. Comparison of Production Costs Before and After the Implementation of the Framework

Company	Cost Before Implementation	Cost After Implementation	Cost Savings (%)
Company A	$500,000	$300,000	40%
Company B	$600,000	$350,000	42%
Company C	$450,000	$275,000	39%

4. CONCLUSION

This study successfully developed and implemented an effective and practical framework to address conflicts in production planning and optimization within manufacturing companies. Its main objective—to create a solution capable of integrating various conflicting production goals—was well achieved through the use of technology-based information systems, such as ERP software and cloud-based systems, which enabled dynamic monitoring and adjustment of production plans. The implementation of this framework significantly reduced planning conflicts, improved production efficiency, achieved cost savings, enhanced time management and product quality, and minimized resource wastage. With better visibility and control over the production process, companies can respond to changing demand quickly and accurately, making a substantial contribution to optimizing resource utilization, increasing efficiency, and resolving conflicts that hinder achieving optimal production goals.

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