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requirements for Master's Degree in
Entrepreneurship and project management**

**The influence of MRP on production planning
efficiency**

Case study: Condor Electronics

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ABSTRACT:

This study aims to investigate the influence of Material Requirements Planning (MRP) on production planning efficiency at Condor Electronics, one of Algeria's leading electronics manufacturers. The study focuses on how MRP contributes to improving planning processes and the main factors affecting the efficiency of its outcomes within an industrial environment. The study adopts a qualitative single-case study approach based on five semi-structured interviews analyzed using NVIVO software and deductive thematic analysis.

The findings show that MRP improves production planning efficiency by enhancing material visibility, supporting decision-making, and improving coordination between departments. The study also reveals a reduction in stock coverage of approximately 50% following system implementation. However, system performance remains strongly affected by data reliability issues related to stock records, Bill of Materials (BOM), lead times, and interdepartmental coordination.

The study recommends improving data accuracy and coordination practices while supporting the development of advanced planning systems and AI-assisted tools within a secure data environment.

Keywords: Material Requirements Planning (MRP), Production Planning Efficiency, Supply Chain Management, Data Reliability, Condor Electronics.

RÉSUMÉ :

Cette étude vise à examiner l'influence du Material Requirements Planning (MRP) sur l'efficacité de la planification de la production au sein de Condor Electronics, l'un des Principaux fabricants d'électronique en Algérie. L'étude se concentre sur la manière dont le MRP contribue à l'amélioration des processus de planification ainsi que sur les principaux Facteurs influençant l'efficacité de ses résultats dans un environnement industriel. L'étude adopte une approche qualitative basée sur une étude de cas unique reposant sur cinq Entretiens semi-structurés analysés à l'aide du logiciel NVIVO et d'une analyse thématique

Déductive Les résultats montrent que le MRP améliore l'efficacité de la planification de la production en renforçant la visibilité des besoins en matières, en soutenant la prise de décision et en améliorant la coordination entre les départements. L'étude révèle également une réduction de la couverture des stocks d'environ 50 % après la mise en œuvre du système. Cependant, la performance du système reste fortement affectée par des problèmes de fiabilité des données Liés aux stocks, à la nomenclature (BOM), aux délais d'approvisionnement et à la coordination interservices.

L'étude recommande d'améliorer la précision des données et les pratiques de coordination Tout en soutenant le développement de systèmes de planification avancés et d'outils assistés

Par l'intelligence artificielle dans un environnement sécurisé.

Mots-clés : Material Requirements Planning (MRP), efficacité de la planification de la Production, gestion de la chaîne logistique, fiabilité des données, Condor Electronics.

ملخص

تهدف هذه الدراسة إلى بحث تأثير نظام تخطيط احتياجات المواد (MRP) على فعالية تخطيط الإنتاج في مؤسسة كوندور للإلكترونيات، إحدى أبرز المؤسسات الصناعية في قطاع الإلكترونيات بالجزائر. وتركز الدراسة على كيفية مساهمة نظام (MRP) في تحسين عمليات التخطيط وأهم العوامل التي تؤثر على كفاءة نتائجه داخل البيئة الصناعية.

تعتمد الدراسة على منهج نوعي قائم على دراسة حالة واحدة، بالاعتماد على خمس مقابلات شبه موجهة تم تحليلها باستخدام برنامج NVIVO ومنهج التحليل الموضوعاتي الاستنتاجي. أظهرت النتائج أن نظام MRP يساهم في تحسين فعالية تخطيط الإنتاج من خلال تعزيز وضوح احتياجات المواد، دعم اتخاذ القرار، وتحسين التنسيق بين الأقسام. كما كشفت الدراسة عن انخفاض في تغطية المخزون بنسبة تقارب 50% بعد تطبيق النظام. ومع ذلك، يبقى أداء النظام متأثرًا بشكل كبير بمشكلات موثوقية البيانات المرتبطة ببيانات المخزون، وقائمة المواد (BOM)، وآجال التوريد، إضافة إلى التنسيق بين الأقسام. وتوصي الدراسة بتحسين دقة البيانات وممارسات التنسيق، مع دعم تطوير أنظمة تخطيط متقدمة وأدوات مدعومة بالذكاء الاصطناعي ضمن بيئة آمنة لحماية البيانات.

الكلمات المفتاحية: تخطيط احتياجات المواد (MRP)، وفعالية تخطيط الإنتاج، إدارة سلسلة التوريد، موثوقية البيانات، كوندور للإلكترونيات.

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INTRODUCTION:

In today's industrial environment, which is marked by strong global competition and increasingly unstable demand, manufacturing firms are under constant pressure to improve how they plan and manage their production activities. In this context, production planning is generally understood as a structured process through which companies organize their resources, schedule operations, and ensure that materials are available in line with demand requirements. It plays a central role in operational performance, since any weakness at this level can directly affect efficiency, costs, and service quality (Vollmann T. , Berry, Clay Whybark, & Robert Jacobs, 2005)

When production planning is not properly managed, several operational problems tend to appear. These may include excessive inventory levels, delays in production schedules, difficulties in meeting delivery deadlines, and inefficient use of available resources. Over time, such issues can reduce profitability and weaken the competitive position of the firm.

To deal with this complexity, companies have progressively adopted information systems that support planning activities. One of the most well-known systems in this area is Material Requirements Planning (MRP). Developed in the 1960s, MRP is designed to translate demand forecasts and production plans into detailed material requirements. In other words, it helps firms determine what to produce, in what quantity, and at what time, based on structured data rather than intuition (Orlicky J. , 1975).

The logic behind MRP is relatively straightforward. If a company knows the final products it needs to deliver, the deadlines, and the components required for each product, it becomes possible to calculate the necessary production and purchasing orders. This allows firms to reduce unnecessary stock while avoiding material shortages, which can contribute to improving planning accuracy.

However, applying MRP in real industrial settings is not always as simple as it appears in theory. Many studies and professional reports emphasize that the effectiveness of MRP largely depends on the quality of the data used. Elements such as the accuracy of the bill of materials, the reliability of inventory records, and the correctness of lead times are essential for the system to function properly. In addition, coordination between different departments remains a key factor (Wight, 1984). When these conditions are not fully met, the system may generate unreliable outputs, which can create additional planning difficulties instead of solving them.

This gap between the theoretical benefits of MRP and the challenges of its practical implementation has been widely discussed in the literature. Researchers have shown that

organizational factors, internal processes, and the overall context in which the system is used can strongly influence its performance (Ptak & Schragenheim, 2000) (Vollmann T. , Berry, Clay Whybark, & Robert Jacobs, 2005).

In Algeria, industrial companies have started to modernize their operations by introducing more structured planning systems. Among them, Condor Electronics represents an interesting case, given the scale and complexity of its activities. The company operates in an environment where demand can fluctuate, products are composed of multiple components, and coordination between departments is essential.

During an internship carried out within the Supply Chain and Production Planning department, it was observed that MRP principles are indeed used in practice. However, several difficulties were also identified, particularly related to data accuracy, communication between departments, and certain scheduling issues. These challenges appear to influence the overall effectiveness of the planning process.

Based on these observations, this study aims to examine the influence of MRP on production planning efficiency in Condor Electronics. Although the existing literature provides valuable theoretical insights, there is still a lack of empirical studies focusing on the Algerian context. This research therefore seeks to contribute both to academic knowledge and to a better understanding of how such systems operate within real industrial environments.

1. Research Problem

In an increasingly competitive industrial environment, companies face significant challenges related to the effective management of production operations. Demand variability, process complexity, and resource constraints require planning systems that are both accurate and responsive.

MRP systems are widely adopted as tools designed to improve operational performance by ensuring better alignment between material requirements and production activities. However, despite their widespread use, many firms encounter difficulties in fully leveraging these systems.

Indeed, the effectiveness of MRP is not solely determined by its technical capabilities, but also by critical organizational factors. In particular, poor data quality such as inaccurate or

incomplete information can lead to incorrect planning decisions, while insufficient interdepartmental coordination may disrupt the consistency of data flows and reduce overall system performance.

Within this context, and Given that Condor Electronics is among the first Algerian companies to implement Material Requirements Planning (MRP) within its production planning processes, and considering that this implementation is still at an early stage, having been adopted only at the beginning of 2026, it becomes essential to examine how MRP systems actually influence production planning efficiency and under what organizational conditions this influence can be maximized.

Accordingly, the research problem is formulated as follows: **How does the use of a Material Requirements Planning (MRP) system influence production planning efficiency in the case of Condor Electronics?**

2. Research Questions

To address the central research problem, this study is structured around the following analytical sub-questions:

- RQ1: What are the main theoretical foundations of MRP, and how is its relationship with production planning efficiency?
- RQ2: How is MRP practically used within the production planning processes of Condor Electronics?
- RQ3: To what extent does MRP contribute to improving planning efficiency (lead time reduction, inventory optimization, decision-making improvement)?
- RQ4: What organizational factors (data quality, coordination practices) affect the way MRP is used and its outcomes?
- RQ5: What are the practical limitations of MRP systems, and what improvements can be proposed?

3. Research Objectives :

The primary objective of this study is to analyze the influence of the Material Requirements Planning (MRP) system on production planning efficiency, while taking into account the organizational factors that condition its effectiveness.

More specifically, this research aims to demonstrate

that although MRP is a powerful planning tool, its effectiveness largely depends on data quality and organizational coordination.

To achieve this objective, the study is structured around several sub-objectives:

- To analyze the role and importance of the MRP system in the production planning process at Condor Electronics;
- To evaluate the impact of MRP on production planning efficiency, particularly in terms of lead time reduction, inventory optimization, and decision-making improvement;
- To identify the practical limitations of MRP systems within the studied context;
- To propose concrete organizational and operational recommendations aimed at improving MRP effectiveness and production planning performance.

4. Significance of the Study:

4.1 Theoretical Contribution

This study contributes to the academic literature on production management and information systems by offering an empirically grounded examination of the influence of MRP on planning efficiency within a large Algerian industrial firm. From a theoretical standpoint, it extends the application of MRP research to an organizational and institutional context that has been substantially underrepresented in the scholarly literature, thereby enriching the collective understanding of how structured planning systems perform in environments characterized by specific resource constraints, coordination dynamics, and data management challenges.

Furthermore, by explicitly incorporating mediating organizational variables namely data quality and human coordination into the analytical framework, this research moves beyond simplistic input-output perspectives on MRP performance. It instead advances a more nuanced

conceptualization of MRP effectiveness as a contingent and organizationally embedded phenomenon, consistent with contemporary theoretical developments in the operations management and information systems literatures.

4.2 Managerial and Practical Contribution

From a managerial perspective, the study's findings are intended to provide direct practical value to production and operations managers responsible for implementing, sustaining, or improving MRP-based planning systems. By identifying the specific organizational factors that facilitate or constrain the effective use of MRP, the research offers actionable guidance for practitioners seeking to diagnose planning inefficiencies and design targeted improvement interventions. The case of Condor Electronics, as a representative large-scale Algerian manufacturer, serves as a concrete and contextually relevant reference for industrial firms operating under comparable conditions.

5. Research Structure

This research is structured as follows: The study begins with a general introduction presenting the research background, objectives, problem statement, and methodology. It is then organized into three main chapters:

- ✓ Chapter 1 is devoted to the literature review and theoretical framework, providing clear definitions and conceptual foundations related to MRP and production planning efficiency.
- ✓ Chapter 2 presents the research methodology and describes the organizational context in which the empirical study was conducted.
- ✓ Chapter 3 outlines the empirical findings, followed by a detailed discussion of the results.

Finally, the study concludes with a synthesis of the main findings, along with a discussion of its limitations and potential avenues for future research.

6. Scope of the Study

The boundaries of this research are defined along the following dimensions:

Temporal Scope: The empirical phase of the study was conducted between March and May 2026, corresponding to the internship period within Condor Electronics.

Spatial and Organizational Scope: The study is limited to Condor Electronics, an Algerian manufacturing company located in Bordj Bou Arréridj. The focus is specifically on the Supply Chain and Production Planning division where MRP is actively used. The findings are context specific and are not intended for statistical generalization beyond the organization.

Human Scope: The study targets employees directly involved in the research subject. Participants were selected purposively based on their operational experience with MRP-based processes.

Thematic Scope: The analysis focuses on the influence of MRP on production planning efficiency, examined through four operational dimensions: scheduling accuracy, inventory management, lead time reliability, and inter-departmental coordination. The study further considers data quality and human coordination as key mediating factors shaping this relationship. Aspects such as financial performance, ERP integration, and strategic-level decision-making are excluded from the scope, as they fall outside the analytical boundaries of this research.

Methodological Scope and Limitations: As a qualitative single-case study, this research is subject to inherent limitations related to contextual specificity and interpretive analysis. The findings are therefore context-bound and cannot be generalized beyond the studied case.

The study relies primarily on semi-structured interviews as the main data collection method. While this approach enables an in-depth understanding of participants' experiences and perceptions, it may also introduce subjectivity and potential bias. To enhance the credibility and trustworthiness of the findings, careful attention was given to interview design, consistency in data collection, and systematic thematic analysis. However, the reliance on a single data source may limit the robustness of the findings compared to studies using multiple sources or triangulation.

**CHAPTER 1: LITERATURE
REVIEW AND THEORETICAL
FRAMEWORK**

This chapter provides a literature review for previous studies related to our subject followed by a comprehensive theoretical foundation for the study. It is organized into three main sections: the first examines Material Requirements Planning (MRP) in depth its definition, objectives, components, functioning, and limitations; the second explores the concept of production planning from both theoretical and managerial perspectives; and the third synthesizes existing knowledge on the relationship between MRP and production planning efficiency.

Section 1: Literature review:

Through this literature review, we will expose in a non-exhaustive way the current literature related to the theme of this research, for the purpose of placing and situating it on a model of analysis.

1. Fundamentals of Material Requirements Planning (MRP):

The concept of Material Requirements Planning (MRP) was initially developed to address the limitations of traditional inventory management systems in handling dependent demand. The pioneering work of Joseph Orlicky laid the foundation for MRP by introducing a structured approach to material planning based on the relationship between finished products and their components (Orlicky, 2011).

MRP systems are based on three essential inputs: the master production schedule (MPS), the bill of materials (BOM), and inventory records. Through a process known as BOM explosion, the system calculates the required quantities of components needed to meet production targets. This is followed by netting procedures that account for existing inventory and scheduled receipts, and lead-time offsetting to determine when orders should be placed.

This structured approach allows organizations to move from reactive to proactive planning, thereby improving coordination and reducing inefficiencies. As noted by Vollmann and his colleagues, MRP plays a central role in aligning production activities with demand requirements across the supply chain. This book provides a comprehensive framework for manufacturing planning and control (MPC) systems, positioning Material Requirements Planning (MRP) as a core component of production and supply chain coordination. It explains how MRP transforms demand from the Master Production Schedule into detailed material requirements through structured planning logic.

The authors emphasize that MRP is not an isolated system but part of an integrated hierarchy of planning decisions that connect strategic, tactical, and operational levels. The system enables organizations to synchronize production activities with customer demand by ensuring that materials are available at the right time and in the right quantity.

The book further highlights that effective MRP implementation improves coordination across the supply chain by reducing delays, minimizing inventory imbalances, and enhancing production visibility. However, its performance depends heavily on data accuracy and system integration (Vollmann, Berry, Whybark, & Jacobs, 2017)

2. MRP and Production Planning Efficiency:

A substantial body of literature has examined the relationship between MRP systems and production planning efficiency. Early research established that MRP improves coordination and reduces inventory levels; however, more recent studies have highlighted the conditions under which these benefits are realized.

For instance, Whybark and Williams conducted a simulation-based study to analyze the effects of forecast bias and demand uncertainty on MRP performance. This study examines how forecast errors and demand variability influence the performance of Material Requirements Planning systems. Using a simulation-based model of a multi-level production system, the authors analyze how different levels of uncertainty affect inventory levels, lead times, and service performance. The results show that MRP systems are highly sensitive to forecast bias, which leads to inefficiencies such as excess inventory and reduced responsiveness. Their findings indicate that inaccuracies in demand forecasting can significantly undermine the effectiveness of MRP systems. Specifically, forecast bias leads to excessive inventory and longer lead times, while demand variability reduces service levels (Whybark, 2002).

Similarly, Lau in his research in 2003, he investigated the impact of operational uncertainties such as machine breakdowns and supply delays. The study demonstrated that these disruptions can propagate through the MRP system, leading to increased delays and reduced reliability. These findings suggest that the effectiveness of MRP is contingent upon both informational and operational stability. (Lau, 2003)

In addition, (Ho, 1989) introduced the concept of “MRP nervousness,” referring to the instability caused by frequent changes in input data. The study highlights that even minor fluctuations in demand or lead times can result in significant changes in production schedules,

thereby reducing planning efficiency. Using analytical modeling, the research demonstrates that MRP systems are highly sensitive to input variations, which can lead to frequent rescheduling and reduced planning stability. (Ho, 1989)

3. Inventory Management and Optimization in MRP Systems

Inventory management is a core function of MRP systems, which aim to balance material availability with cost efficiency. Traditional MRP approaches focus on minimizing inventory levels through accurate demand calculations and time-phased planning.

However, determining optimal lot sizes and safety stock levels remains a complex challenge. (Karimi, 2003) reviewed various models addressing the lot-sizing problem and emphasized the trade-off between production efficiency and inventory costs. Their work highlights the importance of optimization in enhancing MRP performance. The study synthesizes existing literature and discusses how production quantities can be optimized under capacity constraints. It highlights the trade-off between inventory costs and production efficiency, which is central to MRP decision-making. (Karimi, 2003)

More recent studies have adopted advanced analytical techniques to address these challenges. For example, Hadj-Hamou and Penz proposed a simheuristic approach that integrates simulation with heuristic optimization. This study proposes a simheuristic approach combining simulation and heuristic optimization to improve MRP performance under uncertainty. The model evaluates different configurations of lot sizes, safety stock, and lead times. The results show that optimized parameters significantly reduce total costs while improving service levels in stochastic production environments. (Hadj-Hamou, 2022)

These contributions indicate a shift in the literature toward more sophisticated approaches that enhance the robustness and efficiency of MRP systems.

4. Integration of MRP with ERP and JIT Systems

The evolution of MRP systems has been closely linked to their integration with other production and enterprise management systems. Benton and Shin examined the integration of MRP with Just-In-Time (JIT) systems, highlighting the complementary strengths of the two approaches.

While MRP provides a structured framework for planning and scheduling, JIT focuses on execution efficiency by reducing waste and improving responsiveness. The integration of these

systems results in improved production flow, reduced inventory levels, and enhanced coordination. (Benton, 1998)

Furthermore, the development of ERP systems has expanded the capabilities of MRP by integrating it with various organizational functions. Jacobs and Weston argue that ERP systems improve decision-making by providing real-time access to information and eliminating data silos. This integration enhances the overall efficiency of production planning processes. This paper reviews the evolution of Enterprise Resource Planning (ERP) systems from traditional MRP systems. It highlights how ERP integrates multiple business functions into a unified system, improving data visibility and decision-making. The study emphasizes that ERP enhances production planning efficiency by enabling real-time information flow. (Jacobs, 2007).

5. Advanced Developments: Demand-Driven MRP and Industry 4.0:

Recent advancements in production planning have led to the development of more adaptive systems such as Demand-Driven MRP (DDMRP). Shamsuzzoha and Jaakkola in their study demonstrated that DDMRP improves system responsiveness by using strategic buffers to absorb demand variability. This case study investigates the implementation of Demand-Driven MRP (DDMRP) in a multinational manufacturing context. The findings show that DDMRP improves material flow and reduces demand variability effects by using strategic buffers and decoupling points, leading to improved responsiveness. (Shamsuzzoha, H, & Jaakkola, 2024).

In parallel, the emergence of Industry 4.0 technologies has transformed production planning systems. Ivanov, D and his colleagues. in their study highlighted the role of digital technologies, such as real-time data analytics and automation, in enhancing production planning efficiency. and analyzes the influence of Industry 4.0 technologies on production planning and supply chain systems. It shows that digitalization enhances system responsiveness, flexibility, and resilience by enabling real-time data processing and advanced analytics. These technologies enable more flexible and responsive systems capable of adapting to dynamic environments.

Together, these developments reflect a shift from static planning models toward more dynamic and resilient systems. (Ivanov, Dolgui, & Sokolov, 2019).

6. Implementation Challenges in Developing Countries

Despite the advantages of MRP systems, their implementation in developing countries presents significant challenges. Nait-Saada examined ERP adoption in Algerian companies and identified several barriers, including resistance to change, lack of technical expertise, and inadequate infrastructure. This study examines ERP adoption in Algerian companies using survey data. The results indicate that ERP systems improve operational performance, particularly in cost control and delivery reliability. However, the study also highlights barriers such as resistance to change, lack of expertise, and infrastructural limitations.

These challenges highlight the importance of organizational and contextual factors in determining the success of MRP systems. Unlike developed countries, where technological infrastructure is well established, developing economies often face constraints that limit the effectiveness of such systems. (Nait-Saada, 2023)

7. Synthesis of the Literature

The reviewed literature demonstrates that MRP systems play a crucial role in improving production planning efficiency by enhancing coordination, reducing inventory levels, and increasing scheduling accuracy. However, their effectiveness is influenced by several factors, including data accuracy, demand stability, and system integration.

Table 1: Summary of Key Studies on MRP and Production Planning

Author	Year	Topic	Main Findings
Orlicky	1975	MRP fundamentals	MRP improves inventory planning and introduced the structured logic of MRP based on dependent demand
Whybark & Williams	2002	Forecast bias and demand uncertainty	Forecast errors reduce MRP efficiency by causing excess inventory and longer lead times
Lau	2003	Operational uncertainties	Machine breakdowns and supply delays negatively affect MRP reliability and production flow
Ho	1989	MRP nervousness	Frequent small changes in demand create instability and constant rescheduling
Karimi et al.	2003	Lot sizing optimization	Optimal lot sizing improves inventory control and production efficiency
Benton & Shin	1998	MRP and JIT integration	Combining MRP with JIT improves production flow and reduces waste
Jacobs & Weston	2007	ERP integration	ERP enhances MRP by improving real-time information flow and decision-making
Shamsuzzoha & Jaakkola	2024	Demand-Driven MRP (DDMRP)	Strategic buffers improve responsiveness and reduce demand variability effects
Ivanov et al.	2019	Industry 4.0 and MRP	Digital technologies improve flexibility, resilience, and production planning efficiency
Nait-Saada	2023	ERP adoption in Algeria	ERP improves operational performance but faces implementation barriers in Algerian companies

Source: Compiled by the student based on previous studies

As illustrated in **Table 1.1**, the literature consistently highlights the role of MRP in improving inventory control, coordination, and planning efficiency. However, it also reveals several limitations, particularly related to data accuracy, uncertainty, and implementation challenges, especially in developing country contexts.

Moreover, the evolution of MRP systems from traditional models to ERP-integrated systems and DDMRP reflects ongoing efforts to address the limitations of earlier approaches and adapt to increasingly complex manufacturing environments.

8. Research Gap

Despite the extensive research on MRP systems, several gaps remain. Most studies have been conducted in developed countries, with limited attention given to developing economies. In particular, there is a lack of empirical research focusing on the Algerian industrial context.

Furthermore, existing studies tend to emphasize technical aspects while overlooking organizational and environmental factors. This gap is particularly relevant in developing countries, where such factors play a critical role in system performance.

Therefore, this study aims to investigate the influence of MRP on production planning efficiency in Condor Electronics, providing context-specific insights into the challenges and outcomes of MRP implementation in Algeria.

Section 2: Material Requirements Planning (MRP):

This section traces the conceptual and technical dimensions of MRP from its foundational definition, through its principal objectives and structural components, to the procedural logic that governs its operation before critically assessing the advantages it confers and the limitations it entails.

1.1 Definition of Material Requirements Planning:

To understand The Influence of Material Requirements Planning (MRP) on Production Planning Efficiency, we need to comprehend what Material Requirements Planning (MRP) is and why firms use it, how it operates, and what benefits and constraints are associated with its application. In manufacturing environments.

Production planning and control constitute core functions within manufacturing systems, as they aim to ensure the effective coordination of resources, materials, and production activities in response to demand requirements. As noted by Nigel Slack and Alistair Brandon Jones (Slack & Jones, 2019), the increasing complexity of manufacturing operations has necessitated the adoption of structured planning systems capable of managing interdependent processes while minimizing inefficiencies such as excess inventory and production delays.

In a similar vein, Jay Heizer, Barry Render, and Chuck Munson argue that modern production environments require integrated information systems that can effectively link demand forecasts with operational execution (Heizer, Render, & Munson, 2017).

One of the fundamental challenges in production management is the handling of dependent demand, whereby the requirement for components and raw materials is directly derived from the demand for finished goods. Unlike independent demand, which must be forecasted, dependent demand can be calculated based on product structure.

According to Joseph Orlicky, traditional inventory management approaches are inadequate in such contexts because they fail to capture the hierarchical relationships between finished products and their components. This limitation highlighted the need for a systematic and logic-based approach to determine material requirements. (Orlicky J. , 1975)

Material Requirements Planning (MRP) emerged in the 1960s as a response to these challenges and was later formalized by Orlicky. He conceptualized MRP as a structured system that translates the master production schedule (MPS) into detailed, time-phased requirements for components and raw materials by utilizing the bill of materials (BOM) and inventory status records. This definition emphasizes the analytical and forward-looking nature of MRP, which enables organizations to plan material flows proactively rather than reactively (Orlicky J. , 1975).

Subsequent academic contributions have expanded this foundational definition by emphasizing the technological and integrative dimensions of MRP systems. For example, in the textbook of Operations Management: Sustainability and Supply Chain Management by Jay Heizer and the others, they define MRP as a computerized information system designed to manage dependent demand by integrating essential data inputs, including the master production schedule, inventory records, and lead times. This perspective highlights the role of MRP in ensuring material availability while simultaneously reducing unnecessary inventory accumulation (Heizer, Render, & Munson, 2017).

Similarly, Nigel Slack and Alistair Brandon-Jones describe MRP as a planning and control mechanism that coordinates manufacturing activities through time-phased scheduling of materials. Their definition underscores the importance of synchronization across different stages of the production process, particularly in complex manufacturing environments characterized by multi-level product structures. (Slack & Jones, 2019).

From a professional and standardized perspective, the Association for Supply Chain Management defines MRP as a set of techniques that utilize bill of materials data, inventory status information, and the master production schedule to compute material requirements. This definition is widely accepted in both academic and industrial contexts, as it clearly identifies the fundamental data inputs upon which MRP systems rely (Blackstone, 2018) .

More recent developments further position MRP as part of an integrated planning framework. According to Carol Ptak and Chad Smith (Ptak & Smith, Orlicky's Material Requirements Planning, 2016), modern interpretations of MRP emphasize its role in synchronizing supply

with demand across multiple levels of the bill of materials, thereby improving responsiveness and reducing variability in production systems. This reflects the evolution of MRP from a purely computational tool into a broader decision-support system.

In light of these perspectives, Material Requirements Planning (MRP) can be defined as a systematic and computerized approach that transforms production plans into time-phased material requirements by integrating key data inputs such as the master production schedule, bill of materials, and inventory records. Beyond its technical dimension, MRP also constitutes a managerial framework that enhances coordination between procurement, production, and inventory management functions, thereby contributing to improved operational efficiency and cost control.

1.2 Objectives of MRP:

Material Requirements Planning (MRP) is a structured production planning and control system designed to translate dependent demand derived from finished goods into time-phased requirements for components and raw materials. It is widely recognized in operations management literature as an information-processing system that integrates production scheduling with inventory control through the use of the Master Production Schedule (MPS), Bill of Materials (BOM), and inventory records (Orlicky J. , 1975) (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005).

The objectives of MRP are multidimensional and primarily focus on improving coordination between demand and supply within manufacturing systems, enhancing planning accuracy, and supporting efficient resource utilization.

1.2.1 Demand-Driven Material Availability

One of the core objectives of Material Requirements Planning (MRP) is to ensure that materials are available at the exact time they are required for production activities. This objective is grounded in the principle of dependent demand, where material requirements are derived from the production schedule of finished goods rather than independent forecasting.

MRP systems achieve this by using the Master Production Schedule (MPS) and Bill of Materials (BOM) to calculate time-phased requirements, a mechanism originally formalized by (Orlicky J. , 1975) and further developed in production planning literature.

According to Vollmann, this structured decomposition of requirements allows firms to coordinate material flows more effectively across multiple production levels (Vollmann, Berry,

& Whybark, Manufacturing planning and control for supply chain management, 2005). Similarly, Krajewski emphasize that MRP improves synchronization between production schedules and material availability, reducing the risk of misalignment between demand and supply (Krajewski, Ritzman, & Malhotra, 2013).

Heizer also highlight that MRP contributes to more structured planning processes by translating production plans into detailed material requirements over time (Heizer, Render, & Munson, 2017).

1.2.2 Inventory Reduction and Cost Efficiency

Another fundamental objective of MRP is the reduction and optimization of inventory levels while maintaining production continuity. Traditional inventory systems rely heavily on safety stock to manage uncertainty; however, MRP replaces this approach with time-phased, requirement-based ordering.

According to Slack and Brandon-Jones, this transition allows organizations to reduce unnecessary inventory holding by aligning procurement decisions more closely with actual production requirements (Slack & Jones, 2019). (Krajewski, Ritzman, & Malhotra, 2013) further argue that MRP systems contribute to lower inventory costs by reducing excess stock and improving material planning accuracy in the 10th edition of Operations management: Processes and supply chains.

In addition, (Heizer, Render, & Munson, 2017)note that inventory related costs including warehousing and capital holding costs can be significantly reduced when material requirements are planned systematically. this view was also supported by (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) by explaining that MRP improves resource utilization by minimizing inefficiencies in ordering and stock accumulation.

1.2.3 Production Coordination and System Integration

A key objective of Material Requirements Planning (MRP) lies in its ability to improve coordination across core production functions, particularly production planning, procurement, and inventory control. In many manufacturing settings, these functions tend to operate in a fragmented manner, which often results in mismatches between material availability and production needs. Such misalignment can lead to inefficiencies including delays, excess inventory, or disruptions in production flow. MRP addresses this issue by bringing these

elements together within a structured and integrated planning system (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005).

At the core of this integration is the interaction between the Master Production Schedule (MPS), the Bill of Materials (BOM), and inventory status records. As originally described by (Orlicky J. , 1975), MRP translates overall production plans into detailed material requirements by linking finished products to their component structures. In practical terms, this allows firms to move from aggregate planning to more precise, time-phased decisions. (Heizer, Render, & Munson, 2017) note that such coordination enables organizations to better align material availability with production activities, thereby supporting smoother and more consistent operations.

From a broader operational perspective, this integration can also reduce inconsistencies across departments. (Krajewski, Ritzman, & Malhotra, 2013) point out that when procurement decisions are closely aligned with production schedules, organizations are less likely to face discrepancies in planning outcomes. In the same vein, (Slack & Jones, 2019) highlight that integrated planning systems contribute to greater process stability, as they ensure that material flows are managed in line with actual operational requirements rather than independently.

Taken together, these elements suggest that MRP should not be viewed merely as a tool for calculating material needs, but rather as a system that supports coordination and coherence across the entire production process (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) (Krajewski, Ritzman, & Malhotra, 2013).

1.2.4 Customer Service and Delivery Performance

Beyond internal coordination, MRP also plays an important role in supporting customer service performance, particularly through its influence on delivery reliability. In manufacturing environments, the ability to meet delivery deadlines is closely tied to how well materials and production schedules are managed. When planning is inaccurate or poorly coordinated, delays in order fulfillment become more likely (Heizer, Render, & Munson, 2017).

By structuring material requirements in line with production schedules, MRP can help reduce such disruptions and support more reliable execution. (Krajewski, Ritzman, & Malhotra, 2013) suggest that improved planning accuracy contributes to greater consistency in production processes, which in turn enhances the firm's ability to meet customer demand on time. While MRP does not eliminate all sources of uncertainty, it provides a more disciplined approach to planning that can reduce variability in operations.

This link between planning and service performance is also emphasized in the broader operations management literature. (Slack & Jones, 2019) argue that effective planning and control systems are essential for achieving dependable delivery performance, especially in complex production environments. Similarly, the Association for Supply Chain Management (Assoyciation for supply chain managment, 2018)highlights that well-implemented material planning systems contribute to operational reliability, which is a key driver of customer satisfaction.

In this sense, the contribution of MRP to customer service is largely indirect, operating through its impact on planning accuracy and coordination rather than through direct interaction with customers (Heizer, Render, & Munson, 2017) (Assoyciation for supply chain managment, 2018).

1.2.5 Decision Support and Planning Visibility

In addition to its operational role, MRP can also be understood as a system that supports managerial decision-making. One of the main challenges in production environments is the lack of clear and timely information regarding future material requirements and inventory positions. Without such visibility, decision-making tends to be reactive rather than proactive. MRP addresses this limitation by providing structured, time-phased information that can guide planning activities (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005).

(Heizer, Render, & Munson, 2017) explain that the outputs generated by MRP systems such as planned order releases and net material requirements offer managers a forward-looking view of production needs. This allows organizations to anticipate potential issues, such as material shortages or excess inventory, and take corrective action in advance. In this way, MRP contributes to reducing uncertainty in day to day operational decisions.

A similar argument is made by (Krajewski, Ritzman, & Malhotra, 2013), who emphasize that improved transparency across the production system enhances the quality of decision-making. When managers have access to accurate and timely information, they are better equipped to coordinate activities and allocate resources efficiently. (Slack & Jones, 2019)further reinforce this idea by highlighting the importance of visibility as a key enabler of effective operations management.

Overall, MRP supports decision-making by transforming dispersed and often fragmented data into structured information that can be used to guide planning and control processes (Vollmann,

Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) (Krajewski, Ritzman, & Malhotra, 2013).

1.2.6 Integrated Perspective on MRP Objectives

When considered collectively, the objectives of MRP reflect a broader, integrated approach to production planning. Rather than operating as separate functions, material availability, inventory control, production coordination, customer service, and decision support are closely interconnected. Improvements in one area often have implications for others, highlighting the systemic nature of MRP.

(Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) describe MRP as a hierarchical planning system in which decisions at different levels are interdependent. For example, accurate material planning contributes to smoother production processes, which in turn supports more reliable delivery performance. In a similar vein, (Krajewski, Ritzman, & Malhotra, 2013) argue that the effectiveness of MRP lies in its ability to integrate multiple planning dimensions into a coherent framework.

(Heizer, Render, & Munson, 2017) further emphasize that the value of MRP stems from this integration, as it enables organizations to coordinate resources, reduce inefficiencies, and improve planning accuracy across the production system. This interconnected structure means that MRP should be understood not simply as a technical tool, but as a comprehensive system that supports overall operational performance.

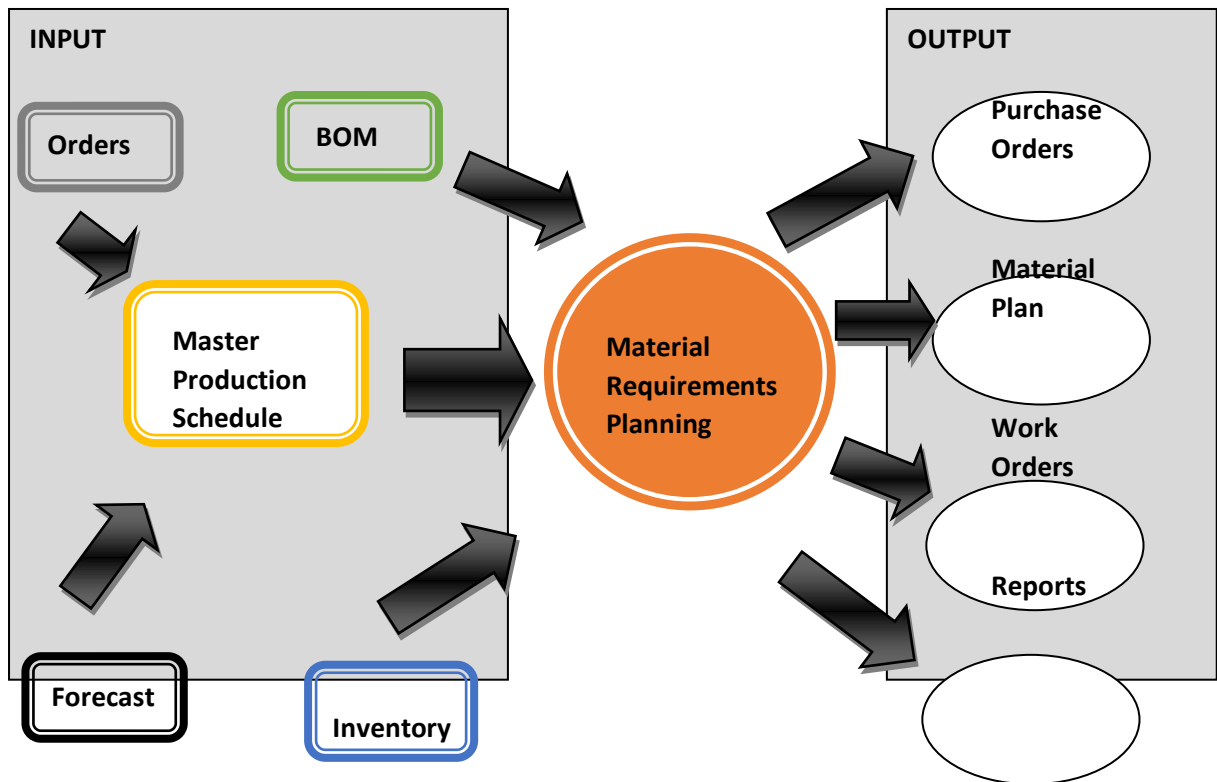
Consequently, MRP can be seen as a central component of manufacturing planning, facilitating the alignment between demand, materials, and production activities in a structured and consistent manner (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) (Heizer, Render, & Munson, 2017).

1.3 Components of MRP (MRP Inputs and outputs):

Material Requirements Planning (MRP) is widely recognized as a foundational planning methodology within manufacturing systems, designed to translate dependent demand into structured, time-phased material plans. In the operations management literature, MRP is not merely a computational procedure but a coordinated decision-support system that integrates demand information, product structure, and inventory status into a unified planning logic. Its effectiveness is strongly conditioned by data integrity and system discipline, which directly influence production planning efficiency and operational stability (Orlicky J. , 1975)

(Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) (Stevenson, 2018) .

Figure 1: Structure of Material Requirements Planning (MRP) System



Source: (Aquilano, Chase, & Jacobs, 2006)

From a systems theory perspective, MRP functions as a hierarchical decomposition mechanism that transforms aggregate production intentions into detailed material requirements across multiple levels of production. However, literature consistently emphasizes that this transformation is highly sensitive to input quality and structural consistency, meaning that MRP performance is as much organizational as it is technical in nature (Nahmias, 2009) (Krajewski, Ritzman, & Malhotra, 2013) (Silver, PYKE, & peterson, 1998) .

1.3.1 MRP Inputs:

The input architecture of MRP constitutes a tightly interconnected information system composed of three primary subsystems. These subsystems collectively determine the accuracy, stability, and responsiveness of production planning outcomes. In advanced manufacturing literature, they are often conceptualized as the “data triad” of MRP systems.

1.3.1.1 Demand Translation Layer: Master Production Schedule (MPS)

The Master Production Schedule (MPS) represents the highest level of demand translation within the MRP hierarchy, converting aggregate forecasts and customer requirements into disaggregated production quantities over a defined time horizon.

(Orlicky J. , 1975) originally positioned the MPS as the initiating driver of all MRP computations, establishing its role as the primary trigger for dependent demand generation. (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) extend this view by framing the MPS as the operational interface between strategic production planning and execution-level scheduling. Stevenson (2018) further highlights that the MPS serves as a capacity-sensitive planning instrument that aligns production feasibility with market demand expectations.

From a critical perspective, the literature also indicates that MPS instability (frequent revisions or forecasting errors) significantly reduces system efficiency by generating volatility in downstream planning processes, thereby increasing operational uncertainty and workload in production systems.

1.3.1.2 Product Structural Logic Layer: Bill of Materials (BOM)

The Bill of Materials (BOM) represents the structural decomposition logic of manufactured products, defining the hierarchical relationships between finished goods, subassemblies, and raw materials.

(Orlicky J. , 1975) conceptualizes the BOM as the structural foundation that enables requirement explosion, where a single end-item demand is systematically translated into multiple dependent component demands. (Krajewski, Ritzman, & Malhotra, 2013) emphasize that the BOM acts as a configuration control mechanism that ensures consistency in material planning across production stages. (Heizer, Render, & Munson, 2017) further underline its role in standardizing production structure and enabling repeatability in manufacturing operations.

(Silver, PYKE, & peterson, 1998) add a more analytical perspective, noting that BOM accuracy is mathematically critical because structural errors propagate exponentially through multi-level product hierarchies.

From a research standpoint, BOM quality is not only a technical issue but also an organizational coordination problem, particularly in environments with engineering changes or customized production systems.

1.3.1.3 System State Layer: Inventory Status and Control Records

Inventory status records represent the real-time system state of all materials within the production environment, including on-hand inventory, scheduled receipts, and lead time parameters.

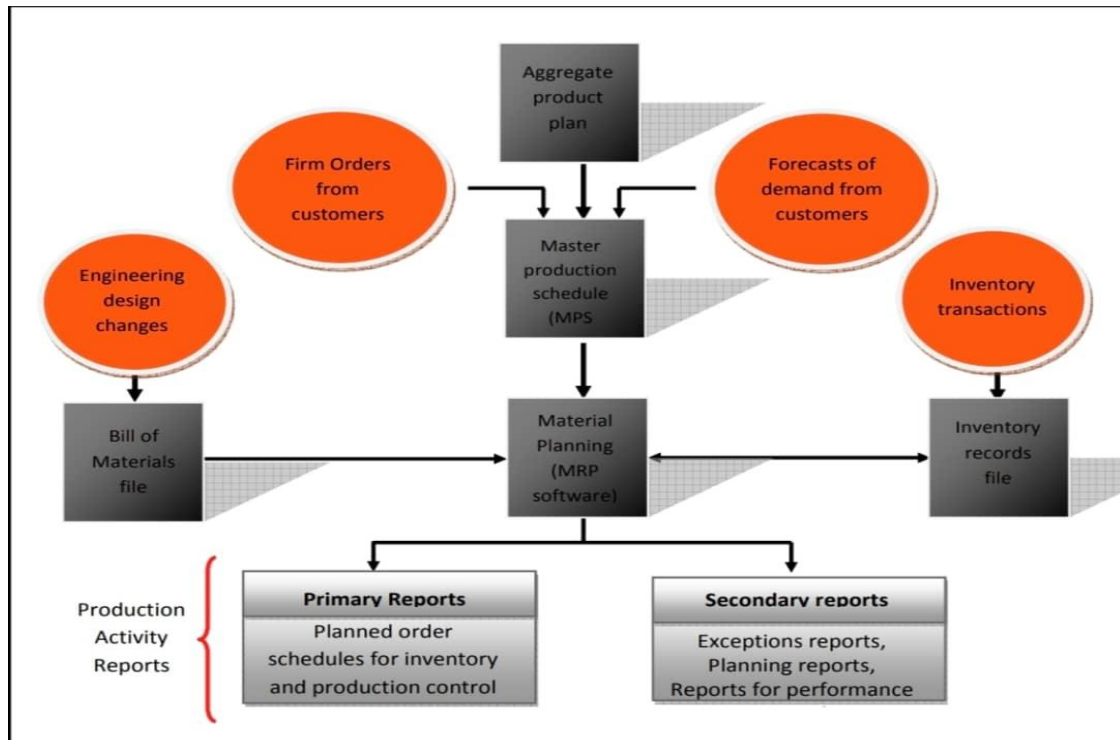
(Nahmias, 2009) emphasizes that inventory status is central to transforming gross requirements into net requirements, thereby preventing redundant ordering. Silver et al. (1998) further develop this perspective by positioning inventory data accuracy as a key determinant of inventory system performance under uncertainty. (Stevenson, 2018) also highlights that inventory visibility reduces operational ambiguity and enhances responsiveness in production environments.

(Krajewski, Ritzman, & Malhotra, 2013) argue that inventory records function as a dynamic feedback mechanism, enabling continuous adjustment of planning decisions in response to real system conditions.

Critically, literature also shows that inventory inaccuracies often caused by transaction delays, system misalignment, or human error are among the most significant sources of MRP system failure in real industrial settings.

The structural composition of MRP inputs and their integration within the system can be further clarified through the following figure, which illustrates the main input data and the corresponding outputs generated by the MRP process. (Aquilano, Chase, & Jacobs, 2006).

Figure 2: Input-Driven Structure of the Material Requirements Planning (MRP) System



Source: (Aquilano, Chase, & Jacobs, 2006)

The input configuration of the Material Requirements Planning (MRP) system demonstrates a highly structured and interdependent data framework, where demand information, product structure, and inventory records collectively form the basis for planning computations. As illustrated in Figure 1, these inputs are systematically processed to ensure consistency and alignment within the production planning system. According to Aquilano, Chase and Jacobs (2006), this integration of inputs is essential for generating reliable planning outputs, which will be further discussed in the following section.

1.3.2 MRP outputs:

The output structure of MRP transforms computational results into actionable production and procurement decisions. These outputs are inherently time phased and are designed to synchronize material flow with production requirements.

1.3.2.1 Net Requirement Derivation Mechanism

Net requirements represent the adjusted material needs after accounting for existing inventory positions and scheduled inflows.

this netting process has been identified by (Orlicky J. , 1975) as the logical core of MRP functionality. (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) explain that netting enables the reduction of excess inventory by ensuring that procurement decisions are strictly demand-driven. (Heizer, Render, & Munson, 2017) further emphasize that this mechanism contributes to cost efficiency by eliminating unnecessary replenishment cycles.

From an analytical viewpoint, net requirements serve as a direct link between inventory optimization and production planning efficiency, making them a critical performance driver in MRP systems.

1.3.2.2 Time Phased Commitment Decisions: Planned Order Releases

Planned order releases define the timing and initiation of procurement or production orders based on lead time offsets.

(Stevenson, 2018) describes this function as essential for coordinating multi-stage production systems, where timing misalignment can propagate disruptions across the entire supply chain. (Krajewski, Ritzman, & Malhotra, 2013) highlight that order release planning integrates temporal constraints into operational decision-making. (Nahmias, 2009) also notes that this mechanism reduces system uncertainty by structuring future commitments.

From a critical standpoint, planned order releases are highly sensitive to lead time variability, which remains one of the main sources of inefficiency in real-world MRP implementations.

1.3.2.3 Forward Visibility Layer: Planned Order Receipts

Planned order receipts provide a forward-looking projection of when materials will become available for production use.

(Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005) emphasize that this visibility layer enhances coordination between procurement and production functions. And also (Heizer, Render, & Munson, 2017) argue that planned receipts enable proactive adjustment of production schedules in response to supply variability. (Stevenson, 2018) further highlights that this function reduces uncertainty in material availability planning.

In research terms, planned order receipts contribute to what is often referred to as “planning transparency,” which is a key enabler of production planning efficiency.

1.3.2.4 Exception-Based Control Mechanisms

Exception reports identify deviations from planned schedules, including delays, shortages, and demand fluctuations.

(Slack & Jones, 2019) describe exception-based reporting as a managerial control mechanism that allows organizations to focus on deviations rather than routine operations. (Krajewski, Ritzman, & Malhotra, 2013) emphasize its importance in enhancing responsiveness in dynamic production environments. And also (Nahmias, 2009) further notes that exception-based control improves managerial efficiency by filtering irrelevant information.

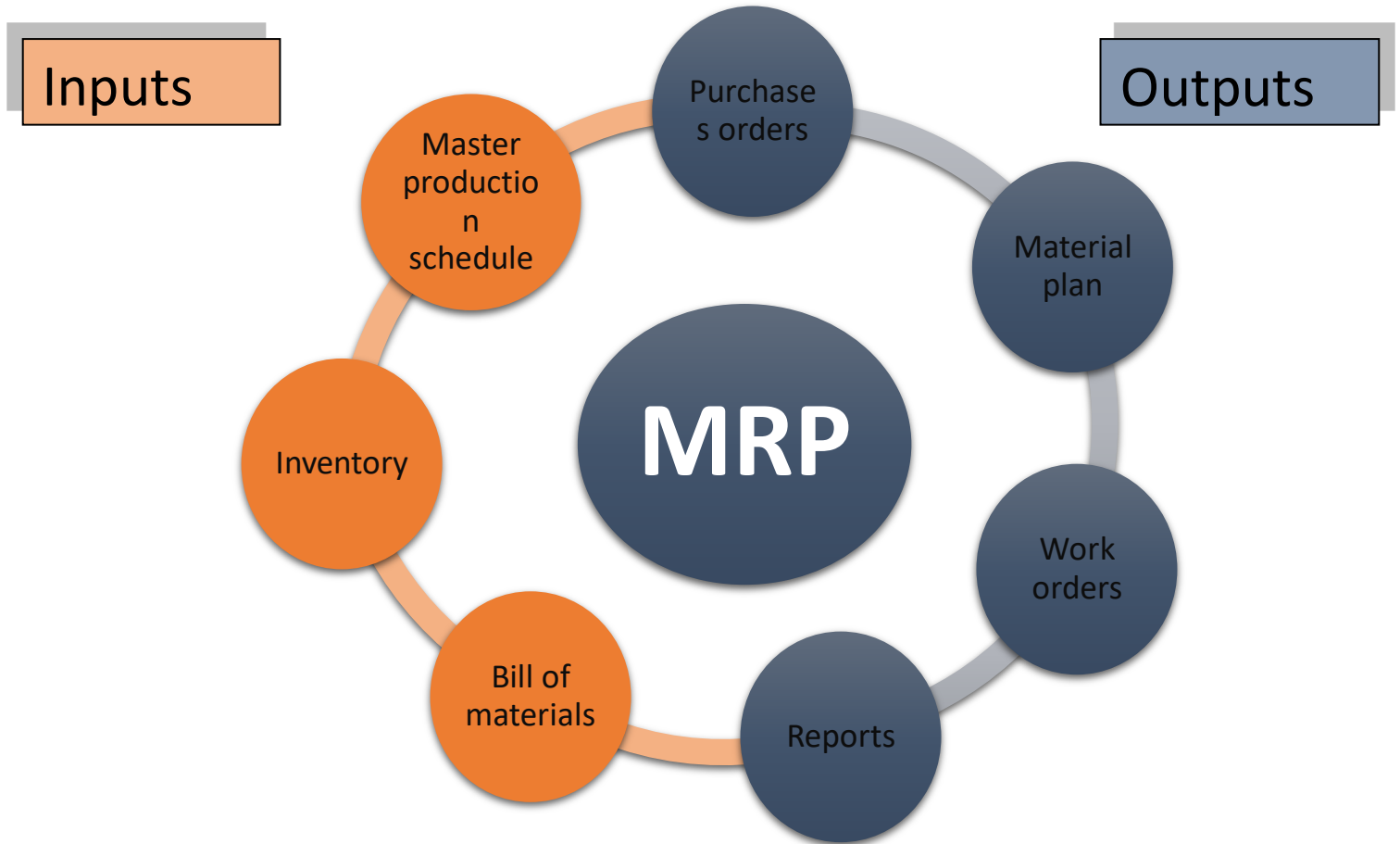
From a systems perspective, exception reporting transforms MRP from a static planning tool into a dynamic decision-support system.

The preceding analysis highlights that Material Requirements Planning (MRP) operates as an integrated information-processing system in which multiple data inputs are systematically transformed into coordinated planning outputs. This transformation is not linear but rather involves continuous interaction between system components, ensuring alignment between material availability, production requirements, and control mechanisms.

To synthesize these interrelated elements, Figure 1 presents a structured representation of the MRP system, illustrating how inputs, processing logic, and outputs are interconnected within a unified planning framework. (Allawi, 2021).

The structure of the Material Requirements Planning (MRP) system can be better understood through its input–process–output configuration. The following figure illustrates how key data inputs are transformed into coordinated production outputs.

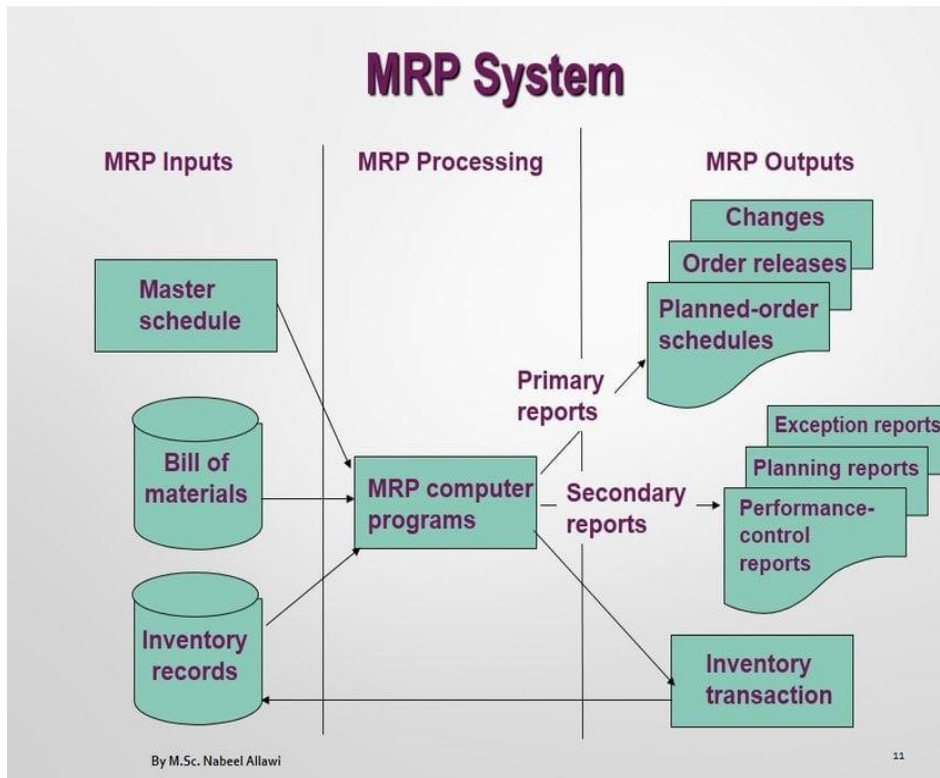
Figure 3: Structure of the Material Requirements Planning (MRP) System



Source: Developed by the student based on (Orlicky J. , 1975), (Aquilano, Chase, & Jacobs, 2006), and (Heizer, Render, & Munson, 2017).

As shown in Figure 1.5, the MRP system integrates the master production schedule, bill of materials, and inventory records to generate planned manufacturing and purchasing decisions, along with relevant control reports.

Figure 4: Structure of Material Requirement Planning(MRP) System



Source: (Allawi, 2021)

1.4 MRP Working Principle and Planning Logic:

Material Requirements Planning (MRP) remains a core method in production and inventory planning systems. It aims to convert dependent demand into structured, time-phased material requirements. The concept of MRP is rooted in hierarchical product decomposition and temporal scheduling, using lead time offsets to align production demand with material availability (Orlicky J. , 1975) (Vollmann, Berry, & Whybark, Manufacturing planning and control for supply chain management, 2005).

Academically, MRP is typically classified as a deterministic, plan-based system. It integrates demand information, inventory records, and product structure data, such as the Bill of Materials (BOM). However, recent research indicates that MRP's performance is increasingly challenged by the complexities of uncertain and dynamic environments, particularly in the face of demand volatility and supply disruptions (Jonsson & Mattsson, 2013) (Stadtler, 2015).

1.4.1 Demand-Driven Planning Logic (Dependent Demand Mechanism)

The dependent demand principle remains a core characteristic of MRP systems, where component requirements are derived directly from finished goods demand.

While (Orlicky J. , 1975) originally formalized this distinction, more recent research confirms that dependent demand structures improve coordination across multi-level production systems but increase vulnerability to forecast errors (Jonsson & Mattsson, 2013). Similarly, (Heizer, Render, & Munson, 2017) note that the linkage between Master Production Schedule and lower-level requirements strengthens planning consistency but reduces flexibility under uncertainty.

In contemporary studies, dependent demand logic is often contrasted with more adaptive planning approaches such as APS (Advanced Planning Systems), which incorporate real-time variability and stochastic conditions (Stadtler, 2015).

1.4.2 Explosion and Netting Mechanism in MRP

The explosion and netting processes are fundamental to the operational logic of MRP. "Explosion" refers to the process of converting finished goods requirements into demands for individual components, based on the BOM. In contrast, "netting" adjusts these requirements by accounting for inventory on hand and scheduled receipts. According (Krajewski, Ritzman, & Malhotra, 2013), this hierarchical breakdown ensures traceability across production levels.

Despite the logical soundness of these mechanisms, recent empirical studies emphasize that their effectiveness is heavily reliant on data accuracy within ERP environments. Inaccurate BOM structures or flawed inventory records can significantly distort planning outputs, exacerbating the bullwhip effect in operational processes (Jacobs, 2007) .

1.4.3 Time-Phased Scheduling and Lead Time Logic

Time-phased planning is a defining feature of MRP systems, ensuring that material orders are released in advance of production needs.

(Stevenson, 2018) explains that lead time offsetting is essential for synchronizing procurement and production activities. However, recent studies show that lead time variability remains one of the most critical limitations of traditional MRP systems (Jonsson & Mattsson, 2013).

In dynamic supply chain environments, research suggests that fixed lead time assumptions reduce planning accuracy and increase system instability, especially in globalized supply chains where disruptions are frequent (Stadtler, 2015).

1.4.4 System Integration and Hierarchical Planning Structure

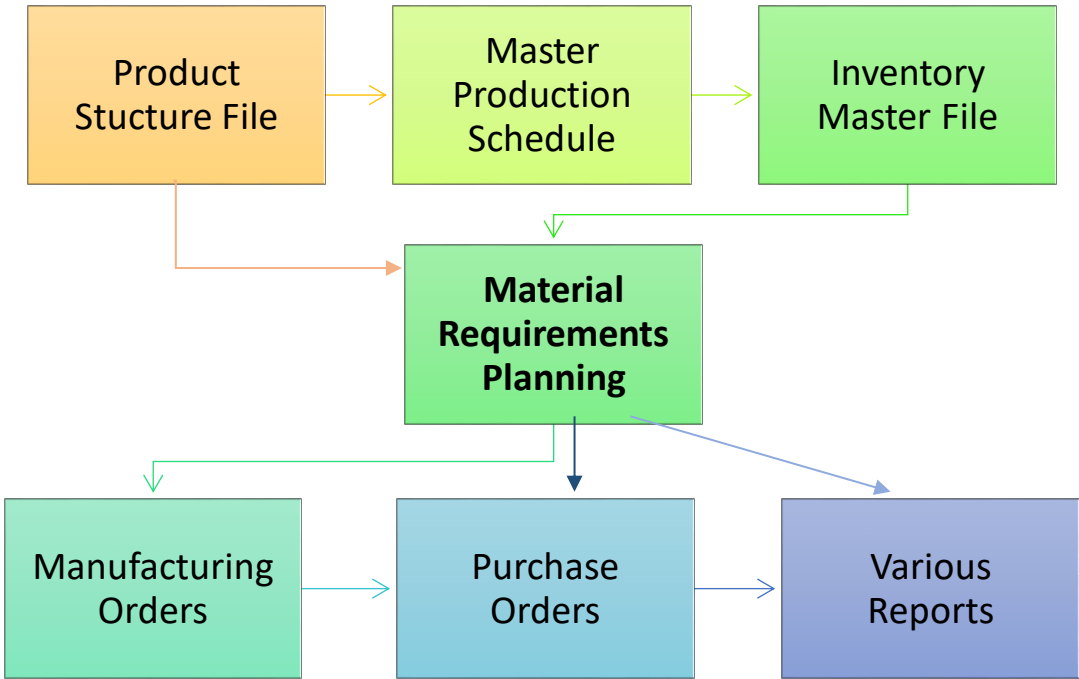
MRP operates within a hierarchical planning architecture where the Master Production Schedule drives all downstream material requirements.

(Heizer, Render, & Munson, 2017) and (Krajewski, Ritzman, & Malhotra, 2013) emphasize that this structure ensures alignment between strategic and operational levels. However, modern research argues that this hierarchical rigidity limits responsiveness in volatile environments and often leads to delayed reaction to demand changes (Jacobs, 2007) .

As a result, many firms have transitioned toward integrated ERP and APS systems, which combine hierarchical planning with real-time data processing and adaptive optimization capabilities (Stadtler, 2015).

To synthesize the interaction between inputs, processing logic, and outputs within a unified framework, the following figure presents a simplified representation of the MRP system.

Figure 5: Overview of the Material Requirements Planning (MRP) System



Source: Compiled by the student based on previous studies

As illustrated in Figure 1.7, the MRP system functions as a coordinated planning mechanism that transforms structured input data into actionable production and procurement decisions, ensuring alignment across manufacturing activities.

Together, these figures illustrate the systemic nature of MRP as a coordinated planning framework linking demand, inventory, and production decisions.

1.5 Advantages and Limitations of MRP:

Material Requirements Planning (MRP) is a widely used method for production and inventory control in manufacturing environments. While MRP offers numerous advantages, it also has certain limitations that need to be considered. And in this title we will discuss both the benefits and challenges associated with MRP, drawing on current academic research and industry practices.

1.5.1 Advantages of MRP Systems:

Inventory Optimization:

Inventory optimization is one of the most documented benefits of MRP is inventory reduction through requirement-based planning.

(Orlicky J. , 1975) established the theoretical foundation for this benefit, while modern studies confirm that MRP reduces excess inventory when data quality is high (Jonsson & Mattsson, 2013).and that shows that inaccurate inputs may reverse this effect and generate overstock situations.

Cross-Functional Integration:

MRP improves coordination between production, procurement, and inventory control.

Recent ERP based studies indicate that integration of MRP modules within ERP systems enhances information flow across departments and reduces decision delays (Jacobs, 2007). This integration is particularly effective in standardized production environments.

Improved Planning and Scheduling Efficiency:

MRP enhances production scheduling by aligning material requirements with demand forecasts.

Empirical studies show that MRP-based systems improve coordination between production stages and reduce scheduling conflicts in stable environments (Jacobs, 2007). (Heizer, Render,

& Munson, 2017) further confirm that structured planning improves operational efficiency by reducing idle capacity and improving resource allocation.

1.5.2 Limitations of MRP Systems:

Forecast Uncertainty:

MRP relies heavily on forecast based demand planning, which introduces structural risk.

And that what (Jonsson & Mattsson, 2013) mentioned in their study. they highlight that forecast errors propagate through the entire planning system, reducing reliability and increasing operational instability.

Limited Responsiveness:

Traditional MRP systems are often criticized for their inability to respond quickly to dynamic market conditions.

(Stadtler, 2015) argues that deterministic planning structures are insufficient in volatile supply chain environments, leading to delays in decision adjustment.

Implementation Challenges:

Implementation of MRP requires strong data governance and organizational alignment.

(Jacobs, 2007) emphasize that ERP-integrated MRP systems require high levels of coordination, training, and system discipline to function effectively.

Data Dependency:

Material Requirements Planning (MRP) systems are highly reliant on the accuracy of key data, particularly the Bill of Materials (BOM) and inventory records. Inaccurate or outdated data can significantly affect MRP's performance, leading to production delays, material shortages, or excess inventory. MRP systems calculate material needs based on the assumption that BOM and inventory data are precise. However, any discrepancies in these inputs can disrupt the entire planning process, showcasing MRP's sensitivity to data quality (APICS, 2016).

Inaccurate inventory records, such as incorrect stock levels or unrecorded material movements, have been shown to be a primary cause of MRP inefficiency. (Brown, Inman, & Galooway, 2001).

Section 3 : Production Planning and Efficiency

2.1 Definition of Production Planning

Production planning is a fundamental managerial function through which industrial organisations systematically determine what to produce, how much to produce, and when to produce it, in order to satisfy anticipated customer demand in the most resource-efficient manner possible. At its broadest level, the concept encompasses a coordinated set of decisions that govern the transformation of raw inputs into finished goods, while ensuring that the necessary labour, materials, machinery, and time are available in the right quantities and at the right moments. Scholars have long recognised that this function lies at the intersection of operational management, logistics, and strategic organisational planning (Luo, Thevenin, & Dolgui, 2022).

In the manufacturing context, production planning takes on a more precise and technical meaning. (Luo, Thevenin, & Dolgui, 2022), writing in the *International Journal of Production Research*, describe the production planning and control (PPC) system as a framework encompassing long-term, medium-term, and short-term decision layers that collectively regulate the flow of materials and resources through a manufacturing enterprise. This hierarchical structure ensures that broad strategic objectives, such as annual production targets and market responsiveness goals, are translated into detailed operational directives at the shop-floor level. The PPC system integrates functional modules relating to demand management, inventory control, capacity allocation, and scheduling into a coherent whole.

(Thevenin, Adulyasak, & Cordeau, 2021), in their study published in *Production and Operations Management*, further sharpen this definition by situating production planning within enterprise resource planning (ERP) systems, where Material Requirements Planning (MRP) serves as the core computational engine for determining production lot sizes and component quantities based on master production schedules. This perspective emphasises that modern production planning is not merely an administrative exercise but a data-driven, technology-mediated process that must respond dynamically to fluctuations in customer demand, supplier reliability, and operational capacity.

From an industrial standpoint, production planning performs several indispensable functions: it aligns manufacturing output with market demand, prevents overproduction and stockouts, governs the allocation of finite resources, and provides a framework for quality

control throughout the production cycle. as cited in the collaborative manufacturing and production planning literature reviewed by (Tuan & Chiadamrong, 2022) emphasise that efficient production planning and scheduling are among the most consequential determinants of factory performance, directly influencing throughput, cost structure, and delivery reliability. In sum, production planning is the strategic and operational blueprint that gives industrial companies the capacity to translate market demand into structured, controlled, and cost-effective manufacturing activity.

2.2 Objectives of Production Planning

The objectives of production planning are multidimensional and reflect the competing pressures that industrial organisations face in satisfying market demand while maintaining financial viability and operational sustainability. Academic literature consistently identifies several overarching goals that production planning systems are designed to achieve, each of which contributes in a distinct way to the broader aim of operational efficiency.

The first and most widely cited objective is cost minimisation (Rodrigues, Pimentel, Duarte, & Matias, 2023), in their study on sustainable short-term production planning published in *SN Computer Science*, identify cost minimisation and lateness minimisation as the two dominant objective functions in contemporary production planning optimisation models. Their research demonstrates that mixed-integer linear programming (MILP) formulations, when applied to real manufacturing environments, can yield substantial reductions in total production costs by optimally sequencing operations and aligning production quantities with actual demand. Cost minimisation in production planning encompasses not only direct production costs such as raw materials and labour, but also inventory holding costs, setup costs, and subcontracting expenses.

A critical objective in aggregate production planning (APP) is meeting customer demand. APP typically spans a medium-term horizon, ranging from three to eighteen months, and is designed to optimise production levels, workforce allocation, and inventory management to align with anticipated demand. This ensures that production processes run smoothly while avoiding the need for costly emergency interventions (Heizer & Render, 2019). The capacity to fulfil customer orders on time and in full serves as a key indicator of planning quality, as consistent failures in this area often signal underlying problems in forecasting, scheduling, or resource management (Slack, Chambers, & Johnston, 2010).

Maximising resource utilisation is another essential objective of APP. Effective production planning necessitates managing capacity constraints, workforce availability, and equipment throughput to prevent both underutilization which increases unit fixed costs and overutilisation, which may lead to bottlenecks, quality issues, and employee burnout. Operational planning literature has confirmed that improving equipment flexibility and utilisation rates can result in reductions of material costs by up to 30%, significantly boosting overall productivity (Simchi-Levi, Kaminsky, & Simchi-Levi, 2020).

Flexibility in manufacturing has become increasingly important in dynamic market conditions, where demand is volatile, product variety is high, and product life cycles are short. Production plans must remain adaptable to sudden shifts in demand without incurring excessive costs or disrupting ongoing workflows. This need for flexibility is closely tied to the concept of leagile manufacturing, a hybrid strategy that integrates lean and agile principles. Such an approach requires production planning systems to balance operational efficiency with responsiveness (Naylor, Naim, & Berry, 2021).

To synthesise the multidimensional objectives discussed in the literature, the following table presents a structured overview of the key objectives of production planning alongside their corresponding operational impacts on organisational performance.

Table 2: Objectives of Production Planning and Their Operational Impact

Objective	Description	Impact
Cost minimization	Reduce production & inventory costs	Higher profitability
Demand satisfaction	Meet customer demand	Service level improvement
Resource utilization	Optimize machines & labor	Productivity increase
Flexibility	Adapt to changes	Responsiveness
Quality assurance	Maintain standards	Customer satisfaction

Source: Compiled by the student based on previous studies

As illustrated in Table 1.2, production planning objectives extend beyond cost considerations to include responsiveness, resource efficiency, and quality consistency. These interconnected objectives collectively determine the effectiveness of production systems and their ability to achieve sustainable operational performance in dynamic industrial environments.

Finally, ensuring consistent product quality is an objective embedded within the production planning process itself. By establishing clear process sequences, defining standard production quantities, and allocating appropriate time and resources to each production stage, planning systems provide the conditions necessary for effective quality control measures. A robust production planning system can reduce production cycle times, enhance equipment utilisation, and improve customer service outcomes, all of which contribute to sustained product quality (Brown & Bessant, 2019).

2.3 Importance of production planning in Industrial Companies

The importance of production planning in industrial companies extends far beyond the mere scheduling of daily operations. It serves as a fundamental management practice that influences multiple facets of organizational performance, including operational efficiency, cost structure, inventory management, customer satisfaction, and long-term competitive positioning (Heizer & Render, 2019) The ability to plan effectively is vital for optimizing resource use, controlling costs, and maintaining a competitive edge in an increasingly complex market environment.

Operational Efficiency and Workflow Synchronization:

From an operational efficiency perspective, effective production planning plays a pivotal role in eliminating redundant activities, synchronizing interdepartmental workflows, and ensuring a balanced and continuous production process. As highlighted by (Heizer & Render, 2019), well-executed production planning enables companies to align various functions, such as engineering, procurement, production, and sales. This alignment significantly reduces cycle times and enhances the effective utilization of equipment and human resources. (Slack, Chambers, & Johnston, 2010) reinforce this by emphasizing that a lack of coordination can lead to production bottlenecks, idle capacity, and unplanned downtime, all of which incur both direct and indirect costs. Furthermore, as companies increasingly adopt lean principles, it is essential to ensure that all production stages are well-aligned with demand forecasts and available resources to avoid inefficiencies (Womack & Jones, 2003).

Cost Management and Reduction:

In terms of cost reduction, the strategic role of production planning cannot be overstated. The literature strongly supports the view that effective production planning and control can significantly lower operational costs. For example, (Heizer & Render, 2019) argue that precise

forecasting and accurate scheduling can minimize waste, optimize material usage, and reduce inventory holding costs. Furthermore, a study by (Simchi-Levi, Kaminsky, & Simchi-Levi, 2020) demonstrated that companies that integrated advanced production planning systems experienced reductions in production and logistics costs, achieving up to 30% savings in material costs through better coordination of supply chain activities. The systematic integration of production planning into operational processes is thus not only a tool for efficiency but also a critical lever for long-term cost management.

Inventory Management and Demand Coordination:

When it comes to inventory management, production planning systems are crucial for maintaining optimal inventory levels. By aligning procurement schedules with production rates and demand forecasts, planning systems help minimize excess inventory while ensuring that demand fluctuations are adequately met. According to (Nahmias S. , 2013), a robust production planning system ensures that inventory is neither overstocked nor understocked, reducing costly stockouts and minimizing the financial burden of holding excessive inventory. Moreover, production planning optimizes the flow of materials, ensuring that the right products are available when needed, thereby reducing lead times and enhancing service levels (Silver, Pyke, & Peterson, 2016).

Enhancing Customer Satisfaction and Service Levels:

From a customer satisfaction standpoint, production planning directly influences delivery reliability, an essential factor in today's competitive manufacturing environment. By ensuring that goods are available in the correct quantities and on time, production planning systems reduce the likelihood of stockouts and ensure that customer expectations are met. Research by (Fisher, 1997) highlights that improving production planning processes, especially in environments with high product variety and demand uncertainty, can significantly enhance service levels. Well-planned production systems ensure that manufacturers can deliver products in a timely manner, meeting customer demand with minimal delays. Additionally, structured production planning leads to fewer urgent orders and more reliable order fulfillment, factors that contribute to stronger customer relationships and improved market position (Cachon & Terwiesch, 2009).

Organizational Resilience and Adaptability:

Finally, the role of production planning in fostering organizational resilience cannot be overlooked. With the advent of Industry 4.0 technologies, including the Internet of Things (IoT), big data analytics, and digital twins, production planning systems are evolving from traditional static cycles to dynamic, real-time systems. These technologies enable manufacturers to adjust their production plans in response to unforeseen disruptions, demand fluctuations, or supply chain delays (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). The increased adoption of real-time data analytics enhances production flexibility, allowing companies to respond more effectively to changes in the production environment. As stated by (Baryannis, Dani, & Antoniou, 2019), real-time data and advanced analytics offer manufacturers the ability to move towards demand-driven, flexible production systems that are better suited to cope with supply chain uncertainties. This shift in production planning systems towards greater agility and responsiveness makes organizations more resilient to disruptions and better equipped to sustain performance in dynamic market conditions.

2.4 Production Planning Process

The production planning process consists of a series of structured activities aimed at meeting anticipated demand using available resources. Although the precise steps may vary depending on industry-specific requirements, production environments, and planning horizons, several core phases consistently emerge in academic literature: demand forecasting, master production scheduling (MPS), material requirements planning (MRP), capacity planning, scheduling, inventory management, and production control. Each phase generates outputs that inform the subsequent stages, creating a seamless and integrated planning cycle (Azzamouri, Elbaz, & Alavi, 2021) (Thevenin, Dufresne, & Kadar, 2021).

To provide a concise visual representation of the production planning process, the following figure illustrates the integration of key planning components, including the Master Production Schedule (MPS), Bill of Materials (BOM), inventory records, and the Material Requirements Planning (MRP) system.

2.4.1 Demand Forecasting:

The initial stage of the production planning process, demand forecasting, provides the quantitative foundation on which subsequent planning decisions are built. Forecasting plays a

critical role in minimizing supply chain disruptions by offering insights into future demand, which influences the entire planning cycle (Lee & Adam, 1986). Inaccurate demand forecasts can cause forecast errors to propagate throughout the planning process, resulting in increased inventory costs and higher shortage rates (Lee & Adam, 1986). Recent advancements in demand forecasting techniques, such as Seasonal Autoregressive Integrated Moving Average (SARIMA) models, long short-term memory (LSTM) networks, and machine learning algorithms, have improved forecasting accuracy, particularly in volatile or seasonally complex environments (Aguirre, Lee, & Kim, 2019). These methods help mitigate the uncertainty inherent in demand forecasting by capturing complex patterns in historical data, leading to more reliable forecasts that enhance overall production planning.

2.4.2 Master Production Scheduling (MPS):

The master production schedule (MPS) serves as the bridge between aggregate demand forecasts and operational production decisions. Translating aggregate demand into specific production targets, the MPS operates over a defined planning horizon, which typically spans from weeks to months. This phase is vital for establishing production priorities and ensuring that material and capacity planning are aligned with forecasted demand (Azzamouri, Elbaz, & Alavi, 2021). According to Azzamouri, the MPS provides the demand signal that is used by MRP systems to calculate the required components and production orders. The accuracy and stability of the MPS are crucial, as any fluctuations or errors in the MPS can negatively impact the reliability of the subsequent stages of production planning, including material procurement and scheduling.

2.4.3 Material Requirements Planning (MRP):

Material requirements planning (MRP) is the computational tool that translates MPS outputs into detailed procurement and production orders for materials and components. MRP systems utilize bills of materials (BOMs), inventory records, and lead time data to determine the quantities and timing of component orders necessary to meet the master schedule (Thevenin, Dufresne, & Kadar, 2021). Traditional MRP systems typically operate on deterministic assumptions, treating demand as known and fixed; however, this approach does not account for demand variability and supply chain disruptions, which can lead to suboptimal planning outcomes (Shamsuzzoha, H, & Jaakkola, 2024). As both (Thevenin, Dufresne, & Kadar, 2021) and (Shamsuzzoha, H, & Jaakkola, 2024) argue, demand-driven MRP (DDMRP) offers a more flexible and responsive alternative by decoupling supply from demand variability,

positioning inventory buffers strategically to absorb demand shocks. This approach has proven particularly effective in environments characterized by high uncertainty and market volatility.

2.4.4 Capacity Planning and Scheduling:

Once material requirements are determined, capacity planning assesses whether the available production resources such as machines, labor, and facilities are sufficient to meet the production targets within the specified time frame. This phase identifies potential capacity constraints and informs scheduling decisions. Production scheduling, which assigns specific tasks to particular resources in a defined sequence, seeks to maximize throughput while respecting these capacity constraints. (Tuan & Chiadamrong, 2022) emphasize that scheduling is one of the most technically complex aspects of production planning, as it often requires sophisticated optimization techniques, including genetic algorithms and tabu search, to navigate large decision spaces. Smart production planning and control (PPC) systems increasingly incorporate machine learning algorithms to enhance both the quality of scheduling decisions and computational efficiency (Kuhnle, Nitz, & Schuster, 2021).

2.4.5 Inventory Management and Production Control:

The final stages of the production planning process involve inventory management and production control. Inventory management ensures that raw materials, work-in-progress, and finished goods are maintained at optimal levels to balance service requirements against holding costs. Effective inventory management prevents overstocking and understocking, both of which can lead to disruptions in production or excessive costs. Production control monitors actual production against the planned schedule, identifying deviations and triggering corrective actions when necessary (Tuan & Chiadamrong, 2022). By continuously adjusting and refining the production process, these functions help close the planning loop and enable a dynamic response to changing market conditions and production performance. This iterative process allows organizations to maintain production efficiency while adapting to external and internal challenges

2.5 Challenges in Production Planning

Despite its crucial role in optimizing manufacturing operations, production planning faces a myriad of challenges that can hinder its effectiveness. These challenges arise from both internal organizational factors and external environmental forces, which can disrupt the smooth

functioning of production processes. Understanding these challenges is key to developing more robust and adaptable planning systems.

To synthesise the main challenges affecting production planning in industrial environments, the following table summarises the most critical constraints identified in the literature, along with their descriptions and operational impacts. These challenges not only affect individual planning stages but also propagate across the entire production system, reinforcing the importance of integrated and resilient planning approaches.

Table 3: Key Challenges in Production Planning and Their Operational Impact

Challenge	Description	Impact
Demand variability	Uncertain demand	Forecast errors
Supply disruptions	Delays, shortages	Production stoppage
Resource constraints	Limited capacity	Inefficiency
Technological change	System complexity	High cost
External factors	Market & politics	Instability

source: Compiled by the student based on previous studies

As shown in Table 1.3, production planning is exposed to a range of interrelated challenges that can significantly disrupt operational performance. These factors highlight the need for flexible, data-driven planning systems capable of adapting to uncertainty and maintaining stability in dynamic industrial contexts.

2.5.1 Demand Variability:

One of the most significant hurdles in production planning is the unpredictable nature of customer demand. Demand fluctuations are often driven by a variety of factors, including market conditions, consumer preferences, and seasonal trends (Jamalnia, Smith, & Liu, 2019)highlight that the uncertainty caused by demand variability severely undermines the reliability of traditional deterministic models, which assume a stable demand pattern. Consequently, production planners are often forced to make decisions based on incomplete or inaccurate information. Moreover, the bullwhip effect, as described by (Sucky, 2009),

exacerbates this issue by amplifying small fluctuations in consumer demand as they move upstream in the supply chain, resulting in inefficiencies such as inflated inventory levels and increased operational costs (Butt, 2022). To mitigate this, modern forecasting techniques, including machine learning-based models and demand sensing technologies, are increasingly being employed to provide more accurate predictions and improve supply chain responsiveness (Aguirre, Lee, & Kim, 2019).

2.5.2 Supply Chain Disruptions:

Supply chain disruptions, whether caused by geopolitical tensions, natural disasters, or economic crises, present another formidable challenge for production planners. These disruptions often disrupt the flow of essential materials needed to meet production schedules. (Mack, Johnson, & Parker, 2023) argue that the unavailability of raw materials is one of the most common causes of disruptions in manufacturing supply chains. The COVID-19 pandemic, for example, highlighted the vulnerability of global supply chains, as it led to labor shortages, disruptions in demand, semiconductor shortages, and logistical delays (Ambrogio, Singh, & Lee, 2022). According to (Badakhshan & Ball, 2024), the pandemic revealed significant gaps in traditional aggregate production planning (APP) models, which were not designed to handle such widespread and dynamic disruptions. This has created an urgent need for the development of more resilient and adaptive planning frameworks that can accommodate such global disruptions and minimize their impact on production.

2.5.3 Resource Constraints:

Internal resource constraints are another critical challenge faced by production planners. These constraints may include limitations in machine capacity, skilled labor availability, storage space, and financial resources, all of which restrict the options available to planners when formulating production schedules. (Rodrigues, Costa, & Fernandes, 2023) emphasize that effective production planning must account for a diverse set of constraints, such as machine downtime, worker absenteeism, and unexpected maintenance requirements, which can introduce significant variability into the planning process. These constraints often require the use of optimization models that incorporate a wide range of factors, making it challenging to find the most efficient and feasible production plans. As noted by (Rodrigues, Costa, & Fernandes, 2023), these limitations necessitate dynamic planning systems capable of adjusting to changing circumstances, ensuring the continued flow of production despite unforeseen setbacks.

2.5.4 Technological Change and Digital Transformation:

The rapid evolution of Industry 4.0 technologies presents both significant opportunities and challenges for production planning. Technologies such as digital twins, IoT enabled sensors, and AI-powered scheduling algorithms have the potential to revolutionize production planning by enhancing accuracy, flexibility, and responsiveness. However, the implementation of these technologies comes with substantial challenges, including high initial investment costs, technical complexity, and a lack of organizational readiness. (Luo, Zhang, & Li, 2022) observe that many manufacturers have yet to fully capitalize on the potential of advanced prescriptive analytics tools due to the high costs associated with their adoption and the lack of necessary skills within the workforce. Despite these barriers, the increasing integration of AI and digital tools into production systems has the potential to significantly improve planning outcomes, offering real-time insights into production processes and enabling more proactive decision-making (Kuhnle, Nitz, & Schuster, 2021).

2.5.5 External and Environmental Factors:

In addition to internal factors, production planning must also contend with external and environmental challenges, such as regulatory changes, geopolitical instability, and the increasing pressure of inflationary costs on input materials. Recent global events have shown how external shocks can disrupt production schedules and require rapid adjustments. For instance, the trade war between China and the United States, the blockage of the Suez Canal, and rising commodity prices have all forced companies to alter their production plans to accommodate changing circumstances (Cohen, Rogers, & Feldman, 2024). These events have underscored the limitations of traditional production planning systems that prioritize cost minimization and efficiency over flexibility and resilience. As a result, there has been growing academic interest in developing planning frameworks that not only optimize for efficiency but also enable organizations to adapt to unexpected external shocks. The ability to maintain operational continuity in the face of these unpredictable factors is becoming a key area of focus in production planning research (Cohen, Rogers, & Feldman, 2024).

2.6 Production Planning Efficiency: Concept and Key Indicators

Production planning efficiency refers to the ability of an organization to plan and control its production processes in a manner that maximizes the use of available resources while minimizing waste, costs, and time. It is a key determinant of operational performance, influencing both short-term outcomes and long-term competitiveness (Axsäter, 2015).

According to (Slack & Jones, 2019), production planning efficiency is driven by the synchronization of demand forecasts, material requirements, production capacities, and inventory management. This concept extends beyond merely meeting production targets; it also involves achieving optimal performance under varying constraints such as resource availability, market conditions, and technological advancements.

In its most basic form, efficiency in production planning is achieved when an organization is able to produce the right quantity of goods at the right time, using the minimum possible amount of resources while meeting quality standards. This requires the alignment of all components of the production process, from supply chain management to human resources, underpinned by effective planning and control systems (Gosling, Naim, & Towill, 2020). Efficiency, however, is not a one-time goal but a continual process of improvement driven by data, feedback, and adaptive strategies.

Key Elements in Defining Production Planning Efficiency:

Production planning efficiency can be defined through several critical dimensions that enable organizations to maximize resource utilization while minimizing waste and optimizing operational performance. These elements include optimal resource utilization, cost minimization, time management, and quality assurance. The following sections explore each of these elements in greater depth, drawing from key academic sources in operations management and production planning.

1. Optimal Resource Utilisation

Optimal resource utilization refers to the effective allocation and management of the various resources involved in the production process, including labor, machinery, and raw materials. According to (Axsäter, 2015), efficient resource utilization is crucial for minimizing downtime and improving overall throughput. This involves aligning production schedules with available resources to ensure that capacity is fully utilized without overburdening any single resource. Effective resource planning ensures that all resources are deployed to their highest potential, balancing workloads across machines and workers to avoid bottlenecks and maximize output. For example, (Gosling, Naim, & Towill, 2020) emphasize the importance of synchronizing labor and machinery schedules with material flow to ensure that each production phase is completed on time, thus preventing idle resources and optimizing the overall production cycle.

2. Cost Minimization

Cost minimization is another vital element of production planning efficiency. Efficient planning seeks to minimize the total cost of production by reducing the costs associated with overproduction, underproduction, and inventory holding. (Chopra & Meindl, 2016) argue that a key goal of production planning is to match supply with demand as accurately as possible to avoid excessive inventory costs and production delays. Overproduction can lead to high storage costs and waste, while underproduction can result in missed sales opportunities and customer dissatisfaction. By incorporating demand forecasts, production schedules, and inventory management, companies can reduce both fixed and variable costs, ensuring that resources are not overused or underutilized. According to (Slack & Jones, 2019), effective planning involves balancing the trade off between production cost, inventory holding cost, and stockout cost to achieve the lowest possible overall cost.

3. Time Management

Time management in production planning refers to the effective scheduling of production processes to ensure that goods are produced and delivered on time. (Coyle, Langley, Novack, & Gibson, 2016) note that timely delivery is not only essential for customer satisfaction but also for maintaining operational efficiency within the organization. Efficient production planning minimizes lead times by aligning procurement, manufacturing, and delivery schedules. This requires a close synchronization between the various stages of production, from material ordering to final product delivery. A well-structured scheduling system ensures that production processes are executed according to a predefined timeline, reducing the risks of delays and bottlenecks (Axsäter, 2015) Moreover, (Gosling, Naim, & Towill, 2020) highlight that time management in production planning enhances an organization's ability to respond to sudden changes in demand, making it a critical factor in maintaining competitiveness in fast-paced markets.

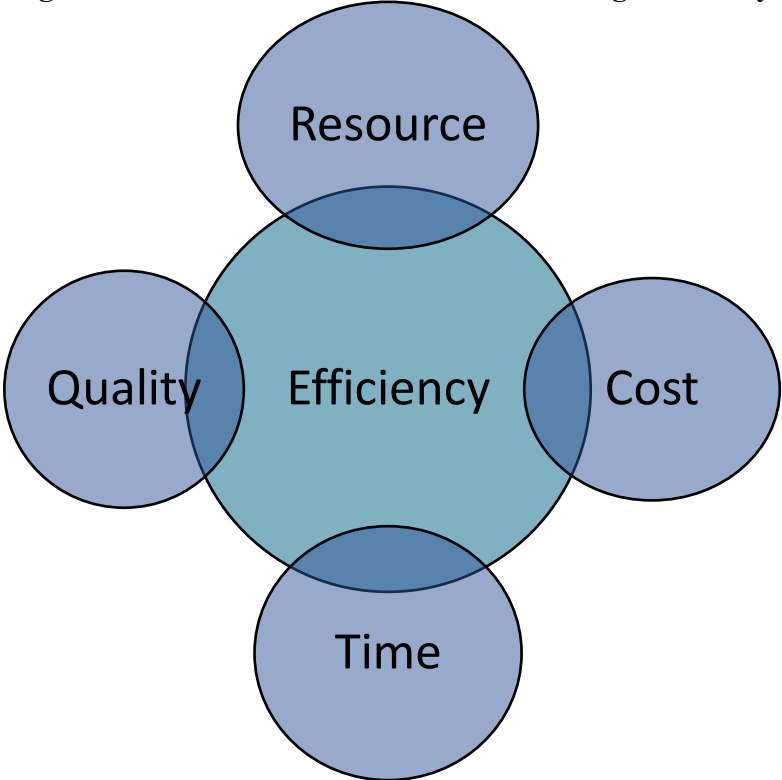
4. Quality Assurance

Quality assurance ensures that the final product meets the required specifications and standards without unnecessary rework or defects. This is an essential component of efficient production planning, as it minimizes waste and rework while enhancing customer satisfaction. (Chopra & Meindl, 2016) state that production planning systems should incorporate mechanisms for monitoring quality throughout the production process, ensuring that potential

issues are identified and corrected early. Effective quality control reduces defects and enhances throughput, as fewer resources are needed to correct issues after production is completed. According to (Slack & Jones, 2019), ensuring high product quality throughout production not only boosts operational efficiency but also improves brand reputation and customer loyalty. In practice, quality assurance is supported by process controls, regular inspections, and feedback loops that allow manufacturers to make real-time adjustments to their processes.

To conceptualise production planning efficiency in a structured manner, the following figure presents its key dimensions as identified in the literature. Rather than being a single measurable variable, efficiency is a multidimensional construct influenced by several interrelated performance factors. The figure illustrates that production planning efficiency is shaped by the combined influence of resource utilization, cost control, time management, and quality assurance.

Figure 6: Dimensions of Production Planning Efficiency



Source: Compiled by the student based on previous studies

As shown in Figure 1.9, production planning efficiency cannot be reduced to a single indicator, but rather emerges from the interaction of multiple performance dimensions. The balance between these elements is essential for achieving optimal operational outcomes in industrial environments. An imbalance among these dimensions may lead to inefficiencies, highlighting

the need for integrated planning approaches that simultaneously address cost, time, quality, and resource constraints.

2.6.2 Key Indicators of Production Planning Efficiency:

Once the concept of production planning efficiency is understood, it is essential to assess it through specific, measurable key indicators. These indicators provide valuable insights into the performance of the production planning process, helping organizations monitor, evaluate, and improve their production systems. Below are the primary key indicators of production planning efficiency:

1. Lead Time:

Lead time refers to the total time required to complete a production order, from the moment the order is placed until the finished product is ready for delivery. Efficient production planning seeks to minimize lead time, thereby increasing responsiveness to market demand (Axsäter, 2015). Shorter lead times lead to greater flexibility and enable manufacturers to respond quickly to changing customer needs. Lead time is closely related to the accuracy of forecasting and scheduling, which ensures that resources are available when needed without unnecessary delays (Gosling, Naim, & Towill, 2020).

2. Inventory Turnover:

Inventory turnover is a measure of how efficiently inventory is used in the production process. It is calculated by dividing the cost of goods sold by the average inventory level during a specific period. High inventory turnover indicates that inventory is being used efficiently and is not accumulating in the system. Conversely, low turnover may indicate overstocking, leading to high holding costs and reduced cash flow (Chopra & Meindl, 2016). Efficient production planning requires balancing inventory levels to ensure a smooth flow of materials without over-investing in stock.

3. Production Cost Per Unit:

The cost per unit produced is an essential efficiency indicator, as it directly impacts profitability. Efficient production planning minimizes the cost per unit by optimizing resource allocation, reducing waste, and enhancing the productivity of workers and machines. This metric is closely tied to factors such as labor cost, material cost, machine utilization, and energy consumption

(Slack & Jones, 2019). Cost per unit is a critical indicator of overall planning effectiveness, highlighting areas where resource utilization can be improved.

4. On-Time Delivery:

On-time delivery is a fundamental indicator of production planning efficiency. It measures the percentage of customer orders delivered on time, meeting the required delivery date. This indicator is critical for customer satisfaction and is a direct reflection of how effectively production schedules and inventory management are aligned with demand. Efficient production planning ensures that all steps in the production process, from procurement to assembly, are synchronized to meet delivery deadlines (Coyle, Langley, Novack, & Gibson, 2016).

5. Capacity Utilization:

Capacity utilization refers to the percentage of available production capacity that is actually used during a given period. High capacity utilization indicates that production resources are being used efficiently, while low utilization suggests inefficiencies or underutilized resources. Effective production planning strives to maximize capacity utilization by aligning production schedules with available resources, ensuring that machines, labor, and facilities are optimally employed (Axsäter, 2015).

6. Quality Control and Yield Rate :

The yield rate is an indicator of production efficiency in terms of product quality. It measures the proportion of products that meet quality standards without rework or defects. High-quality production planning ensures that resources are used effectively to produce high-quality products while minimizing defects, scrap, and rework. Effective quality control systems are integral to improving production efficiency, as they reduce the need for corrective actions and increase overall throughput (Gosling, Naim, & Towill, 2020).

7. Flexibility:

Flexibility in production refers to the ability to adapt production schedules and processes in response to changes in demand or unexpected disruptions. A production system with high flexibility is able to adjust quickly to fluctuations in customer orders, supply chain disruptions, or changes in production conditions. Efficient production planning enhances flexibility by

ensuring that systems are agile enough to accommodate shifts in demand without compromising operational efficiency (Coyle, Langley, Novack, & Gibson, 2016).

To operationalise the concept of production planning efficiency, it is essential to examine measurable performance indicators that reflect how effectively planning objectives are achieved. The following table summarises the key indicators commonly used in the literature, along with their definitions and their significance in evaluating operational performance.

Table 4: Key Indicators of Production Planning Efficiency and Their Significance

Indicator	Definition	Importance
Lead time	Time to produce	Responsiveness
Inventory turnover	Inventory usage	Cost control
Cost per unit	Production cost	Profitability
On-time delivery	Delivery performance	Customer satisfaction
Capacity utilization	Resource usage	Efficiency
Yield rate	Quality output	Waste reduction
Flexibility	Adaptability	Resilience

Source: by the student based on previous studies

As presented in Table 1.4, production planning efficiency is assessed through a set of interrelated indicators that capture time performance, cost management, resource utilization, quality outcomes, and system adaptability. Together, these indicators provide a comprehensive framework for evaluating the effectiveness and responsiveness of production planning systems in dynamic industrial environments. These indicators not only measure performance outcomes but also serve as critical feedback mechanisms for continuous improvement in production planning processes.

Section 4: The Influence of MRP on Production Planning Efficiency

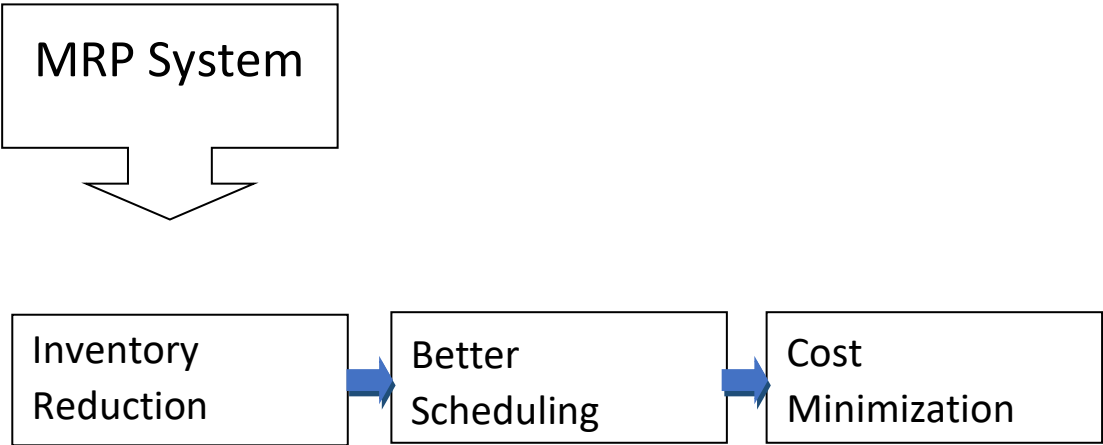
4.1 MRP’s Role in Optimizing Resource Allocation and Cost Minimization:

Material Requirements Planning (MRP) systems are integral in optimizing resource allocation and minimizing costs within production planning. The role of MRP in this context is primarily focused on streamlining the utilisation of resources such as raw materials, labour, and

machinery, ensuring that these elements are employed in the most efficient way possible. The accurate allocation of resources not only ensures the smooth flow of production activities but also reduces waste, enabling companies to maintain a competitive edge in terms of cost control and operational efficiency (Jacobs & Chase, 2021).

To illustrate the role of MRP in enhancing resource allocation and reducing operational costs, the following figure presents a simplified cause-effect relationship between MRP functionalities and key performance outcomes. The figure shows how MRP contributes to inventory reduction and improved scheduling, which collectively lead to cost minimization.

Figure 7: MRP Impact on Resource Optimization and Cost Minimization



Source: Compiled by the student based on previous studies

As illustrated in Figure 1.10, MRP systems optimize resource utilization by aligning material availability with production needs, thereby reducing waste and improving cost efficiency.

Optimising Resource Allocation

The central function of MRP systems is to ensure that resources are available at the right time and in the right quantities, which leads to significant improvements in resource allocation. By integrating demand forecasts with production schedules, MRP systems can optimize inventory levels and ensure that materials are purchased only when necessary, minimizing the need for large inventories (Chopra & Meindl, 2016). This precise management of materials helps prevent stockouts and overstocking, which are both costly and disruptive to production. Furthermore, MRP helps optimize labor and machine usage by providing detailed schedules that align with production needs, ensuring that labor and machinery are neither underused nor overburdened (Heizer & Render, 2020).

Resource optimization through MRP systems is essential for reducing the operational costs associated with inefficient production practices. By automating the ordering process based on actual requirements, MRP systems reduce the likelihood of excess raw material procurement, thus minimizing the associated storage costs and the capital tied up in unsold goods (Slack & Jones, 2019). Additionally, MRP enables manufacturers to plan production with greater accuracy, reducing the time spent on idle machines or labor, which leads to higher throughput without increasing resource consumption (Jacobs & Chase, 2021).

Cost Minimization through Inventory and Scheduling Management

One of the primary operational benefits associated with MRP systems is reducing inventory costs and improving inventory turnover, which directly contributes to cost minimization in production planning. Empirical evidence shows that firms implementing MRP report significant improvements in inventory management outcomes, including reduced material stock levels and enhanced delivery performance, compared to their performance before adoption (Schroeder, Anderson, Tupy, & White, 1981). These improvements occur because MRP systems schedule material procurements strictly based on production requirements, preventing excess ordering and lowering the need for large safety stocks, which in turn reduces holding costs and the capital tied up in inventory. Furthermore, survey data indicate that as companies mature in their use of MRP, they achieve progressively better coordination between production schedules and material availability, thereby reducing disruptions, eliminating unnecessary inventory, and lowering overall production costs as the system becomes more integrated into operational processes. This aligns with broader inventory management theory, which holds that more accurate planning and scheduling methods are central to minimizing total inventory costs while maintaining service levels (Schroeder, Anderson, Tupy, & White, 1981).

Moreover, MRP systems enhance scheduling accuracy, which in turn contributes to cost minimization. Accurate production schedules ensure that labor and machinery are utilized optimally, and they help in reducing the downtime between production cycles. Efficient scheduling leads to reduced lead times, enabling manufacturers to meet customer demand more promptly without overextending their resources (Chopra & Meindl, 2016). By aligning production schedules with actual demand, MRP systems help reduce the costs associated with both overproduction and underproduction, two factors that often result in either surplus inventory or stockouts, both of which can significantly increase operational expenses (Slack & Jones, 2019).

Reduction of Waste and Operational Inefficiencies

MRP systems contribute to cost minimization by reducing various forms of waste, a principle that is central to lean manufacturing practices. By ensuring that only the necessary quantities of materials are ordered and used in production, MRP systems reduce material waste that would otherwise arise from overstocking or excess procurement (Heizer & Render, 2020). Additionally, the precise planning and scheduling of labor and machinery resources help prevent wasteful downtime, idle workers, and machinery, ensuring that resources are used efficiently across all stages of production.

In conclusion, Material Requirements Planning systems play a crucial role in optimizing resource allocation and minimizing costs in production planning. By ensuring that materials, labor, and machinery are used efficiently, MRP systems help manufacturers reduce operational inefficiencies and waste. Furthermore, MRP contributes to cost reduction by minimizing inventory holding costs, preventing overproduction, and improving scheduling accuracy. The precise allocation of resources enabled by MRP systems not only improves production efficiency but also enhances the overall financial performance of manufacturing firms (Jacobs & Chase, 2021).

4.2 Enhancing Time Efficiency and Scheduling Accuracy with MRP

Material Requirements Planning (MRP) systems have a profound impact on time efficiency and scheduling accuracy in production planning. These systems facilitate the synchronization of materials, labor, and machinery, ensuring that production processes are executed within the required timelines. By providing a structured approach to the timely procurement and utilization of resources, MRP systems significantly reduce lead times, streamline operations, and improve the overall responsiveness of production activities.

The primary function of MRP systems in enhancing time efficiency is their ability to accurately calculate the materials needed for production and ensure their timely delivery. This precision reduces the waiting time for materials and minimizes production delays, ensuring that resources are available just when they are needed. MRP's ability to reduce lead times is particularly beneficial in environments where meeting customer demand promptly is crucial, as it enables manufacturers to respond quickly to shifts in demand or unexpected disruptions (Chopra & Meindl, 2016). By coordinating the procurement of raw materials with the production schedule,

MRP systems help avoid unnecessary delays and excess inventory, which further contributes to smoother operations and more efficient use of storage space (Jacobs & Chase, 2021).

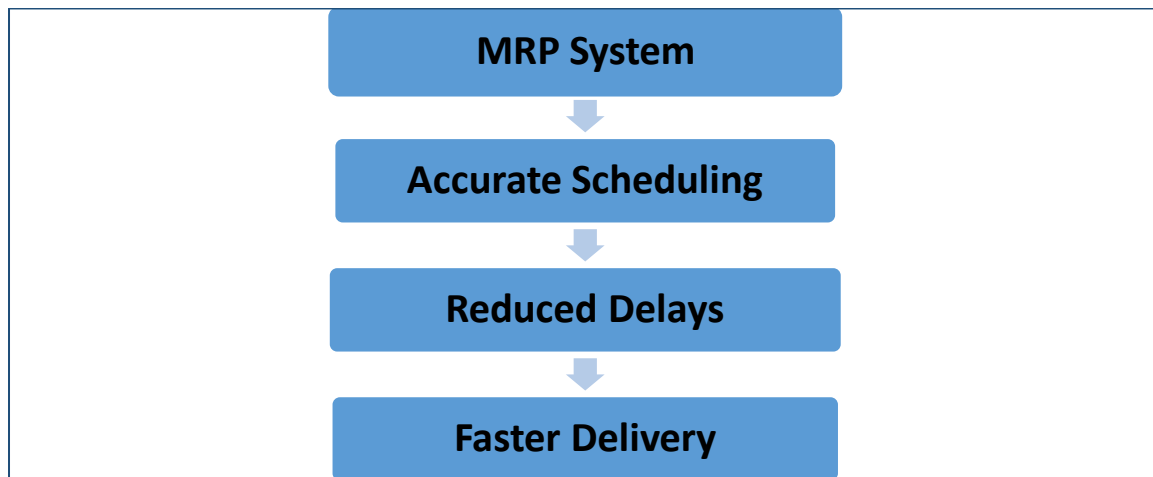
In addition to reducing lead times, MRP systems are essential in improving scheduling accuracy. Accurate scheduling is critical to maintaining an efficient production flow, and MRP helps achieve this by taking into account multiple variables, including available materials, labor, and machine capacity. By integrating these factors into a cohesive schedule, MRP reduces the likelihood of production bottlenecks and ensures that operations proceed as planned. The precise alignment of production activities with available resources ensures that production deadlines are met consistently and that customer orders are fulfilled on time, enhancing overall operational efficiency (Heizer & Render, 2020).

Furthermore, MRP systems contribute to effective time management by providing real-time data and analysis, which allows for adjustments to be made as needed. This flexibility is particularly useful in responding to unforeseen challenges, such as material shortages or machine breakdowns. With the ability to quickly adapt production schedules to changing conditions, manufacturers can maintain control over their operations and minimize disruptions to production timelines (Slack & Jones, 2019).

The integration of MRP with other enterprise systems, such as Enterprise Resource Planning (ERP), further enhances scheduling accuracy and time efficiency. Real-time updates and data sharing between systems ensure that any changes in inventory levels, production schedules, or customer demands are reflected immediately across all areas of the operation. This integration helps ensure that all departments are aligned and that production schedules are adjusted promptly to reflect current conditions, contributing to both efficiency and on-time delivery (Chopra & Meindl, 2016).

To better understand the contribution of MRP to time efficiency, the following figure illustrates the mechanism through which MRP improves scheduling accuracy and reduces lead times. The figure highlights how accurate scheduling enabled by MRP reduces production delays and enhances delivery speed.

Figure 8: MRP and Lead Time Reduction Mechanism



Source: Developed by the student based on (Chopra & Meindl, 2016); (Heizer & Render, 2020); (Jacobs & Chase, 2021).

As shown in Figure 1.11, MRP systems play a critical role in improving time efficiency by ensuring the timely coordination of production activities and material flows.

In conclusion, MRP systems play a critical role in enhancing time efficiency and scheduling accuracy in production planning. Through their ability to reduce lead times, improve scheduling precision, and provide flexibility in response to disruptions, MRP systems help manufacturers achieve higher levels of operational efficiency. This, in turn, allows companies to meet customer demands more effectively, maintain a competitive edge, and improve overall performance in an increasingly dynamic market environment (Jacobs & Chase, 2021).

4.3 MRP's Influence on Quality Assurance and Production Control

One of the key ways that MRP influences quality assurance is by aligning production schedules with the availability of materials. By ensuring that only the required quantities of materials are ordered and delivered at the right time, MRP systems help prevent issues related to overstocking or understocking, both of which can lead to quality problems. Overstocking may result in expired or degraded materials, while understocking can lead to rushed or incomplete production runs, increasing the likelihood of defects. The MRP system's real-time inventory tracking allows companies to monitor the quality and condition of materials throughout the production process, ensuring that the right materials are used at every stage (Heizer & Render, 2020).

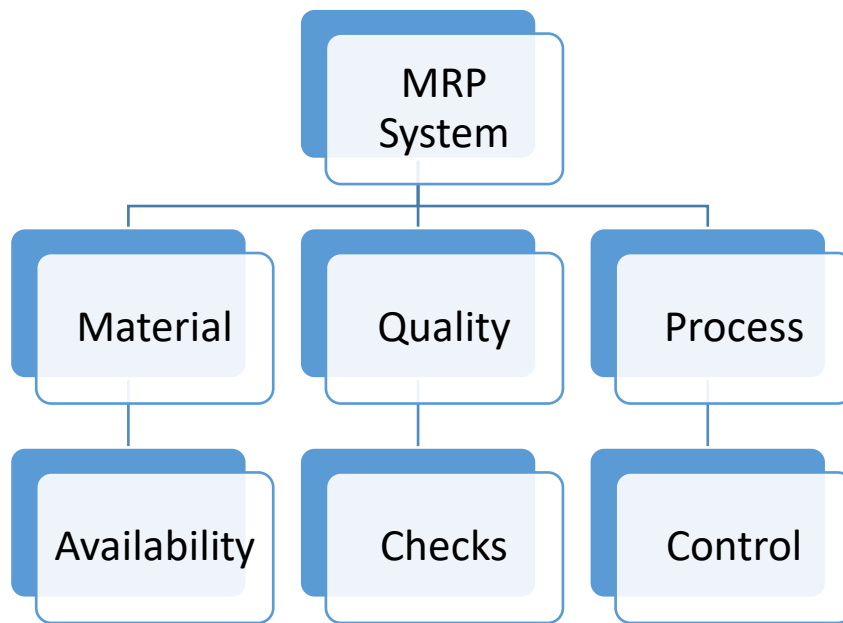
MRP systems also facilitate the implementation of strict quality control measures by integrating quality checks into the production workflow. By embedding quality assurance checkpoints within the scheduling system, MRP allows for the systematic review of production processes

at various stages. These checkpoints can include inspections for defects, adherence to specifications, and testing of finished products. Additionally, MRP systems enable manufacturers to maintain detailed records of quality control activities, which can be used for future reference and continuous improvement. This comprehensive approach helps ensure that products meet the required standards without the need for costly rework or scrap (Jacobs & Chase, 2021).

In terms of production control, MRP systems contribute by providing greater visibility and control over production schedules and processes. With accurate and up-to-date information on material availability, inventory levels, and production progress, managers can make informed decisions about production adjustments, identify potential bottlenecks, and proactively address issues before they affect product quality. By maintaining real-time synchronization between production activities and material availability, MRP helps ensure that production runs are completed on time, minimizing delays and optimizing resource utilization (Slack & Jones, 2019). Furthermore, MRP systems can assist in monitoring and controlling production costs by identifying inefficiencies, reducing waste, and enhancing resource allocation, which in turn supports the maintenance of quality standards throughout the production cycle.

To conceptualise the role of MRP in supporting quality assurance and production control, the following figure presents its key functional contributions within the production system. The figure demonstrates how MRP ensures material availability, facilitates quality checks, and enhances process control within manufacturing operations.

Figure 9: MRP Role in Quality Assurance and Production Control



Source: Developed by the student based on (Heizer & Render, 2020); (Jacobs & Chase, 2021); (Slack & Jones, 2019).

As illustrated in Figure 1.12, MRP systems contribute to maintaining production quality and control by integrating material planning with monitoring and coordination mechanisms.

Another significant aspect of MRP's influence on quality assurance is its ability to improve collaboration between various departments, including production, procurement, and quality control. By providing a unified system that tracks the movement of materials from procurement to production, MRP enhances communication and coordination between departments. This coordination helps prevent misunderstandings regarding quality requirements, materials specifications, and production timelines, fostering a more integrated approach to quality management. Furthermore, the data collected by MRP systems can be used for statistical process control (SPC) and other quality improvement tools to monitor production trends and ensure that products consistently meet quality benchmarks (Chopra & Meindl, 2016).

In conclusion, MRP systems have a profound influence on quality assurance and production control by ensuring the timely availability of materials, facilitating quality control checks, and providing greater visibility and control over production processes. These capabilities help manufacturers produce high-quality products, maintain production schedules, and optimize resource utilization, all of which contribute to enhanced operational efficiency. By aligning production activities with the availability of quality materials and integrating quality control

measures within the production flow, MRP systems help ensure that manufacturing operations meet both quality and performance standards (Jacobs & Chase, 2021) (Heizer & Render, 2020).

4.4 Challenges and Limitations of MRP in Production Planning

While Material Requirements Planning (MRP) systems have proven to be valuable tools for enhancing production planning efficiency, they are not without their challenges and limitations. These constraints can affect the effectiveness of MRP systems and the overall success of production planning in manufacturing environments. Under this title we are going to explore the primary challenges and limitations associated with MRP systems and how they impact production planning processes.

To summarise the main limitations discussed in this section, the following table presents the key constraints associated with MRP systems along with their underlying characteristics.

Table 5: Key Limitations of Material Requirements Planning (MRP) Systems

Limitation	Description
Data dependency	Requires accurate data
Demand variability	Poor flexibility
Complexity	Difficult integration
Lead time dependency	Sensitive to delays
High cost	Expensive implementation

Source: by the student as a summary for what we have seen

As illustrated in Table 2, the effectiveness of MRP systems is strongly influenced by data accuracy, system flexibility, and implementation constraints. These limitations highlight the need for more adaptive and integrated planning approaches in modern manufacturing environments. Collectively, these constraints explain why traditional MRP systems may struggle in dynamic and uncertain environments, thereby justifying the shift toward more flexible approaches such as demand-driven MRP (DDMRP).

1. Data Accuracy and Integrity

One of the most critical limitations of MRP systems is the reliance on accurate and timely data. MRP systems require a vast amount of information to function effectively, including data on

inventory levels, lead times, bills of materials (BOMs), and production schedules. Inaccurate or incomplete data can lead to incorrect planning outputs, which in turn can result in material shortages, production delays, or excess inventory (Stevenson, 2018). According to (Rainer, 2019), even small errors in data entry can have significant downstream effects, as MRP systems depend on precise data for calculating material requirements. Therefore, maintaining the accuracy and integrity of data is crucial for the success of MRP-based production planning.

2. Handling Demand Variability

Another challenge faced by MRP systems is their inability to effectively handle demand variability. Traditional MRP systems operate under the assumption that demand is relatively stable and predictable. However, in many industries, demand can be volatile and subject to fluctuations. As a result, MRP systems may struggle to respond quickly to changes in customer demand, leading to either overproduction or underproduction (Mollenkopf, Stolze, & Tate, 2019). This issue is further exacerbated by the bullwhip effect, where small variations in demand at the customer level lead to larger fluctuations in orders placed with suppliers, creating inefficiencies throughout the supply chain (Lee, Padmanabhan, & Whang, 2021). To address this, some manufacturers are moving toward demand-driven MRP (DDMRP), which incorporates more flexibility and responsiveness into the system (Shamsuzzoha, H, & Jaakkola, 2024).

3. Complexity and Integration Issues

The complexity of MRP systems and their integration with other enterprise systems such as Enterprise Resource Planning (ERP) and supply chain management software is another limitation. Many organizations find that integrating MRP systems with their existing IT infrastructure is both time-consuming and costly (Aydin & Tirkolae, 2024). The challenge of ensuring that data flows seamlessly between systems without errors or delays can significantly impact the performance of the MRP system. Furthermore, the complexity of managing multiple variables, such as inventory levels, lead times, and capacity, in an MRP system requires advanced planning capabilities, which may not be readily available in all manufacturing environments (Stevenson, 2018). In smaller organizations, these challenges can be particularly pronounced due to limited resources and expertise in systems integration.

4. Limited Flexibility

While MRP systems are highly effective in environments with stable demand and a predictable supply chain, they often lack the flexibility needed to adapt to rapidly changing circumstances. For instance, MRP systems are generally not well-suited for managing disruptions in the supply chain, such as raw material shortages, transportation delays, or unforeseen fluctuations in demand (Chopra & Meindl, 2016). During such disruptions, MRP systems may generate inaccurate orders or fail to adjust production schedules appropriately, leading to inefficiencies. As noted by (Jacobs & Chase, 2021), MRP systems tend to operate on fixed parameters, which can limit their ability to accommodate unexpected changes or emergencies in the production process.

5. High Dependency on Lead Times

Another significant limitation of MRP systems is their heavy reliance on accurate lead time data. Lead times the time required for materials to be ordered, delivered, and used in production are a critical component of MRP calculations. However, lead times can be highly variable due to factors such as supplier reliability, transportation delays, and production backlogs (Jacobs & Chase, 2021). If lead time data is inaccurate or outdated, MRP systems may generate orders too early or too late, resulting in production delays or inventory shortages. The dependency on precise lead time data can also lead to a lack of flexibility in responding to unforeseen changes in the supply chain.

6. High Implementation and Maintenance Costs

Implementing and maintaining an MRP system can be a costly and resource-intensive process, particularly for smaller manufacturing organizations. The initial investment required for system setup, staff training, and integration with other enterprise systems can be substantial (Aydin & Tirkolaei, 2024). Furthermore, MRP systems require continuous monitoring and updating to ensure that data remains accurate and that the system functions optimally. This ongoing maintenance can place a significant financial burden on organizations, especially those with limited budgets or IT resources. For some companies, the cost of maintaining an MRP system may outweigh the benefits, especially in industries where demand is highly variable or production schedules are difficult to predict.

7. Complexity in Demand Forecasting

MRP systems are heavily reliant on accurate demand forecasting to generate material requirements. However, demand forecasting itself is a complex and often uncertain process. According to (Heizer & Render, 2020), inaccurate demand forecasts can lead to either stockouts or excessive inventory, both of which are detrimental to production efficiency. This challenge is particularly significant in industries with highly unpredictable or seasonal demand patterns. MRP systems that rely on historical data for forecasting may struggle to adjust to sudden shifts in market conditions or customer preferences, limiting their effectiveness in dynamic environments.

Conclusion of the chapter:

This chapter has outlined the main theoretical foundations related to Material Requirements Planning (MRP) and production planning efficiency. It has highlighted the key concepts, objectives, and interactions between MRP systems and production planning processes, as well as their impact on organizational performance.

These theoretical insights provide a basis for understanding how MRP can influence production planning efficiency. The following chapter will present the research methodology and introduce the host organization in order to analyze these concepts in a real-world context.

**CHAPTER 2: ORGANIZATIONAL
CONTEXT AND
METHODOLOGICAL FRAMEWORK**

This chapter presents the key elements related to the methodological framework adopted in this research. It includes an overview of the organizational context of Condor Electronics, followed by the research methodology used in this study. Furthermore, this chapter outlines the data collection methods, the selected sample, as well as the tools and techniques used to analyze the collected data. The aim is to ensure a clear understanding of how this research was conducted in order to investigate the influence of Material Requirements Planning (MRP) on production planning efficiency.

Section 1: Presentation of Condor Electronics

1.1 Overview of the company:

Presentation of BENHAMADI Group:

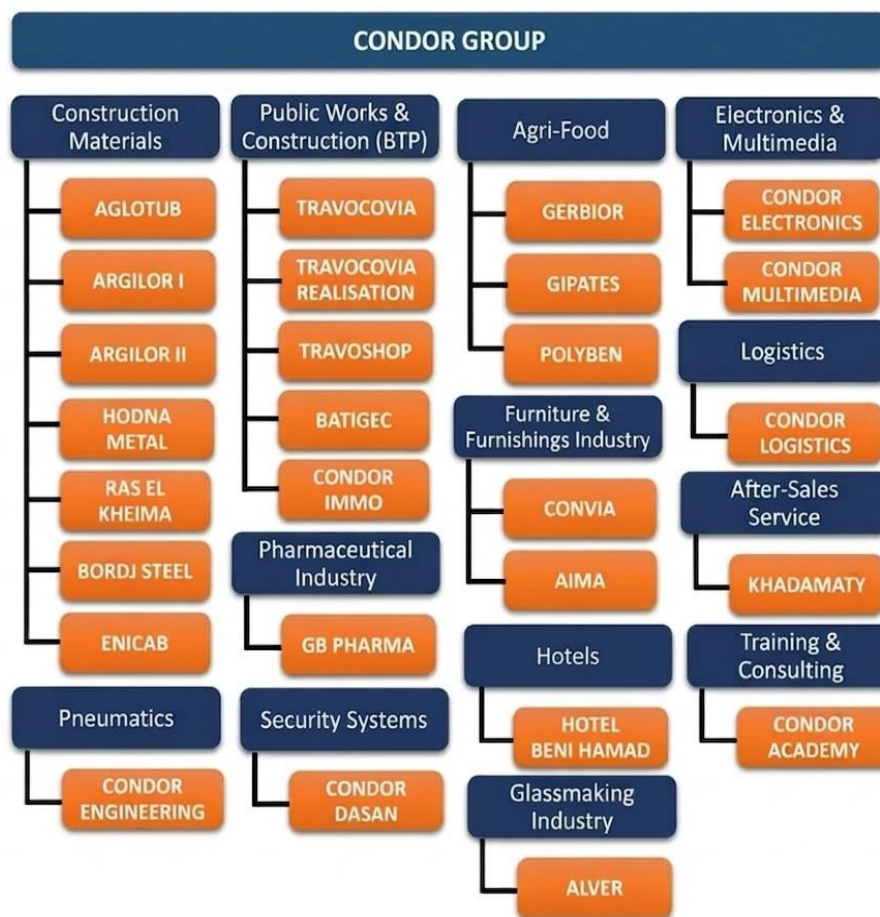
Benhamadi Group is an Algerian industrial conglomerate specialized in the manufacturing and marketing of electronic goods, household appliances, construction materials, and food products.

Recently, the Benhamadi Group has experienced significant growth across various sectors. Today, the group operates **27 subsidiaries** spanning a wide range of activities:

Construction & Public Works (BTP), Electronics & Multimedia, Agri-food (Food Processing), Hospitality & Tourism, Logistics, Pharmaceutical Industry, After-Sales Service (SAV), Tire Manufacturing (Pneumatics), Furniture & Home Furnishings, Security Systems, Glass Industry, Training & Consulting.

The group is now recognized as one of the most powerful and active Algerian corporate entities within the national economy. It operates across diverse fields of activity and consistently delivers impressive results. The following chart illustrates the different components of the group.

Figure 10: the different components of Benhamadi group



Source: internal document of the company

Presentation of SPA CONDOR ELECTRONICS:

Condor was established within a favorable economic climate, leveraging a competitive local market that serves as a gateway for both national and potential international investment. The company was created to meet the increasingly significant and evolving needs of the electronic products sector.

BENHAMADI "Trade Antar", more commonly known as "**Condor**", operates in the manufacturing, marketing, and after-sales service of electronic devices and household appliances.

The headquarters of **SPA CONDOR** is located in the industrial zone of the **Bordj Bou Arreridj** wilaya, specifically on the M'Sila road. The company covers a total area of **40,108**

square meters and operates with a share capital of **4,277,000,000 DA**. Its turnover stands at **58,277,336,043.48 DA**, and it currently employs **4,614 people**.

Condor is structured around **six production units** (business units), all located in Bordj Bou Arreridj. Registered in April 2002, it conducts its activities in accordance with Algerian commercial law.

Furthermore, the company has obtained several certifications that testify to its commitment to quality, environment, and safety:

ISO 9001 version 2000, issued by the AFAQ AFNOR body on March 27, 2007.

ISO 9001 version 2015, for the quality management system.

ISO 14001 version 2015, for environmental management.


ISO 45001 version 2018, relating to occupational health and safety (OH&S).

As part of its strategy for diversification and industrial integration, in 2025, **CONDOR** launched an ambitious new project: the creation of **SPA Zentech**. This department is dedicated to the production of compressors for refrigerators and other household appliances, with the objective of manufacturing a 100% Algerian and entirely localized product.

1.2. History and Evolution:

Born from the entrepreneurial initiative of the **Benhamadi brothers** in the late 1990s, the company began with the importation of electronic products. As early as 2002, it pivoted toward local assembly, followed by increasingly integrated production.

This progressive evolution, supported by over **\$300 million** in cumulative investments since 2012, has enabled **CONDOR** to consolidate its position on the national market while adapting to the requirements of the international context.

Category	Details
Logo	
Date of Creation	02/09/2002
Legal Form	Joint-Stock Company (SPA)
Headquarters	Activity Zone, M'sila Road, Lot 70, Section 161, Bordj Bou Arreridj, 34000 - Algeria
Activity	Manufacturing, marketing, and after-sales service (SAV) of electronic and household appliances.
General Manager (DG)	Harouz Ahmed
Chairman of the Board (PCA)	Omar Benhamadi
Website	https://www.condor.dz/
Strategic Partners	<ul style="list-style-type: none"> • GREE, HISENSE, MIDEA, NINGBO TEC, IMP AND EXP (China) • DONGBU DAEWOO (South Korea) • INTEL and MICROSOFT (USA) • OUEST ISOL VENTIL (France)
Trademark Filing Date (INAPI)	04/30/2003

Missions and Objectives of the Company SPA CONDOR ELECTRONICS:

The company "Antar Trade" – widely known as Condor – located in Bordj Bou Arreridj, plays a key role in the national economy. It contributes actively to meeting local demand for electronic and household appliances, while supporting the development of the private sector by providing a wide range of equipment tailored to the needs of Algerian businesses.

Objectives :

- Maximize profit.
- Rationalize production.
- Increase market share and attract new customers.
- Build customer loyalty.
- Ensure a high quality-to-price ratio.
- Develop professionalism among employees.
- Strengthen the Condor brand within the Algerian market.
- Constantly create and innovate.

Missions:

- Lead the way for Algerian companies in the field, demonstrating that success is possible when rules of seriousness and commitment are applied.
- Ensure a steady supply to the household appliance and electronics market.
- Conquer the international market, increase production volumes, and boost profits.
- Drive industrial development, production, innovation, promotion, marketing, and distribution for the company.

Vision of CONDOR Electronics:

To become the leader in the national market and the preferred choice of the Algerian consumers.

Values of CONDOR Electronics:

The core values of Condor Electronics:

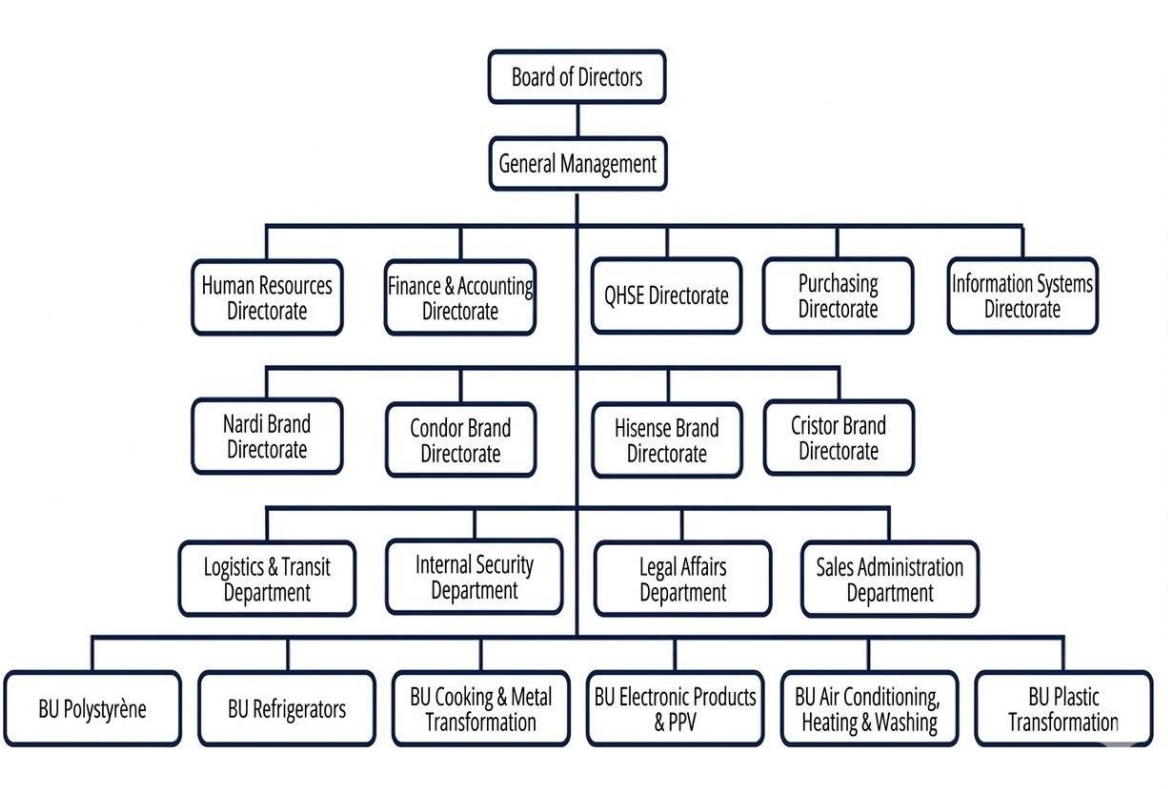
- **Health, Safety, Environment, and Social Responsibility:** Condor is committed to ensuring a safe workplace, protecting the environment, and promoting responsible and ethical practices.

- **Customer Satisfaction at the Core of Priorities:** Customer satisfaction is a major priority for the company through the delivery of quality products and services.
- **Excellence:** The company aims to achieve high standards of quality, efficiency, and continuous improvement in its operations.
- **Innovation:** Condor encourages innovation and the adoption of modern technologies to enhance competitiveness and meet market needs.
- **Respect and Loyalty:** The company promotes respect, integrity, and loyalty in its relationships with employees, customers, and partners.
- **Team Spirit:** Condor values teamwork, collaboration, and communication to achieve common organizational goals.

Company Organizational Chart:

The organizational structure of Condor is based on the interaction between several functions, with a clear distribution of responsibilities and a division of labor among departments. The attached figure provides an illustration of this.

Figure 11: organisational chart of condor electronics



Source: Internal company documentation

1.3. Presentation of the SCM Department

In this section, we present the Supply Chain Management (SCM) function within **Condor Electronics** by outlining its objectives and missions. SCM plays a strategic role in the company's overall logistical performance, particularly by ensuring the fluidity of material flows and guaranteeing the availability of resources necessary for production.

Objectives of the SCM Department:

The objectives pursued by the SCM department are multifaceted:

- **Ensure product availability:** Deliver the right quantities, at the right time, and to the right place.
- **Reduce logistical costs:** Optimize procurement, warehousing, and transportation costs.
- **Improve lead times:** Make the chain more responsive to demand and unforeseen events.
- **Strengthen internal coordination:** Streamline exchanges between purchasing, production, logistics, and sales.
- **Enhance overall performance:** Guarantee an agile, reliable, and sustainable supply chain to support the company's competitiveness.

Missions of the SCM Department:

- **Manage purchasing and procurement:** Secure the flow of raw materials from suppliers.
- **Plan and organize logistical flows:** by Coordinating transportation, storage, and distribution.
- **Optimize inventory management:** Avoid stockouts and overstocking in alignment with sales forecasts.
- **Monitor logistical performance:** Use Key Performance Indicators (KPIs) such as service levels, lead times, and inventory turnover to drive efficiency.
- **Anticipate and manage risks:** Implement resilience strategies to handle disruptions (delays, crises, shortages, etc.).

1.4 MRP function in Condor Electronics:

The Material Requirements Planning (MRP) system within Condor Electronics is a module integrated into the SAP ERP system.

The MRP process is based on several operational data, including customer orders, production forecasts, inventory levels, and the bill of materials (BOM). These data are entered and updated within the SAP system by the relevant departments.

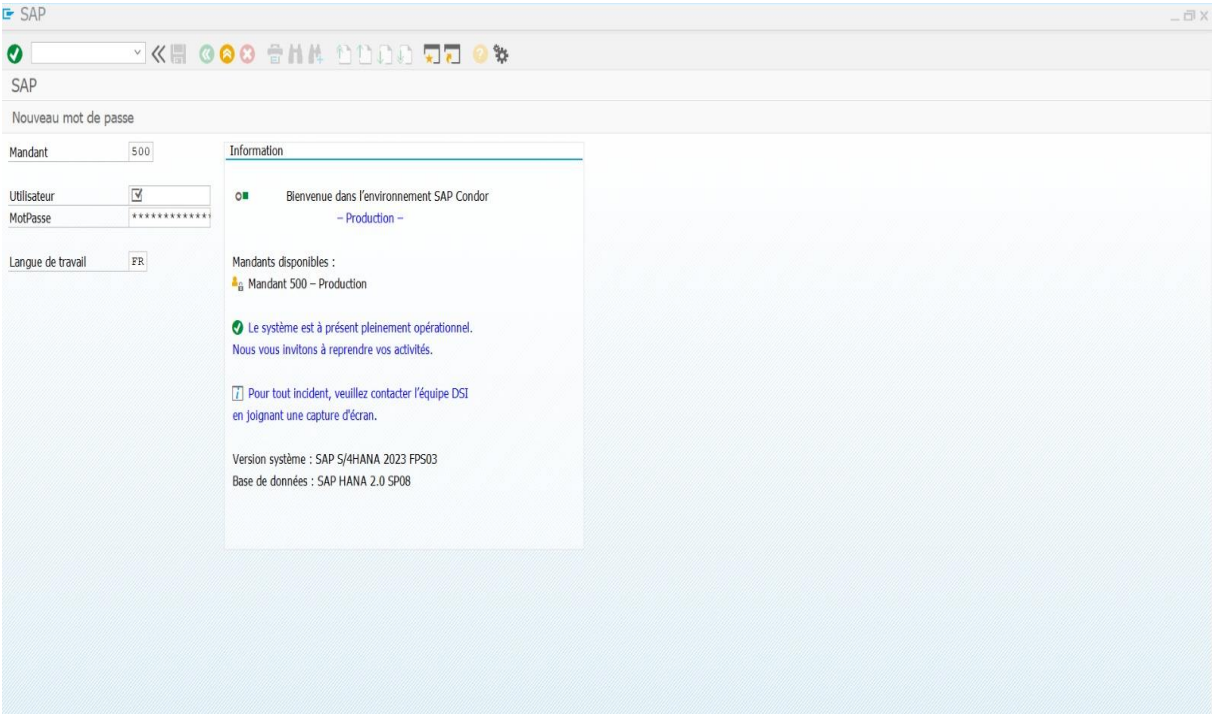
The system processes these inputs to calculate material requirements. It compares the available stock with the required quantities and takes into account the lead times for procurement and production.

Based on these calculations, the SAP system generates production orders, purchase requisitions, and purchase orders.

The MRP system is used by production planners and supply chain teams in their daily operational activities to manage material requirements and production planning within the company.

The following figure provides a visual overview of the SAP interface used in Condor Electronics for managing production-related data.

Figure 12: visual overview of the SAP interface used in Condor Electronics



Source: screenshot captured during the internship in Condor Electronics

While the screenshot does not explicitly display the entire MRP process, it highlights the system environment in which such planning activities are performed, providing insight into the technological tools used by the company.

A key input for the MRP system is the Bill of Materials (BOM), also referred to as nomenclature in SAP. It defines the structure of products by listing all required components and their quantities. The following figure illustrates an example of a nomenclature table used within Condor’s SAP system.

Figure 13: Example of a real Bill of Materials in SAP – Condor Electronics

Niv. éclatement	Poste	Obj.	N° composante	Désignation objet	Dép.	Qté composants (UMC)	UQ	Ty.	Exc.	Segment de besoin	Segment de stock	Niv.	ChP	Ca	Gd	Ty	Ar	Div.	VerF	Stat.gest.art. comp.	Statut d.
.1	0010		609901000433	BODY REFREGERATEUR		1	PCE	L				1	1	M	ZMAP	DA01			KVEDLBSZS		
.1	0020		609902000603	REFRIGERATOR DOOR		1	PCE	L				1	2	M	ZMAP	DA01			KDELBVGSZ		
.1	0030		400104000012	COMPRESSEUR R600a		1	PCE	L				1	3	M	ZMAP	DA01			KEBVDLGSZ		
.1	0040		350110002463	UPPER HINGE COVER/42		1	PCE	L				1	4	M	ZMAP	DA01			KDELBVGS		
.1	0050		350105000827	DAMPING RUBBER/10065		1	PCE	L				1	5	M	ZMAP	DA01			KVEDLBSZS		
.1	0060		702600501822	SCREWS M5X16 A3 SELF-		2	PCE	L				1	6	M	ZMAP	DA01			KVEDLBSZ		
.1	0080		600503000003	FILTRE /1001959		1	PCE	L				1	7	M	ZMAP	DA01			KEBVDLGSZ		
.1	0090		300304000002	TUBE DE CHARGE DINT4		1	PCE	L				1	8	M	ZMAP	DA01			KEBVDLGSZ		
.1	0100		550502000010	25B WELD ROD / 1563453		1,250	G	L				1	9	M	ZMAP	DA01			KVEDLBSZ		
.1	0110		550501000004	WELDING ROD/ZB / 1130		0,001	UN	L				1	10	M	ZMAP	DA01			KEBVDLGSZ		
.1	0120		300406001225	LOWER SHELF / 2174286		1	PCE	L				1	11	M	ZMAP	DA01			KVEDLBSZ		
.1	0130		300406001226	MIDDLE SHELF / 2174283		1	PCE	L				1	12	M	ZMAP	DA01			KVEDLBSZ		
.1	0140		300406001227	UPPER SHELF / 2174281		1	PCE	L				1	13	M	ZMAP	DA01			KVEDLBSZ		
.1	0150		550301000513	ENERGY CONSUMPTION		1	PCE	L				1	14	M	ZMAP	DA01			KVEDLBSZ		
.1	0160		550301000514	NAMEPLATE RCU130W /		1	PCE	L				1	15	M	ZMAP	DA01			KVEDLBSZ		
.1	0170		350101001735	EGG STAND / 2197006		1	PCE	L				1	16	M	ZMAP	DA01			KVEDLBSZ		
.1	0180		300402004132	HOLD-DOWNPLATE CRF-		2	PCE	L				1	17	M	ZMAP	DA01			KDELBVGSZ		
.1	0190		300402004557	TOP HINGE / 2174319		1	PCE	L				1	18	M	ZMAP	DA01			KVEDLBSZ		
.1	0200		550103000002	RUBAN EN FIBRE ADHESI		0,220	M	L				1	19	M	ZMAP	DA01			KEBVDLGSZ		
.1	0210		300403000763	TRADEMARK/LOGO CON.		1	PCE	L				1	20	M	ZMAP	DA01			KVEDLBSZ		
.1	0230		650101000001	RUBAN CERCLAGE PLAS.		8,710	M	L				1	21	M	ZMAP	DA01			KEBVDLGSZ		
.1	0240		701700400822	SCREW M4X8 WHITE WI.		1	PCE	L				1	22	M	ZMAP	DA01			KVEDLBSZ		
.1	0250		300406000459	STEEL BUSH 1,0 MM \156		2	PCE	L				1	23	M	ZMAP	DA01			KEBVDLGSZ		
.1	0260		650301000097	SAC D'EMBALLAGE		1	PCE	L				1	24	M	ZMAP	DA01			KVEDLBSZ		
.1	0270		701900600252	SCREW HEX 6x25 +SP W.		2	PCE	L				1	25	M	ZMAP	DA01			KEBVDLGSZ		
.1	0280		450200000013	FREON R600a		27	G	L				1	26	M	ZMAP	DA01			KEBVDLGSZ		

Source: Internal SAP data, Condor Electronics (2026)

As illustrated the Figure, the nomenclature structure plays a critical role in the MRP process, as it determines the dependent demand for each component.

During the internship, access to certain internal data was provided through collaboration with employees from the Research and Development department. The following figure presents an example of product-related information extracted from the SAP system for MRP-related purposes.


Figure 14: Example of Product Data Extracted from SAP for MRP Purposes – Condor Electronics

Merci de codifier l'article suivant :

Article	Code F	Désignation article	Unité de qté base	Division	Type D'approx*	Données MRP			
						Type de planification (FD/ND)	Délai fabrication interne (SF/PF) jours	Délai prév. Livraison (MF) jours	Stock de sécurité
codifier	2.1.01.17.003.00011	process pipe	IPCE	DA01	Acheter	PD	/	145	500

Salutation
(Ticket : 2026023197)

Ingénieur Soutien Technique
BU Réfrigérateurs
+213
SPA Condor Electronics



Source: captured by the student during the internship in Condor Electronics

As shown in Figure 6, the extracted data relates to a specific product and includes several fields such as article code, designation, unit of measure, division, procurement type, planning type, delivery lead time, and safety stock. These data were obtained upon internal request and are recorded within the SAP system.

Section 2: Research Methodology

Every research project relies on a set of methodological choices that shape the reliability and coherence of its findings. This section presents the epistemological stance adopted for this study, the methods used to collect and analyze empirical data, and the rationale behind each decision. It also describes how the fieldwork was carried out at Condor Electronics, within the Supply Chain Management (SCM) department, during an internship conducted in early 2026. The overall aim is to demonstrate that the methodology deployed is appropriate to the research question and consistent with established practices in qualitative management research.

2.1 Epistemological Positioning

The present study is anchored in an interpretivist epistemological paradigm. Interpretivism rests on the premise that social reality is not an objective, mind-independent entity waiting to be discovered, but is instead constructed through the meanings, interpretations, and experiences of social actors (Creswell & Poth, 2018). Unlike positivism, which seeks universal laws and employs measurement to reveal them, interpretivism prioritises the depth and richness of understanding over statistical generalisability (Bryman, 2016).

This positioning is particularly appropriate for the present research, which investigates how different professionals within Condor Electronics perceive, use, and evaluate the Material Requirements Planning (MRP) system in their daily work. MRP is not merely a technical

artefact; its effectiveness in practice is inseparable from the way it is understood and mobilised by the individuals who interact with it. As (Orlikowski, 1992) argued in her influential study of technology in organisations, the same technological tool can be appropriated in radically different ways depending on the interpretive schemes and organisational contexts of its users. Adopting an interpretivist paradigm also means acknowledging the researcher's own role in the knowledge-production process. Rather than claiming a neutral, detached stance, the interpretivist researcher embraces proximity to the field and relies on inter-subjectivity to access participants' lived experiences (Guba & Lincoln, 1994). In this study, the researcher conducted face-to-face semi-structured interviews, which enabled the establishment of a relationship of trust and the collection of nuanced, contextualised accounts.

2.2 Reasoning Approach

Consistent with the interpretivist paradigm, the study adopts an inductive reasoning approach. Induction proceeds from particular observations towards broader theoretical insights: rather than testing pre-formulated hypotheses against empirical data, the researcher allows themes and patterns to emerge organically from the data collected in the field (Strauss & Corbin, 1998).

This approach is especially suited to a context such as MRP implementation in an Algerian electronics manufacturer where existing theoretical frameworks, largely developed in Western industrial contexts, may not fully account for the local operational realities and constraints. Starting from the perceptions and experiences of the actors involved, rather than imposing external theoretical categories, enables the researcher to capture the specificities of MRP use at Condor Electronics with greater fidelity.

In practical terms, the inductive logic means that the analytical process began with raw interview data, from which codes were derived, then aggregated into sub-themes and overarching themes, eventually leading to interpretive conclusions that respond to the central research question.

2.3 Research approach: Qualitative Single-Case Study

This research employs a qualitative strategy, specifically a single-case study design centred on Condor Electronics. Qualitative research is appropriate when the aim is to explore complex social phenomena in their natural setting, to understand processes and meanings, and to generate nuanced, context-sensitive knowledge (Denzin & Lincoln, 2018). It stands in contrast to quantitative research, which prioritises measurement, control, and statistical inference.

The choice of the case study strategy is motivated by three considerations. First, MRP is an organisational system whose impact on production planning efficiency cannot be reduced to a

set of measurable variables; it unfolds through human interactions, organisational routines, and data management practices that require qualitative investigation to be properly understood. Second, as (Yin, 2018) argues, the case study is the preferred strategy when the researcher poses 'how' and 'why' questions about contemporary phenomena over which the researcher has no control both conditions that obtain in the present study. Third, the single-case design is appropriate when the case constitutes a unique or revelatory instance (Yin, 2018): Condor Electronics, as one of Algeria's largest private electronics manufacturers with an operational MRP system integrated into its supply chain, offers an exceptional opportunity to study MRP in an under-researched national context.

It is important to acknowledge that the single-case design limits the statistical generalisability of the findings. However, the objective of this research is not to generalise to a broader population of firms, but to achieve what (Yin, 2018) calls analytical generalisation the extension of findings to broader theoretical propositions. The insights generated here can thus contribute to the literature on MRP in emerging economies while offering practical recommendations for Condor Electronics and similar organisations.

2.4 Data Collection methods

2.4.1 Semi-Structured Interviews

The primary instrument of data collection in this study is the semi-structured interview. This technique occupies a middle ground between the rigidity of fully standardised questionnaires and the openness of unstructured conversations: the interviewer follows a thematic guide but retains the flexibility to probe responses, seek clarification, and allow participants to raise issues not initially anticipated (Kvale & Brinkmann, 2015) This flexibility is essential in the present research, as the reality of MRP use at Condor Electronics is shaped by factors such as data quality problems, interdepartmental dynamics, and managerial priorities that could not have been fully foreseen at the design stage.

In total, five participants were interviewed across three distinct interview guides. The differentiation of guides reflects the heterogeneity of roles within the MRP process: senior managers interact with MRP outputs at a strategic and operational decision-making level, while technical and data-support staff engage with MRP at the level of data inputs and system maintenance. Using tailored guides for each profile allowed the researcher to elicit role-specific knowledge while maintaining thematic coherence across all interviews. The use of manual note-taking rather than audio recording was adopted to respect participants' preferences for discretion and to encourage open, candid responses.

All interviews lasted between 30 and 45 minutes and were conducted on-site at Condor Electronics during the researcher's internship period, which facilitated natural access to participants and enhanced the contextual richness of the data collected.

2.4.1 Participant Sample

Sampling in qualitative research does not follow the logic of probability sampling used in quantitative studies. Instead, purposive (or purposeful) sampling is employed: participants are selected because they are likely to provide information-rich data relevant to the research question (Patton, 2015). In the present study, all five interviewees were selected on the basis of their direct involvement in the MRP process at Condor Electronics, whether as end-users, planners, data providers, or system administrators. This ensures that the data collected covers the full spectrum of roles implicated in MRP-driven production planning.

Table 3 below presents a summary profile of all participants, identified by anonymised codes to preserve confidentiality.

Table 6: Summary Profile of Research Participants

Code	Job Title	Department	Duration	Guide Used
I-01	Supply Chain Manager	SCM Department	45 min	Guide 1
I-02	Planning Manager	SCM / Production	35 min	Guide 1
I-03	Procurement Officer	SCM Department	30min	Guide 2
I-04	R&D Technical Support	R&D Department	45 min	Guide 2
I-05	SAP Consultant	Information systems department	32min	Guide 3

Source: prepared by the student

This sample provides a multi-perspective view of MRP use within the organisation: I-01 and I-02 offer a managerial and planning-level perspective; I-03 and I-04 provide insights into the data production side of the MRP process (procurement data and technical/BOM data respectively); and I-05 brings the data governance dimension, focusing on the quality and accuracy of master data that underpins MRP calculations.

Section 3: Data Collection Tools

3.1 Interview guide

Three distinct interview guides were developed, each tailored to the professional profile of the corresponding participant(s). All guides shared a common introduction comprising: a presentation of the research topic and objectives; an assurance of confidentiality and anonymity;

an indication of the approximate duration (30 to 45 minutes); and an explanation of the data collection method (manual note-taking).

Guide 1, designed for the Supply Chain Manager and the Planning Manager, is the most comprehensive, comprising seven thematic sections. It covers the participants' professional profiles and relationship to MRP; their daily use of the system and the decisions it supports; the production planning process and the tools used alongside MRP; the indicators of planning efficiency and MRP's contribution to them; data quality requirements and problems encountered; interdepartmental coordination mechanisms and communication challenges; and, finally, a forward-looking evaluation of MRP limitations and improvement priorities.

Guide 2, addressed to the Procurement Officer and the R&D Technical Support, takes the form of a sequence of direct questions without formal sectioning. It focuses on each participant's role in contributing data to MRP; the types of data they produce (supplier lead times, demand forecasts, Bills of Materials, etc.); information-sharing practices and inter-functional communication; data quality problems and the complaints they receive or generate; and suggestions for improving the MRP process.

Guide 3, designed for the Master Data Employee, is structured into five thematic sections: professional profile; daily use of MRP; data quality (accuracy of BOMs, lead times, stock levels, and supplier data; data control mechanisms; and the impact of data errors on planning); interdepartmental coordination and conflicts; and a concluding evaluation section that includes an estimation of current data reliability.

Table 7 below provides a comparative summary of the three guides.

Table 7: Summary of Interview Guides

Guide	Participants	Thematic Coverage	Structure
Guide 1	Supply Chain Manager, Planning Manager	A: Participant Profile; B: Use of MRP; C: Production Planning Process; D: Planning Efficiency; E: Data Quality; F: Interdepartmental Coordination; G: Evaluation & Improvement	Semi-structured ; 7 thematic sections
Guide 2	Procurement Officer, R&D Technical Support	Role & contribution to MRP data; Types of data produced (forecasts, lead times, BOMs); Information sharing; Data quality issues; Impact of coordination; Suggested improvements	Direct questions ; non-sectioned
Guide 3	SAP Consultant (DSI)	A: Profile; B: Use of MRP; C: Data Quality; D: Coordination; E: Evaluation & Improvement (incl. data reliability estimation)	Semi-structured ; 5 thematic sections

Source: prepared by the student

The design of the guides reflects the multi-level nature of the research question: while all guides address MRP use and data quality the two central themes of the study they approach these themes from angles specific to each role. This complementarity ensures that data collected across guides can be triangulated to build a coherent, multi-perspective account of MRP's influence on production planning efficiency at Condor Electronics.

3.2 Data analysis methods

3.2.1 Thematic analysis:

The interview data collected in this study was analysed using thematic analysis (TA), one of the most widely used and methodologically versatile frameworks for qualitative data analysis (Braun & Clarke, 2006). Thematic analysis involves the systematic identification, organisation, and interpretation of patterns of meaning or themes across a qualitative dataset. Unlike grounded theory or discourse analysis, which carry more prescriptive theoretical commitments,

thematic analysis is a flexible method that can be applied across a variety of epistemological positions and research designs (Braun & Clarke, 2006).

In the present study, a data-driven (inductive) form of thematic analysis was applied, meaning that the themes were derived from the content of the data rather than mapped onto a pre-existing theoretical framework. This approach is consistent with the inductive reasoning logic adopted in this research and ensures that the analysis remains grounded in the empirical reality of MRP use at Condor Electronics.

The analysis followed a structured process including data familiarization, coding, and theme development. Coding was guided by the interview questions, where each question served as an initial reference for organizing the data.

When multiple ideas appeared in a single response, they were coded separately to preserve the richness of the data. A hierarchical coding structure was also applied using parent nodes and child nodes, allowing the identification of main themes and more specific sub-themes. This approach ensured a clear and organized understanding of participants' perspectives regarding MRP and production planning efficiency.

3.2.1 Data Analysis Tool (Nvivo 10):

Nvivo 10 software was used as a Computer-Assisted Qualitative Data Analysis Software (CAQDAS) to support the analysis of interview data collected from five participants within Condor Electronics Services in SCM.

All interviews were imported into a single Nvivo project to ensure a unified analysis. The coding process was based on the interview questions, with responses coded according to their relevance. When necessary, multiple ideas within the same response were coded separately.

A hierarchical structure of parent and child nodes was used to organize the data into main themes and sub-themes. In addition, Nvivo enabled the generation of a global word cloud and frequency analysis, helping to highlight the most recurring concepts.

The use of Nvivo 10 enhanced the rigor, structure, and transparency of the data analysis process.

3.3 Methodological Limitations

Identifying the limitations of a research project is not an exercise in self-criticism but a sign of intellectual honesty. Acknowledging what a study cannot do is necessary for properly situating what it can. Four main limitations apply here.

Sample size and missing profiles

Four interviews, while consistent with the exploratory nature of this qualitative study, do not ensure full theoretical saturation. Most notably, the manager of the Master Data function was

not represented among the respondents. This department plays a critical role in entering and maintaining the data on which MRP calculations depend an absence that the R&D interviewee (I-03) himself signaled when he suggested that the Master Data team "is in a better position to evaluate data quality, since they are the ones managing and controlling the data in the system." Incorporating this perspective in future research would substantially strengthen the analysis.

Recency of the system

The MRP module at Condor Electronics had only been deployed at the beginning of 2026, meaning that the system was still in its early integration phase at the time of the study. As I-01 explicitly acknowledged, "we can be considered to be in the initial integration phase of the system." This means that some of the system's potential impacts whether positive or negative had not yet fully materialized, and that performance indicators were not yet stabilized enough to support robust trend analysis. The findings are therefore best understood as a snapshot of an evolving situation rather than a consolidated evaluation.

Interpretive subjectivity

Even with a structured, closed-coding approach, qualitative analysis inevitably involves interpretive judgment in selecting and categorizing units of meaning. This research was conducted by a single analyst without triangulation between multiple coders, which introduces a degree of subjectivity that cannot be entirely eliminated. Peer review of the coding process or independent verification by a second analyst would have strengthened the analytical reliability of the findings.

Researcher positionality

The dual role of intern and researcher carries both advantages and risks. On the positive side, the internship context facilitated access to the field, generated trust with the respondents, and provided sustained exposure to the organizational practices being studied. On the other hand, participants may have moderated their criticisms or framed their accounts more favorably in the presence of a colleague, introducing a social desirability effect that is difficult to measure or correct for after the fact. This limitation is worth keeping in mind when interpreting the findings.

CHAPTER 3: PRESENTATION AND DISCUSSION OF THE RESULTS

Introduction of the chapter:

This chapter presents and discusses the empirical results obtained from the field study conducted at Condor Electronics. It focuses on analyzing the findings related to the use of the Material Requirements Planning (MRP) system and its influence on production planning efficiency. The chapter is divided into two main sections: the first section presents the results of the lexical and thematic analyses for the data that has been collected through the semi-structured interviews, while the second section discusses these findings in relation to the research questions and proposes practical recommendations and an action plan.

Section 1: Resultats and interpretation

1.1 Lexical Analysis:

The lexical analysis constitutes the first analytical layer applied to the interview data collected in this study. Conducted with the assistance of NVIVO 10 software, this phase of the analysis aimed to identify the dominant concepts, recurring terminology, and underlying semantic orientations present across the three sets of interview transcripts. Rather than treating word frequency as a straightforward quantitative measure, this study employs lexical analysis as an interpretative instrument: the recurrence of specific terms is read as a reflection of respondents' cognitive priorities, organizational preoccupations, and perceptual frameworks regarding MRP and production planning. Each interview guide is examined separately, through two complementary outputs of the NVIVO word cloud visualization and word frequency table.

1.1.1 First Interview Guide

The first interview guide was conducted with the Supply Chain Management (SCM) Manager and the Production Planning Manager, due to their direct involvement in production planning activities and the operational use of the MRP system within Condor Electronics. This guide was structured around seven main sections designed to explore different dimensions related to the use of MRP and its influence on production planning efficiency.

The interview guide included:

- Section A : Participant Profile (4 questions)
- Section B: Use of the MRP System (4 questions)
- Section C: Production Planning Process (4 questions)
- Section D: Planning Efficiency (4 questions)

The terms 'MRP,' 'system,' 'production,' 'data,' and 'planning' emerge with the greatest visual prominence, collectively suggesting that the two respondents (the SCM Manager and the Production Planning Manager) orient their professional discourse primarily around the technical and functional dimensions of the MRP system and its embeddedness in the broader production planning architecture of Condor Electronics.

The co-prominence of 'MRP' and 'system' in the word cloud is analytically significant. It indicates that respondents at this organizational level perceive MRP not as an isolated tool but as a system that is, as an integrated, rule-governed structure that shapes and mediates a wider set of organizational processes. This reading is further reinforced by the notable presence of terms such as 'data,' 'materials,' 'lead,' 'times,' and 'stock,' which together trace the operational logic of MRP: the generation of material requirements based on production plans, procurement lead times, and inventory levels. The lexical clustering of these terms suggests a well-internalized understanding of MRP's functional mechanics among senior respondents.

Equally significant is the prominence of the term 'coordination' within this word cloud. Its visual weight, alongside terms such as 'departments,' 'supply,' 'chain,' 'information,' and 'ensure,' reflects the extent to which senior managers conceive of MRP performance as fundamentally dependent upon cross-functional collaboration. This finding anticipates a central theme that will emerge more fully in the thematic analysis: coordination between departments is not merely a peripheral organizational concern but a constitutive condition for the reliable functioning of the MRP system. The presence of 'purchasing' further underscores the supply-side orientation of the first interview guide participants, both of whom interact with MRP primarily through the lens of procurement planning and material availability management.

Finally, the visual weight of 'ensure' which is a process-oriented, action-driven verb is worth noting. Its recurrence suggests that respondents at the managerial level are preoccupied not only with describing how the system functions in principle, but with articulating how its outputs are translated into actionable decisions and how planning reliability is actively maintained in operational practice. Taken together, the word cloud of the first interview guide reveals a discourse organized around systemic integration, data-driven planning, and coordinative management.

B. Word Frequency:

The word frequency table produced through NVIVO 10 provides a more granular and quantitative perspective on the lexical patterns identified in the word cloud. The twenty most

frequent terms are presented below, with their respective occurrence counts and weighted percentage values.

Table 8: Word Frequency Table for the First Interview Guide

Mot	Longueur	Nombre	Pourcentage pondéré (%)
Mrp	3	113	3,06
System	6	102	2,76
production	10	80	2,17
Data	4	70	1,90
Planning	8	64	1,73
Plan	4	31	0,84
Stock	5	31	0,84
materials	9	29	0,79
Process	7	26	0,70
department	10	25	0,68
coordination	12	24	0,65
departments	11	22	0,60
Lead	4	22	0,60
purchasing	10	22	0,60
Supply	6	22	0,60
Material	8	20	0,54
Time	4	20	0,54
Use	3	20	0,54
Chain	5	19	0,52
performance	11	17	0,46

Source: NVivo 10 Output, Top 20 Terms

The word frequency analysis generated through NVivo 10 highlights the most recurrent terms identified in the interviews conducted with the SCM Manager and the Production Planning Manager. As presented in the table above, the term “mrp” appears as the most frequently used word with 113 occurrences, followed by “system” (102 occurrences), “production” (80 occurrences), “data” (70 occurrences), and “planning” (64 occurrences).

Other recurrent terms include “plan,” “stock,” “materials,” “process,” “department,” “coordination,” “purchasing,” and “supply,” which reflect the operational vocabulary

commonly associated with production planning and supply chain management activities within Condor Electronics.

The frequency table also shows the presence of words related to inventory management, lead times, interdepartmental coordination, and organizational performance, such as “lead,” “time,” “chain,” and “performance.” These recurring terms illustrate the diversity of themes discussed during the interviews and provide an overview of the principal concepts addressed by the respondents regarding the use of the MRP system and production planning practices.

1.1.2 Second Interview Guide:

This guide was conducted with the Purchasing Specialist within the Supply Chain Management (SCM) department, as well as technical support staff from the Research and Development (R&D) department. These participants were selected due to their direct involvement in data generation, information exchange, and coordination processes supporting the Material Requirements Planning (MRP) system at Condor Electronics.

This guide focused mainly on data management and interdepartmental coordination, which are key factors influencing production planning efficiency and MRP effectiveness. Unlike the first guide, it was designed in a more direct semi-structured format without detailed sections, allowing a flexible exploration of operational practices.

The interview covered the following main points:

- Participant role and responsibilities
- Contribution to MRP and planning data
- Types and frequency of data generated (forecasts, lead times, BOMs, etc.)
- Information sharing between departments
- Data quality issues and inconsistencies
- Impact of coordination on planning outcomes
- Suggestions for improvement

A closing question was included to gather additional insights from participants regarding data flow and coordination within the organization.

A. Word Cloud:

The word cloud below was generated from the transcripts of the Purchasing specialist and the R&D Technical Support respondent. Their operational proximity to MRP's data inputs produces

a lexical field that overlaps with but is meaningfully distinct from the managerial discourse of the first guide.

Figure 16: Word Cloud of the Second Interview Guide



Source: NVIVO output for the 2nd interview guide

The word cloud highlights a set of the most recurrent terms used by the respondents, particularly words such as: “department”, “data”, “system”, “times”, “production”, “MRP”, “materials”, and “technical”.

The prominence of the word “department” indicates that the respondents frequently focused on the relationship between different departments while discussing workflow and operational practices, especially regarding communication and coordination between organizational functions inside the company. This reflects the respondents’ repeated references to continuous interaction between departments during daily operations.

The frequent appearance of the word “data” shows the respondents’ strong focus on the information used within the system, whether related to technical information, material data, inventory records, or order management. This term reflects the respondents’ emphasis on the importance of having accurate and updated information during operational activities.

The strong presence of the word “system” also reflects the numerous references made by respondents to the information system used within the company. The interviewees discussed its role in organizing information, monitoring operations, and linking activities related to production and supply management.

In addition, words such as “plans”, “times”, and “production” indicate that the respondents repeatedly referred to planning activities, scheduling, timing, and production organization. This reflects their attention to workflow organization and respect of production and supply deadlines.

Furthermore, terms such as: “materials”, “purchase”, “supply”, and “item” show that the respondents frequently discussed issues related to raw materials, purchasing activities, supply operations, and the monitoring of production components, particularly from both technical and administrative perspectives.

The appearance of words such as: “technical”, “process”, “management”, and “coordination” also reflects that the respondents’ discourse was not limited to operational aspects only, but also included technical and organizational dimensions related to workflow management inside the company.

Overall, the word cloud shows that the respondents mainly focused on topics related to data, systems, coordination, materials, and planning, which were recurrent themes throughout the interviews.

B. Word Frequency:

The word frequency table presents the most frequently used terms by the respondents, together with the number of occurrences and weighted percentages of each word. This analysis makes it possible to identify the concepts that appeared most prominently in the interview content.

Table 9: Word Frequency Table for the 2nd Interview Guide

Mot	Longueur	Nombr e	Pourcentag e pondéré (%)	Mots similaires
data	4	34	2,72	Data
department	10	31	2,48	department, departments
system	6	29	2,32	System
plans	5	26	2,08	plan, planned, planning, plans
times	5	24	1,92	time, timely, times
mrp	3	23	1,84	Mrp
production	10	23	1,84	product, production, products
materials	9	16	1,28	material, materials
item	4	15	1,20	item, items
technical	9	15	1,20	technical, technically
information	11	14	1,12	Information
ensure	6	13	1,04	ensure, ensured, ensures, ensuring
process	7	13	1,04	process, processes
purchase	8	12	0,96	purchase, purchasing
supply	6	12	0,96	Supply
management	10	12	0,96	manage, managed, management, manager, managing
coordination	12	11	0,88	coordinated, coordination
lead	4	11	0,88	Lead
structured	10	10	0,80	structure, structured, structures
used	4	10	0,80	use, used, uses, using

Source: NVIVO output

The word “data” ranked first with 34 occurrences, reflecting the respondents’ frequent discussions about information and data used during operational activities, particularly data related to materials, orders, inventory, and technical operations.

The word “department”, which appeared 31 times, indicates that the respondents continuously referred to different departments while explaining workflow processes and professional

communication practices, highlighting the importance of functional relationships between organizational units.

The term “system” appeared 29 times, reflecting the strong presence of the information system in the respondents’ discourse. It was frequently mentioned as a tool used to organize operations, monitor information, and coordinate daily activities. And also, the recurrence of the words: “plans”, “times”, and “production” shows that the interviews included repeated discussions concerning planning activities, scheduling, production flow, and operational timing, particularly regarding execution deadlines and workflow organization.

The terms: “materials”, “item”, “purchase”, and “supply” reflect the respondents’ focus on issues related to raw materials, production components, purchasing operations, and supply management, which corresponds to the nature of their professional responsibilities. Moreover, the appearance of words such as: “technical”, “process”, “management”, “coordination”, and “structured” indicates that the respondents also focused on technical and organizational aspects related to process management, workflow procedures, and coordination mechanisms between the different actors involved.

Therefore, the word frequency table shows that the respondents’ discourse mainly revolved around concepts related to data, systems, departments, planning, materials, and coordination, which were the most dominant themes throughout the interviews.

1.1.3 Third Interview Guide:

The third interview guide was conducted with a SAP consultant specializing in the Production Planning (PP) module, who is also a member of the MRP project team led by the Information Systems Department (DSI) and the Business Units of Condor Electronics. The participant was selected due to their technical involvement in the implementation and configuration of the MRP system.

This interview aimed to explore the system-level perspective of MRP usage, focusing on its functioning, data requirements, and coordination between technical and business teams, as well as issues related to system reliability and improvement opportunities.

The interview was structured around the following sections:

Section A: Participant Profile

Section B: Use of the MRP System

the respondent frequently referred to data accuracy, data integration, and the role of information in ensuring the proper functioning of the system.

Similarly, the prominence of the term “MRP” indicates that the participant’s discourse remained highly centered on the operational and technical aspects of the Material Requirements Planning system. The repeated use of this term reflects the respondent’s direct involvement in the implementation and monitoring of the system.

The appearance of the word “planning” highlights the importance given to scheduling activities, production organization, and operational forecasting. The participant repeatedly referred to planning processes while discussing system functionality and workflow management. And alsoThe prominence of 'project' establishes MRP at Condor as an implementation-phase undertaking rather than a fully embedded operational system, introducing a temporal and organizational dimension absent from the other guides.

We can say that all the terms related to the technical and organizational aspects of the system, including: “data”, “MRP”, “planning”, “project”, “coordination”, and “system”. The clear recurrence of these terms reflects the interviewee’s emphasis on the importance of data accuracy in ensuring the effectiveness of the system, as well as the role of coordination and communication between technical teams and different departments during the implementation and monitoring phases of MRP. In addition, words such as “incorrect”, “errors”, and “problems” emerged, indicating that the participant addressed certain difficulties related to data quality and operational errors that may affect system performance. Conversely, terms like “stock”, “materials”, “production”, and “BOM” show a focus on inventory-related aspects, production components, and process monitoring within the system. Overall, the lexical content of the interview reflects a technical and organizational orientation centered on data management, inter-stakeholder coordination, and the monitoring and improvement of system performance.

Overall, the word cloud demonstrates that the participant’s discourse mainly revolved around data management, project coordination, communication between teams, system reliability, and operational monitoring within the MRP environment.

B. Word Frequency:

The word frequency table for the third interview guide, generated through NVivo 10, presents a notably more concentrated lexical distribution than those of the first two guides, reflecting

both the shorter length of the interview transcript and the respondent's highly focused, technically specific discourse.

Table 10: Top 20 terms of the Word Frequency Table for the 3rd Interview Guide

Mot	Longueur	Nombre	Pourcentage pondéré (%)
Mrp	3	16	3,91
Data	4	15	3,67
Planning	8	8	1,96
Project	7	7	1,71
Incorrect	9	6	1,47
System	6	5	1,22
Bom	3	4	0,98
business	8	4	0,98
communication	13	4	0,98
coordination	12	4	0,98
impact	6	4	0,98
problems	8	4	0,98
results	7	4	0,98
section	7	4	0,98
stock	5	4	0,98
teams	5	4	0,98
department	10	3	0,73
Direction	9	3	0,73
Dsi	3	3	0,73
Errors	6	3	0,73

Source: Developed by the student using Nvivo 10 software from primary interview data.

With weighted percentages of 3.91% and 3.67% respectively, 'MRP' and 'data' together account for nearly 7.6% of the corpus a hyper-concentration suggesting that this respondent's understanding of MRP is almost entirely mediated through the prism of data governance. The ranking of 'incorrect' as the fifth most frequent term (1.47%), above 'system,' 'communication,' and 'coordination,' is the most distinctive lexical feature of the third guide. Its frequency reflects the SAP Consultant's precise enumeration of data failure modes, constituting a diagnostic taxonomy that complements the more general data quality concerns voiced by other

respondents. The equal distribution of 'communication,' 'coordination,' 'problems,' and 'impact' at four occurrences each indicates a systematic perception of these factors as consequential rather than incidental a reading consistent with the respondent's broader framing of MRP success as contingent on both organizational alignment and technical data integrity.

1.2 Thematic Analysis:

The thematic analysis constitutes the empirical core of this dissertation. Conducted through systematic coding in Nvivo 10 and organized around the thematic axes structuring each interview guide, it moves beyond lexical description toward a critical, interpretative engagement with the meanings and operational realities expressed by respondents. Quotations are integrated throughout and subjected to academic interpretation.

1.2.1 Thematic Analysis of the First Interview Guide:

This thematic analysis was conducted based on the semi-structured interviews carried out with the Production Planning Manager and the SCM Manager at Condor Electronics. The analysis aimed to explore how the MRP system influences production planning efficiency, as well as the organizational and operational factors affecting its implementation and daily use.

The findings revealed several recurring themes related to the use of MRP in planning activities, its contribution to decision-making and planning efficiency, the importance of data quality, the role of interdepartmental coordination, and the current limitations affecting the system. Although both respondents shared similar perceptions regarding the usefulness of the MRP system, some differences appeared depending on their responsibilities and level of interaction with planning operations.

Theme 1: The Use of MRP in the Production Planning Department

The first thematic axis examines how the MRP system is used within the production planning environment at Condor Electronics. Both respondents explained that the MRP system is integrated within SAP and used as part of the company's broader ERP infrastructure. The Production Planning Manager stated that the department uses MRP through SAP, where: "specific transactions are used to input and manage data."

The respondent further explained that the system: "is integrated within SAP, which allows us to adapt and apply MRP functionalities effectively in our daily operations."

This integration demonstrates that MRP is not used as an isolated planning tool, but rather as part of a centralized information system connecting planning, purchasing, inventory, and supply chain activities.

Both respondents also emphasized the different frequencies of MRP utilization depending on operational needs and managerial responsibilities. The Production Planning Manager explained that when he said: "we mainly use the MRP outputs on a monthly basis."

Similarly, the SCM Manager stated that MRP is used: "on a weekly basis, and also at the beginning of each month to make sure that the plan is running correctly"

while purchasing specialists refer to it almost daily for procurement activities.

This variation in usage frequency reflects the organizational structure of planning activities within the company. Operational actors rely on the system more frequently for execution-related decisions, whereas managerial use is more focused on monitoring, validation, and periodic re-planning.

Both interviewees also described MRP as a decision-support tool rather than a fully autonomous planning system. The Planning Manager identified several types of decisions supported by MRP, including purchasing launch decisions, purchasing acceleration decisions, inventory management decisions, contingency planning decisions, and order adjustment decisions. Similarly, the SCM Manager described the system as: "a simulation and decision-support tool."

However, both respondents stressed that the final decisions remain dependent on managerial evaluation and operational realities. The SCM Manager explicitly stated that: "the final decision on whether to follow or adjust these suggestions remains on our side."

This demonstrates that although MRP improves visibility and supports planning activities, human intervention remains essential, especially in situations where operational conditions differ from system assumptions.

Theme 2: Production Planning Process and MRP Integration

This theme concerns the structure of the production planning process and the current level of MRP integration within it.

Both respondents described production planning as a hierarchical process beginning with sales forecasts and progressively translated into production and procurement activities. The Production Planning Manager explained: "We start the production planning process based on

the annual commercial forecast. Based on this forecast, we develop the annual production plan, which aims to meet the expected demand.”

According to both interviewees, once the production plan is validated, the MRP system generates material requirements and purchasing needs based on BOM structures, stock levels, and lead times.

Despite this integration, a major finding emerging from the interviews is that the MRP system is still in an initial implementation phase within the company. The Production Planning Manager clearly stated that: "the MRP system is not yet fully integrated into the production planning process.”

The respondent further explained that the implementation only started recently and that users are still adapting to the system’s functionalities and outputs.

This partial integration explains why MRP outputs are sometimes manually modified or adjusted. Both respondents referred to situations where external disruptions affected the reliability of system calculations. The Production Planning Manager mentioned geopolitical disruptions such as: “the recent situation involving Iran and the Strait of Hormuz,”

while the SCM Manager referred to transportation crises affecting supply conditions.

In such cases, both respondents explained that the system continues to generate results based on outdated or theoretical data, requiring planners to manually adapt procurement and production decisions.

The interviews also revealed the importance of complementary tools such as S&OP meetings and reporting tools. The Planning Manager described S&OP meetings as: “crucial, "because they allow teams to adjust forecasts and respond to operational disruptions not directly reflected in the MRP system.

Similarly, the SCM Manager highlighted the use of Power BI and S&OP meetings to improve visibility and coordination between departments.

These findings suggest that MRP currently functions as one component within a broader hybrid planning structure rather than as the sole planning mechanism.

Theme 3: MRP Contribution to Planning Efficiency

This concerns the contribution of the MRP system to production planning efficiency, which directly relates to the central research question of this dissertation.

Both respondents confirmed that the implementation of MRP contributed positively to planning efficiency and inventory management. The Production Planning Manager stated that: “the MRP system has contributed to improving efficiency by enabling more accurate and timely procurement of raw materials.”

The respondent further explained that the system helps ensure that:

“the right quantities are available at the right time.”

Similarly, the SCM Manager highlighted the improvement in stock visibility and order monitoring through SAP integration. According to the respondent, MRP improved efficiency because: “it gives us visibility on all orders in one place.”

The SCM Manager also compared MRP with previous Excel-based planning practices, explaining that: “Excel has limitations in terms of data processing, while the MRP has a higher capacity.”

One of the most important findings concerns the evolution of stock coverage after the implementation of MRP. The SCM Manager explained that stock coverage improved by approximately **50%** following the implementation of the MRP system: “before was around **60** days, and after using MRP, it went down to around **30 to 45** days.”

This reduction indicates an improvement in inventory management and better alignment between purchasing decisions and actual production needs.

Both respondents also highlighted that MRP contributed to reducing the frequency of unexpected planning changes and improving visibility regarding material availability. According to the SCM Manager: “the frequency of changes in the production plan has decreased.”

This suggests that the system improved planning stability and reduced reactive decision-making caused by missing materials or lack of visibility.

However, despite these improvements, both interviewees emphasized that the implementation remains recent, making it difficult to fully evaluate the long-term impact of MRP on indicators such as delays, stockouts, or overproduction.

Theme 4: Data Quality and Its Impact on Planning

Data quality emerged as one of the most critical and recurring themes throughout both interviews.

The Production Planning Manager emphasized that: “the proper functioning of the MRP system relies mainly on the accuracy of key data, particularly lead times and required quantities.”

Similarly, the SCM Manager identified procurement lead times, delivery lead times, production capacity, sales forecasts, and stock levels as essential data for the proper functioning of the MRP system.

Both respondents agreed that inaccurate data directly affect planning reliability and system performance. The Planning Manager explained that inaccurate forecasts may lead either to excess inventory or material shortages, both of which negatively affect operational and financial performance.

A particularly important finding concerns forecast reliability. The Production Planning Manager stated that: “the reliability of forecast data does not exceed **50%**.”

As a consequence, planning decisions are not based exclusively on MRP outputs. The respondent explained: “we do not fully rely on the results provided by the MRP system.” and further added that: “we often rely on our own experience and internal analysis to adjust or validate the final decisions.”

This finding highlights a major limitation affecting the effectiveness of the MRP system within the company. Since the quality of outputs depends directly on the quality of inputs, unreliable forecasts reduce the credibility of system-generated recommendations and increase dependence on human expertise.

The SCM Manager similarly explained that incorrect stock data may result in either stock shortages or overstock situations, affecting the balance between supply and demand.

Both respondents also identified the importance of cross-functional data verification and the role of DSI and Master Data teams in ensuring data consistency within SAP.

And Both respondents also highlight the broader consequences of data inaccuracy: incorrect forecasts can lead to either overstocking or material shortages, while inaccurate lead times can produce either premature orders (generating excess inventory) or delayed orders (causing stockouts and production disruptions). These consequences are not merely operational inconveniences but have direct financial and customer service implications.

Overall, the findings demonstrate that data quality represents one of the most decisive factors influencing MRP performance and planning reliability.

Theme 5: Interdepartmental Coordination

Both respondents described MRP as a cross-functional system involving several departments, including planning, SCM, purchasing, inventory management, R&D, DSI, and Master Data teams.

The Production Planning Manager explained that SAP ensures coordination because: “activities are structured in a sequential and interdependent manner.”

This means that each department depends on the outputs of the previous process before continuing its activities.

Similarly, the SCM Manager explained that SAP acts as: "a common platform where all departments share and access the same information.”

Both respondents highlighted that coordination is also reinforced through meetings, communication procedures, and information sharing between departments.

The Planning Manager reported that communication is generally smooth due to: “well-defined and structured communication procedures.”

The SCM Manager also confirmed that good coordination improves the reliability of planning activities and reduces last-minute adjustments.

The findings therefore suggest that MRP performance is not only dependent on technical system capabilities, but also on the quality of organizational communication and collaboration between departments.

Strong coordination contributes to improving data reliability, planning stability, and process synchronization across the supply chain.

Theme 6: Limitations, Improvements, and Future Directions

The final thematic axis concerns the limitations of the current MRP system and the improvements proposed by the respondents.

The Production Planning Manager identified several limitations related to the rigidity of the system and its limited integration with real production constraints. According to the respondent, the MRP system relies on: “relatively fixed assumptions,” and does not fully consider production capacity constraints or unexpected operational disruptions.

The SCM Manager expressed a similar view, explaining that MRP recommendations become less reliable during exceptional situations such as transportation crises or geopolitical disruptions.

Both respondents also emphasized that the effectiveness of MRP remains strongly dependent on the quality of data and the maturity of the implementation process.

Regarding future improvements, both interviewees stressed the importance of improving data reliability and integrating additional operational variables into the system.

The Production Planning Manager recommended: “making the MRP system more integrated with the real conditions of production,”

and proposed moving toward: “a more complete system such as MRP II.”

The respondent explained that such an evolution would allow better integration of capacity planning and shop floor control.

Another significant finding concerns the respondent’s perception of artificial intelligence integration. When asked about the possibility of integrating AI tools into the MRP system, the Planning Manager rejected the idea due to cybersecurity concerns, explaining that: “the main concern for us is security.”

The respondent further stated that: “exposing internal data to AI systems is not something we would consider acceptable.”

This response reflects the company’s cautious approach toward external digital technologies and highlights the importance of data protection within the organization.

Overall, the thematic analysis of the first interview guide demonstrates that the MRP system has already contributed to improving planning visibility, inventory management, and

coordination within Condor Electronics. However, its effectiveness remains constrained by data reliability challenges, the recent nature of its implementation, and the need for greater integration with real operational conditions. The findings also show that human expertise, coordination, and continuous data updating remain essential elements for ensuring effective production planning performance.

1.2.2 Thematic Analysis of the second Interview Guide: Purchasing specialist and R&D Technical Support

Theme 1: Roles and Contributions to MRP Data

The second interview guide focused on two operational actors who contribute directly to the preparation and management of the data used by the MRP system: The Purchasing Specialist within the SCM department and the Technical Support Assistant in the R&D department. Although both respondents contribute to the same planning system, their roles differ significantly according to the nature of the data they manage.

The Purchasing Specialist's contribution is mainly related to procurement and supply data. The respondent explained that the department contributes to the MRP system by ensuring that "procurement-related data is accurate, updated, and reliable for planning purposes." More specifically, the respondent highlighted the importance of supplier lead times, purchase order status updates, safety stock levels, and supplier information. According to the interviewee: "We contribute to the MRP system by ensuring that procurement-related data is accurate, updated, and reliable for planning purposes. In particular, we provide accurate supplier lead times, which are essential for calculating material availability and planning purchase orders."

This response shows that the purchasing function plays a critical role in maintaining the operational reliability of MRP outputs. The interview also reveals that the MRP system supports procurement decisions by identifying stock risks and generating purchase requirements according to lead times and inventory levels. The respondent stated that the system helps "identify potential stockout situations in advance" and supports inventory management by triggering purchasing decisions before shortages occur.

On the other hand, the R&D Technical Support respondent contributes mainly through technical and product structure data. The interviewee explained that the department is responsible for preparing and validating the Bill of Materials (BOM), which represents the technical structure of products. According to the respondent: "We define all the components, their quantities, and

how they are linked together within the product. This information is essential because the MRP system relies on it to calculate material requirements.”

The respondent also emphasized that their responsibility goes beyond creating the BOM, since they are also involved in validating new materials and suppliers through the homologation process before integration into the system. This demonstrates that the R&D department contributes directly to the technical reliability of MRP data at the source level.

A comparison between both interviews shows that the Purchasing Specialist focuses mainly on dynamic procurement parameters such as lead times and stock management, while the R&D Technical Support role is more centered on technical structures and product consistency. Despite these differences, both respondents strongly associate MRP performance with data reliability and accuracy.

Theme 2: Information Sharing and Departmental Workflow

Another important theme emerging from the interviews is the structured process of information sharing between departments involved in the MRP system. Both respondents described MRP as a cross-functional process requiring coordination and continuous data exchange between several departments.

The Purchasing Specialist explained that, before the implementation phase of MRP, the company organized “meetings and workshops involving all departments in order to define roles and clearly structure the input data required from each service.” The respondent further described how responsibilities were distributed between departments. For example, the R&D department defined the BOM structures, while planning identified which items would be managed through MRP and which would remain outside the system.

Similarly, the R&D Technical Support respondent described a sequential workflow where each department contributes specific information before integration into SAP. The interviewee explained: “At the beginning, the Supply Chain Management department provides key input data such as the packing list, procurement or delivery lead times, and they also define the safety stock levels.”

The respondent also stated that the process department defines manufacturing lead times, while technical support defines quantities, assigns item codes, and builds the BOM structure before transmitting the information to the Master Data team for integration into SAP.

These responses demonstrate that MRP implementation at Condor Electronics depends heavily on interdepartmental coordination and structured information flows. The interviews reveal that the success of the system is not based only on the technical configuration of SAP, but also on the ability of departments to collaborate and maintain consistent data exchange processes.

The Purchasing Specialist explicitly confirmed this idea by stating: “This strong interdepartmental coordination and structured information sharing allowed us to successfully implement the MRP system.”

Therefore, coordination appears not only as an operational necessity, but also as a key factor behind the successful integration of the MRP system within the organization.

Theme 3: Data Quality Challenges at the Operational Level

Data quality emerged as one of the central concerns in both interviews. However, the two respondents approached this issue from different operational perspectives.

The Purchasing Specialist mainly emphasized problems related to supplier lead times and external disruptions affecting procurement operations. The respondent referred specifically to geopolitical crises and transport disruptions, explaining that: "During the recent disruption linked to the Strait of Hormuz crisis, there was a mismatch between the expected lead times recorded in the MRP system and the actual delivery times.”

This response highlights one of the main limitations of MRP systems in unstable supply chain environments. Although lead times may initially be accurate when entered into the system, external events such as geopolitical crises can rapidly make this data obsolete. As a result, MRP outputs become less reliable because they continue to operate based on outdated assumptions.

The respondent also explained that safety stock levels helped absorb some disruptions, but acknowledged that stockouts still occurred for certain chemical materials due to supply difficulties and price increases. In addition, the planning department expressed concerns because these delays forced them to modify production plans and reschedule operations.

The R&D Technical Support respondent presented a more moderate view regarding data quality problems. According to the interviewee, there are no major issues, but rather “small discrepancies” caused by delays in updating technical modifications within the system. The respondent explained: “Sometimes a technical update is not immediately reflected in the system, especially when there are frequent changes. So there can be a small gap between what is actually happening and what appears in the system.”

Unlike the Purchasing Specialist, whose concerns are strongly influenced by external supply chain volatility, the R&D respondent focuses more on internal synchronization and update timing. Nevertheless, both interviews confirm that even small inaccuracies or delays in data updates can affect planning reliability and require continuous adjustments between departments.

Theme 4: Coordination, Communication, and Planning Impact

Both respondents emphasized the strong relationship between coordination quality and planning performance. The interviews suggest that effective planning depends not only on system calculations, but also on the speed and quality of communication between departments.

The R&D Technical Support respondent particularly highlighted the importance of timely information sharing, stating: "When information flows well and on time, the planning becomes much more reliable and stable."

The respondent also explained that delays or incomplete information may create "gaps in the planning" and lead to "last-minute adjustments or small delays." This demonstrates that coordination directly influences planning stability and operational responsiveness.

The Purchasing Specialist approached coordination from a broader implementation perspective. According to the respondent, coordination between departments was one of the main reasons why the company was able to implement the MRP system within the expected timeline. However, the respondent also admitted that it remains difficult to fully evaluate the long-term impact of this coordination because the company is still in the early stages of system usage.

Both interviews therefore converge on the idea that coordination plays a fundamental role in ensuring planning reliability, improving information consistency, and facilitating MRP integration into operational processes.

Theme 5: Recommendations for Improvement

The final theme identified in the interviews concerns the improvements that could enhance the effectiveness of the MRP system.

The Purchasing Specialist proposed several operational improvements. One of the main recommendations concerns item standardization. According to the respondent, many items with similar characteristics are still managed separately, which complicates procurement activities

and increases processing time. The respondent explained that better standardization “would save a significant amount of time and simplify the purchasing process.”

The respondent also emphasized the importance of employee training and awareness, noting that some employees are “not fully familiar with how it works.” This indicates that human understanding of the system remains an important factor influencing MRP effectiveness.

Another important recommendation concerns the integration of historical disruption data into the planning process. The Purchasing Specialist suggested that previous crises such as the Red Sea disruption could help improve the realism of procurement lead times and increase the system’s ability to anticipate future disruptions.

The R&D Technical Support respondent focused more on communication and system optimization. The interviewee suggested improving “the fluidity of communication between departments” and reducing delays in updating technical information. The respondent also mentioned that better automation could help reduce “small data entry mistakes or omissions.”

Overall, both respondents agree that the MRP system is already improving planning processes, but that several adjustments are still needed to enhance its efficiency and reliability. Their recommendations mainly focus on three dimensions: improving data quality, strengthening coordination and communication, and increasing process standardization and automation.

In summary, the findings from the second interview guide reveal that the effectiveness of MRP at Condor Electronics depends heavily on the quality of operational data and the level of coordination between departments. While the Purchasing Specialist emphasizes procurement-related constraints and external disruptions, the R&D Technical Support respondent highlights the importance of technical data consistency and timely updates. Together, these perspectives provide a detailed operational understanding of the organizational mechanisms supporting MRP implementation and planning activities within the company.

1.2.3 Thematic Analysis of the third Interview Guide: SAP Consultant (DSI)

Theme 1: MRP System Use from a Technical and SAP Perspective

The third interview guide, conducted with a SAP Consultant from the DSI (Direction des Systèmes d’Information) department, provides a technical and system-level perspective on MRP implementation at Condor Electronics. As a member of the MRP project team working on the SAP PP (Production Planning) module, the respondent occupies a central position between system configuration and production planning operations.

The SAP Consultant explains that MRP usage is structurally linked to the production planning process, stating that the system “is launched based on the PDP (Plan de Production)” and that “the net requirements calculation is based on the version of the BOM defined in the PDP.” This confirms that MRP execution follows a structured logic where the Production Plan drives BOM selection, which then generates net requirements.

The respondent further clarifies that MRP outputs include planned orders for finished and semi-finished products, as well as purchase requisitions for raw materials. This reflects the standard SAP PP-MRP functionality and confirms that the system is used as a decision-support tool embedded within the broader production planning cycle.

Regarding frequency of use, the SAP Consultant indicates that MRP “was launched for the S2 2026 period,” and that its use “depends on procurement lead times.” The respondent also notes that a one-week interruption would not significantly affect their work, since “planning is managed on a monthly basis.” This confirms that MRP at Condor operates within a periodic planning cycle rather than a real-time decision environment.

Theme 2: Data Quality A Technical Taxonomy of MRP Failures

The most significant contribution of this interview lies in the technical classification of data quality issues affecting MRP performance.

The SAP Consultant identifies four main categories of recurring problems: “The most frequent problems are, first, incorrect theoretical stock levels. Then, errors in the BOM (nomenclature). After that, incorrect supplier data, and finally, lead times that are not updated.”

This classification highlights four critical data domains:

- Stock level inaccuracies
- BOM (Bill of Materials) errors
- Supplier master data inconsistencies
- Outdated procurement lead times

Each of these issues directly affects MRP calculation accuracy. For example, incorrect stock levels distort net requirements, BOM errors propagate incorrect material dependencies, and outdated lead times affect procurement timing decisions.

The respondent emphasizes the impact of these errors by stating: "when the data is incorrect, it leads to planning results that are also incorrect, which can directly impact customer satisfaction."

The SAP Consultant also provides an important quantitative assessment, estimating that: "around **50%** of MRP data" is reliable at a given time.

This indicates that data reliability remains a major constraint in the current implementation phase and directly affects system performance.

Data quality control is described as a shared responsibility between the DSI and business teams, supported by weekly follow-up meetings. However, the respondent notes that full reliability assessment is not yet possible, as the system is still in its early implementation phase.

Theme 3: Interdepartmental Coordination in the Context of MRP Implementation

The SAP Consultant describes coordination in MRP as a cross-functional and change-driven process involving both technical and business actors.

The respondent highlights that multiple services are involved, including:

- DSI project team
- ERP support
- Master Data team
- Business departments (R&D, Process, Planning, SCM, GDS)

Coordination is ensured through multiple communication channels such as emails, meetings, Microsoft Teams, manuals, and training sessions.

However, the respondent also highlights a key implementation challenge: "It is often difficult to guide the business teams toward a new project. There is usually some resistance at the beginning, but it gradually decreases over time as the project progresses."

This indicates that coordination challenges are not only technical but also organizational and behavioral, particularly during early stages of system adoption.

The SAP Consultant also acknowledges that, as in any project, communication issues may occur, but these remain part of the normal implementation process rather than systemic failure.

Theme 4: System Limitations and Improvement Priorities

From a system perspective, the SAP Consultant identifies a fundamental requirement for MRP effectiveness: “the system requires good performance in both planning and stock management in order to be properly implemented.”

This shifts the focus from system limitations to organizational readiness and data maturity.

Regarding improvement axes, two main directions are identified:

Extending MRP coverage to products without BOM structure

Improving system accuracy through continuous data updates and adjustments

When asked to prioritize improvements, the respondent clearly states: “My priority would be the regularization of stock.”

This aligns with findings from other interviews and confirms that stock accuracy is perceived as the most critical operational issue affecting MRP reliability.

Overall, the third interview guide provides a technical and system-oriented understanding of MRP at Condor Electronics. Unlike managerial and operational perspectives, the SAP Consultant’s view emphasizes system architecture, data taxonomy, and implementation governance.

The findings confirm that MRP performance is strongly dependent on data quality, particularly stock accuracy, BOM integrity, supplier data reliability, and lead time updates. In addition, the interview highlights that system effectiveness is also influenced by organizational readiness and user adoption dynamics during the implementation phase.

The estimate of **50%** data reliability provides a critical benchmark that contextualizes all MRP outputs and reinforces the importance of ongoing data governance and system stabilization efforts.

Section 02: Discussion of results

Having presented the empirical findings through lexical and thematic analysis in Section 1, this section now engages in a critical and integrative discussion of those findings

2.1 Answering the Research Questions:

RQ1: What are the main theoretical foundations of MRP, and how is its relationship with production planning efficiency established?

From a theoretical standpoint which we already mention in chapter 1, MRP is grounded in the logic of dependent demand planning, where material requirements are derived from the Production Plan (PDP) through the Bill of Materials (BOM), inventory records, and lead time parameters. It functions as a structured mechanism for translating production demand into time-phased procurement and manufacturing orders.

The empirical findings strongly validate this theoretical foundation in the case of Condor Electronics. The SAP Consultant confirms this alignment by stating that MRP “is launched based on the PDP” and that “the net requirements calculation is based on the version of the BOM defined in the PDP.” This demonstrates that the system is implemented in strict accordance with classical MRP logic, where the BOM acts as the core structural element of requirements calculation.

However, while the theoretical model assumes stable and reliable input data, the empirical evidence reveals that this condition is only partially met in practice. The SAP Consultant explicitly reports that “around 50% of MRP data” is reliable at a given time, which introduces a significant deviation from the theoretical assumption of data stability. This gap is essential in explaining why MRP at Condor functions as a semi-dependable planning system rather than a fully deterministic one.

RQ2: How is MRP practically used within the production planning processes of Condor Electronics?

The empirical results indicate that MRP is operationally embedded within the SAP and is activated based on the Production Plan (PDP). It is not used as a standalone system but as an integrated planning engine within SAP.

The SAP Consultant explains that MRP generates planned orders for finished and semi-finished goods, and purchase requisitions for raw materials. This confirms its dual role in both production and procurement planning.

The system is used in a periodic planning logic, primarily monthly, as highlighted by the SAP Consultant who states that planning is managed on a monthly basis and that MRP usage depends on procurement lead times. This is consistent with the SCM Purchasing Specialist's explanation that MRP outputs are used to determine required purchase quantities and anticipate stock shortages.

Therefore, MRP at Condor Electronics functions as a decision-support system embedded in cyclical planning processes, rather than a real-time operational control system.

RQ3: To what extent does MRP contribute to improving planning efficiency (lead time reduction, inventory optimization, decision-making improvement)?

The findings show that MRP contributes positively to planning efficiency, particularly in inventory optimization and improved visibility of material requirements.

The SCM Purchasing Specialist provides a key quantitative indicator, reporting that stock coverage decreased from approximately **60** days to between **30** and **45** days after MRP implementation. This demonstrates a tangible improvement in inventory efficiency and capital utilization.

In addition, respondents report a reduction in production plan instability, particularly fewer ad hoc adjustments due to missing materials or lack of visibility. This indicates that MRP has enhanced anticipatory planning capabilities.

However, this efficiency gain remains context-dependent. During supply chain disruptions, such as geopolitical crises affecting lead times, the Purchasing Specialist notes that “there was a mismatch between the expected lead times recorded in the MRP system and the actual delivery times.” This reveals that efficiency gains are weakened under volatile external conditions.

And MRP improves efficiency primarily under stable planning assumptions, but its performance decreases under high uncertainty.

RQ4: What organizational factors affect the way MRP is used and its outcomes?

The empirical analysis identifies two dominant organizational determinants: data quality and interdepartmental coordination.

1. Data Quality as a Structural Constraint

All respondents converge on the critical importance of data accuracy. The SAP Consultant identifies four key failure points:

“incorrect theoretical stock levels, errors in the BOM (nomenclature), incorrect supplier data, and lead times that are not updated.”

These issues directly affect planning reliability. Most critically, the SAP Consultant quantifies system reliability at approximately **50%**, highlighting a substantial gap between system expectations and operational reality.

Similarly, the Purchasing Specialist confirms that procurement lead times often deviate from real conditions during disruptions, reinforcing the instability of key planning parameters.

2. Interdepartmental Coordination

Coordination emerges as a central enabling factor for MRP success. The R&D Technical Support respondent describes a structured workflow where:

“the Supply Chain Management department provides key input data... the process department is responsible for defining manufacturing lead times... while we define the BOM.”

This confirms that MRP performance depends on a distributed data production system.

The Purchasing Specialist further emphasizes that structured workshops and cross-functional alignment were essential for MRP implementation success, indicating that coordination is not only operational but also foundational.

However, the SAP Consultant introduces an important nuance by highlighting initial resistance from business users, showing that coordination is also a change management process, not only a technical one.

RQ5: What are the practical limitations of MRP systems, and what improvements can be proposed?

The empirical findings identify a coherent set of practical limitations that collectively constrain MRP's effectiveness at Condor Electronics. These limitations fall into three categories: systemic, organizational, and environmental. At the systemic level, the most frequently cited limitation is MRP's rigidity its dependence on stable, pre-defined parameters (lead times, BOM structures, safety stock levels) that do not adapt dynamically to changes in the operational

environment. As the Planning Manager notes, the system performs well under theoretical conditions but is less effective in a constantly changing operational environment.

The system's failure to incorporate capacity planning constraints is identified by multiple respondents as a significant functional gap, producing production plans that are materially feasible but not always operationally executable given machine and labor availability.

At the organizational level, the primary limitation is data quality a constraint whose quantitative significance has been established above. The convergence of all five respondents on data quality as the most critical challenge facing MRP at Condor Electronics is arguably the single most significant finding of this study, and it implies that technical improvements to the system itself will generate limited efficiency gains unless accompanied by substantial improvements in the organizational processes through which data is produced, validated, and maintained.

At the environmental level, MRP's limitations are exposed most starkly by the geopolitical supply chain disruptions experienced by Condor Electronics during the study period. The Strait of Hormuz crisis, the Red Sea disruption, and other external shocks have repeatedly rendered MRP's encoded lead times obsolete, forcing planners to rely on experience and judgment rather than system outputs. This environmental vulnerability is not a limitation that can be fully resolved through system optimization alone; it reflects the inherent mismatch between MRP's stable-environment design logic and the inherently uncertain, volatile character of global supply chains in the contemporary geopolitical context.

The improvements proposed by respondents are largely convergent, centering on three strategic directions: upgrading toward MRP II to incorporate capacity planning; improving data quality through stock regularization, BOM management, and lead time update disciplines; and enhancing employee training and awareness. The Purchasing Officer's suggestion of incorporating historical disruption data into lead time parameters represents an innovative, empirically grounded recommendation that merits particular consideration. These improvement directions are operationalized in the action plan presented below.

To summarise, the study identifies several structural limitations affecting MRP performance:

- Dependence on static assumptions (lead times, stock levels)
- Limited flexibility in responding to disruptions
- Partial system integration due to implementation phase
- Low data reliability (~50%)

- Exposure to external volatility (geopolitical disruptions)

And the most Proposed improvements (from interviews) are:

- Standardization of similar items
- Improvement of training and user awareness
- Better communication and faster data updates
- Integration of historical disruption data into planning logic
- Strengthening stock regularization

The SAP Consultant emphasizes that “the regularization of stock” is the top priority, confirming that inventory accuracy is the most critical lever for improving system performance.

2.2 Action Plan and Recommendations

Drawing on the empirical findings of this study, this part presents a structured action plan based on the findings obtained from the interviews and supported by the theoretical framework of the study. The proposed recommendations aim to improve the efficiency, reliability, and integration of the MRP system at Condor Electronics by addressing the main organizational, technical, and operational issues identified during the field study.

the following action plan presents a set of concrete, prioritized recommendations for improving MRP performance and production planning efficiency at Condor Electronics. Each recommendation identifies the action to be taken, the objective it serves, and the expected outcome it is designed to produce.

Table 11: Proposed Action Plan for MRP Improvement at Condor Electronics

Action	Objective	Expected Outcome
1. Stock Regularization Program Conduct a systematic physical inventory audit to reconcile theoretical and actual stock levels in SAP; establish a regular cycle counting process.	Eliminate stock data discrepancies the most frequently identified source of MRP planning errors, as confirmed by the SAP Consultant.	Improved accuracy of MRP net requirements calculations; reduction of planning errors caused by stock discrepancies.
2. BOM Validation and Update Protocol Implement a formal BOM review process with defined update frequency and	Ensure BOM accuracy as the foundational technical input to MRP calculations, and reduce	Reduction in BOM-related planning errors; increased reliability of material requirements

responsibility assignment between R&D and Master Data.	the gap between actual product structures and system records.	calculations across all product families.
3. Lead Time Review and Resilience Adjustment Establish a periodic lead time review process; integrate historical disruption data (Red Sea, Strait of Hormuz) to develop scenario-based lead time parameters.	Make MRP lead time parameters more realistic and resilient, reducing the system's vulnerability to supply chain disruptions.	More accurate purchase order timing, reduced stockout risk during geopolitical supply disruptions, improved forecast reliability.
4. Standardization of Item Management Review and standardize procurement parameters (MOQ, lead times, safety stock levels) for item categories with similar characteristics.	Reduce the complexity and variability of item-level management in MRP, simplifying the purchasing process and reducing parameter maintenance burden.	Time savings in procurement management; more consistent MRP recommendations across similar items; reduced risk of parameter errors.
5. Employee Training and System Awareness Design and deliver structured SAP-MRP training programs tailored to each user group (planners, buyers, warehouse staff, R&D).	Reduce user errors in data entry and system usage; increase organizational MRP literacy and reduce resistance to system adoption.	Improved data entry accuracy; higher system utilization rates; faster progression through the implementation maturity curve.
6. . KPI Monitoring Dashboard Develop a planning performance dashboard (integrated with SAP and Power BI) tracking plan adherence rate, stock coverage ratio, stockout frequency, and data reliability metrics.	Provide real-time visibility of MRP and planning performance indicators, enabling early identification of problems and data-driven continuous improvement.	Evidence-based performance management; faster problem detection; improved accountability for planning KPIs across departments.
7.Automation of SAP Data Updates	Increase automation of repetitive system updates and data synchronization processes.	Reduction of manual entry errors, improved data consistency, and faster information updates.

<p>8. MRP II Upgrade Planning</p> <p>Conduct a feasibility study and roadmap for upgrading the current MRP implementation toward MRP II, incorporating capacity planning (CRP).</p>	<p>Address MRP's identified limitation regarding production capacity constraints, enabling more feasible and integrated production plans.</p>	<p>Production plans that are both materially and operationally feasible; reduced plan revision frequency; better resource utilization.</p>
<p>9. AI-Assisted Decision Support Integration</p>	<p>Integrate an AI-powered assistant or chatbot within SAP/MRP to facilitate information extraction, data analysis, and planning support.</p>	<p>Faster access to information, improved responsiveness, and enhanced decision-making support for planners and managers.</p>
<p>10. Secure AI Integration Framework</p>	<p>Strengthen cybersecurity architecture and define secure access protocols before integrating AI functionalities into SAP.</p>	<p>Protection of sensitive industrial data while enabling safe digital transformation and AI adoption.</p>

Source: prepared by the student

Overall, the proposed action plan reflects the main findings of the empirical investigation. The recommendations particularly emphasize the importance of data quality, stock accuracy, and continuous system improvement as critical conditions for enhancing the effectiveness of MRP within Condor Electronics. At the same time, the integration of advanced technologies such as AI-assisted tools represent a potential strategic evolution capable of improving planning responsiveness and supporting future digital transformation initiatives.

Conclusion of the chapter

In conclusion, this chapter analyzed the empirical findings from the three interview guides in order to assess how the MRP system influences production planning efficiency at Condor Electronics. The results show that MRP is broadly aligned with its theoretical foundations and contributes to improved planning visibility and inventory control. However, its effectiveness remains partially constrained by data quality issues, limited system maturity, and external supply chain disruptions. The analysis also highlights that interdepartmental coordination and data governance are key determinants of MRP performance. Overall, MRP provides meaningful planning support, but its full efficiency potential is still dependent on organizational and data-related improvement

GENERAL CONCLUSION:

In this chapter, the thesis is concluded through a comprehensive synthesis of the research findings, an overview of the entire study, the main results obtained from the empirical investigation, as well as the theoretical and managerial contributions. Finally, the chapter highlights the limitations of the study and proposes directions for future research.

1. Summary and Overview

This thesis investigates the influence of Material Requirements Planning (MRP) systems on production planning efficiency in the case of Condor Electronics in Algeria. The study aims to understand how MRP contributes to improving planning processes, particularly in terms of inventory optimization, lead time reduction, and decision-making support.

To address this research problem, a qualitative approach was adopted. The study is based on five semi-structured interviews conducted with key actors involved in production planning, supply chain management, procurement, and technical support within Condor Electronics. The collected data was analyzed using deductive thematic analysis in order to answer the main research question:

How does the use of a Material Requirements Planning (MRP) system influence production planning efficiency in the case of Condor Electronics?

This thesis is structured as follows:

The introduction presented the research context, objectives, problem statement, and research questions, along with the methodological orientation of the study.

Chapter I developed the theoretical framework, covering the literature on MRP systems and production planning efficiency, as well as the conceptual relationships between dependent demand planning, Bill of Materials (BOM), inventory management, and planning performance.

Chapter II presented the methodological framework, including the qualitative research design, data collection through semi-structured interviews, and the deductive thematic analysis approach used to interpret the data.

Chapter III presented and discussed the empirical findings, structured around the research questions, highlighting both the operational use of MRP at Condor Electronics and the organizational factors influencing its performance.

Finally, this chapter concludes the study by summarizing the key findings, discussing their implications, and outlining limitations and future research perspectives.

2. Main Results of the Research

The empirical findings show that MRP is fully integrated within the SAP system at Condor Electronics and is activated based on the Production Plan (PDP). It plays a central role in generating production orders and purchase requisitions, making it a key decision-support tool in production and procurement planning.

The results confirm that MRP contributes positively to production planning efficiency, particularly by improving inventory management and enhancing visibility of material requirements. A significant improvement was observed in stock coverage, which decreased from approximately 60 days to between 30 and 45 days following the implementation and use of MRP.

However, the study also reveals that MRP effectiveness is not absolute. It is highly dependent on data quality, which was identified as the most critical limitation, with system reliability estimated at around 50%. Errors in BOM data, inaccurate stock records, and outdated lead times negatively affect planning accuracy.

In addition, MRP performance is influenced by external environmental factors, particularly supply chain disruptions caused by geopolitical events. These disruptions often create mismatches between system-generated lead times and actual delivery times, reducing the reliability of planning outputs.

Furthermore, organizational factors such as interdepartmental coordination play a crucial role in determining system effectiveness. MRP performance depends on the collaboration between production planning, procurement, supply chain management, and R&D departments.

Overall, the study shows that MRP improves production planning efficiency, but its full potential remains dependent on organizational readiness, data reliability, and environmental stability.

3. Theoretical Contributions

This research contributes to the existing literature on MRP systems by providing empirical evidence from an Algerian industrial context, which remains underexplored in academic studies.

The study confirms the theoretical foundation of MRP, which is based on dependent demand planning derived from the Production Plan (PDP), Bill of Materials (BOM), inventory

records, and lead time parameters. However, it also highlights a significant gap between theoretical assumptions and practical implementation, particularly regarding data reliability and system stability.

Moreover, this study extends the understanding of MRP by demonstrating that it should not be viewed solely as a technical planning tool, but rather as a socio-technical system whose performance is strongly influenced by organizational processes, data governance, and cross-functional coordination.

4. Managerial Contributions

From a managerial perspective, this study provides valuable insights for Condor Electronics and similar manufacturing companies using MRP systems.

The findings highlight that improving production planning efficiency does not depend only on system implementation, but mainly on:

Improving data accuracy and stock regularization

Strengthening BOM and lead time management

Enhancing interdepartmental coordination

Investing in user training and system awareness

The proposed action plan offers practical recommendations that can directly support operational improvements, particularly in reducing planning errors and improving system reliability.

5. Limitations

This study presents several limitations. First, the sample size is limited to five interviews, which, although diverse in roles, does not fully represent all perspectives within the organization. A larger sample could have strengthened the robustness of the findings.

Second, the study focuses on a single case study (Condor Electronics), which limits the generalizability of the results to other industrial contexts.

In addition, it is important to note that the use of MRP within Condor Electronics is still relatively recent. This means that the system has not yet reached full maturity in its implementation. As a result, this may limit the ability to provide a comprehensive and long-term assessment of its full impact on production planning efficiency, especially given that the organization is still in a phase of adaptation and continuous improvement.

6. Suggestions for Future Research

Despite these limitations, this study opens several avenues for future research. Future studies could expand the sample size by including multiple manufacturing companies in Algeria to allow comparative analysis.

It would also be valuable to compare the performance of MRP systems in companies at different levels of implementation maturity.

Another promising direction would be to study the transition from MRP to MRP II or advanced AI-assisted planning systems, particularly in relation to capacity planning and predictive analytics.

Finally, future research could investigate the long-term impact of MRP after the system reaches full operational maturity within organizations

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Appendix

Appendix: Semi-Structured Interview Guide

Introduction

This interview is conducted as part of a Master's thesis entitled:

“The Influence of Material Requirements Planning (MRP) on Production Planning Efficiency: A Case Study of Condor Electronics”

The objective of this research is to understand to what extent the MRP system influences production planning efficiency, as well as the role of data quality and interdepartmental coordination in this relationship.

The information collected will remain strictly confidential and will be used solely for academic purposes. The interview will last approximately 30 to 45 minutes. Notes will be taken manually, and no recording will be kept without explicit permission.

Guide No. 1: Supply Chain and Planning Managers

Section A: Participant Profile

- What is your current position within the company?
- How long have you been in this position?
- What are your main responsibilities in planning or supply chain management?
- What is your level of interaction with the MRP system?

Section B: Use of the MRP System

- How is the MRP system used within your department?
- What types of decisions does the MRP enable you to make?
- How frequently do you use MRP outputs? Do you use it daily, weekly, or only during the monthly re-planning cycle?
- If the MRP system were unavailable for one week, how would your work be directly affected?

Section C: Production Planning Process

- How is production planning carried out?
- What tools are used in addition to MRP?
- How is MRP integrated into this process?
- Can you provide an example where MRP improved planning?

- Can you describe a recent situation where the MRP generated a purchase or production proposal that you had to reject or manually modify?

Section D: Planning Efficiency

- What are, in your opinion, the three most important indicators of effective planning (e.g., service level, inventory turnover, delivery time compliance)?
- Has MRP improved efficiency? How?
- Does it help reduce delays, stockouts, or overproduction?
- Have you observed changes in these indicators since the introduction or improvement of MRP?
- Are there situations where MRP does not improve performance?
- In which specific cases do you ignore or override MRP suggestions?

Section E: Data Quality

- What data is required for the proper functioning of MRP?
- How do you evaluate the quality of this data?
- What problems arise when the data is incorrect?
- Can you provide a concrete example?
- How is data quality controlled or improved? Is there a defined control frequency (daily, weekly), and is there a responsible person or department?

Section F: Interdepartmental Coordination

- Which departments are involved in the MRP process?
- How is coordination ensured between these departments?
- Are there communication problems ?
- What is the impact of this coordination on MRP performance?
- Have you ever experienced a conflict between departments due to MRP data or outputs? Can you elaborate ?

Section G: Evaluation and Improvement

- What are the main limitations of the MRP system?
- What improvements would you suggest?
- If you had to improve only one aspect of the current MRP system or its usage, what would be your top priority?

Closing Question

- Would you like to add anything else?
-

Guide No. 2: Purchasing specialist (SCM) , technical support (R&D)

Focus: Data and Coordination

- What is your role within the company?
 - How do you contribute to the data used in MRP or planning?
 - What data is produced by your department (sales forecasts, lead times, bills of materials), and how frequently?
 - How is information shared with other departments?
 - Have you encountered any data quality issues? Have you ever received complaints from other departments regarding the data you provided?
 - How does coordination influence planning outcomes?
 - What improvements would you recommend?
-

Guide No. 3: SAP CONSULTANT

Focus: Data Quality

Section A:

Q1: What is your current position in the company?

Q2: How long have you held this position?

Q3: What is your role in managing MRP data?

Section B: Use of the MRP system

Q1: How is the MRP system used in your service?

Q2: What types of decisions does the MRP allow you to make?

Q3: How often do you use the MRP results?

Q4: If the MRP was unavailable for one week, how would your work be affected?

Section C: Data Quality

Q1: What data is necessary for the proper functioning of the MRP?

Q2: How do you ensure the reliability and accuracy of the data?

Q3: What problems appear when the data is incorrect?

Q4: What are the most frequent problems?

Q5: What is the impact of data errors on planning?

Q6: How is data quality controlled or improved? Is there a control frequency or responsible service?

Section D: Interdepartmental Coordination

Q1: Which services are involved in the MRP process?

Q2: How is coordination ensured between these services?

Q3: Are there communication problems?

Q4: What is the impact of this coordination on MRP performance? Have you encountered conflicts?

Section E: Evaluation and Improvement

Q1: What are the main limitations of the MRP system?

Q2: What improvements would you propose?

Q3: If you had to improve only one thing, what would be your priority?

Closing Question:

What percentage of MRP data do you consider reliable at a given time?