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Optimizing Manufacturing Supply Chains Through SAP-Based Material Planning At Danfoss Systems Private Limited

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Abstract— In dynamic supply chains, material planning and inventory management play pivotal roles in ensuring uninterrupted manufacturing and cost reduction. The importance of integrating Enterprise Resource Planning (ERP) systems with Material Requirements Planning (MRP) tools for inventory management is emphasized in the existing literature, as it aids in optimizing inventory levels and managing supplier performance while tracking procurement. The aim of this study is to analyse the material planning processes of Danfoss Systems Private Limited, Pune, a global supplier of hydraulic solutions to achieve supply continuity. The main aim is to analyse the existing planning process, evaluate the extent of use of SAP/MRP and pinpoint supply constraints such as supplier delays, quality delays etc., and make practical recommendations. The methodology used in this study is a qualitative approach in applied industrial research which is carried out during a period of 2 months. The data was gathered by direct process observation, cross functional interaction and analysis of secondary data in SAP Materials Management transactions, Purchase Order (PO) Log and Non Conformance Report (NCR).

The results show that although SAP is providing the necessary real-time material information, it is not enough that the components are physically received to be ready for production because of the quality checks that must be performed and pending NCRs. Continuous tracking of open POs, shipment visibility, and proactive supplier expediting are all critical to overcoming recurring material shortage issues. The study results that the material planning system is a very integrated center of the system and the continuity of supply depends on the cross-functional smoothness of coordination between procurement, quality, and logistics. Manual shortage tracking can be replaced by automated, centralized dashboards (like SAP Power BI) that track shortages across the supply chain to improve supply chain resilience. Further, the weekly follow up with suppliers, along with daily cross functional review of quality held inventory will help material release in a much quicker time, reduce risks of supply, and enhance overall operational efficiencies.

Keywords: Material Planning, Inventory Management, SAP ERP, Supply Chain Efficiency, Material Shortages.

I. INTRODUCTION

Operational efficiency, inventory management and supply chain optimization are essential factors that enables the manufacturing industry to compete in today's industry. Businesses are constantly confronted with various challenges such as changing customer requirements, increasing inventory expenses and unforeseen delays from suppliers that make it difficult to manage inventory optimally. Therefore, it is crucial for manufacturing to plan materials to ensure that the appropriate amount of material is on hand at the appropriate time. Material planning is a key step that bridges the gap between production needs and the control of materials, procurement and logistics. With the help of Enterprise Resource Planning (ERP) systems such as SAP or Material Requirements Planning (MRP) software, companies can determine the need for materials, track purchase orders and monitor stock levels to avoid any production delays.

Danfoss Systems Private Limited is based at Pimpri, Pune, in the field of hydraulic power and control solutions, providing essential components to key Original Equipment Manufacturers (OEMs) for the agriculture, construction and mobile machinery sectors. The facility faces continuous

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supply chain issues due to the dynamic nature of the global sourcing process despite its structured material planning and inventory management system.The structured material planning and inventory management practices in the facility are still facing ongoing supply chain issues due to the dynamic nature of global sourcing. Danfoss commonly deals with the challenges of different lead times between domestic and international suppliers, materials on hand quality checks and materials that are not usable until they have been installed in the system. These factors may cause shortages in materials, too much inventory to carry, and constant supplier claims for expediting to avoid failing planned production schedules.

This study will perform an operational evaluation of the material planning and inventory management processes at Danfoss Systems to find opportunities for better supply continuity and improve the overall operational processes. The study focuses on the transactions used in SAP ERP specifically: ME21N, MB52 and MD04 to control material requirements, material receipts and open purchase orders. The paper discusses important issues associated with material shortages, such as On-Time Delivery (OTD) performance by suppliers, ABC classifications of inventory and quality held materials. The overall goal of the research is to offer practical and data-based suggestions to increase material availability, optimize material control and optimize the overall efficiency of the supply chain in the organization.

II. LITERATURE REVIEW AND THEORITICAL BACKGROUND

A. Literature Review

Enterprise Resource Planning (ERP) systems have regularly been shown to transform manufacturing supply chains, a fact consistently emphasized in academic literature. This research by Palewatta and Perrera (2017) and Kurniawan et al. (2025) highlights the fact that ERP implementation can substantially cut down the inbound logistics costs, lower product lead times and enhance inventory control. In particular, Sambhaji et al. (2022) and Jayachandran (2014) have argued that using SAP ERP tools is essential to ensure deliveries are on schedule and materials are automatically managed within the complex manufacturing environment. Additionally, Sengottuvelu (2020) and Pratiwi (2025) explain that the combination of Material Requirements Planning (MRP) and a good digital inventory management system improves the production planning process and helps to overcome critical material shortages.

The need for cross-functional alignment also keeps recurring, as recent studies have shown that digital ERP solutions can drive critical supply chain integration and flexibility, which, in turn, have a direct impact on business performance (Anjum et al., 2023; Pattanayak et al., 2019). Together, this literature highlights the need to move beyond isolated tracking and towards an integrated, SAP-driven approach for effective material planning. These basic studies are directly applicable to this research, which focuses on using ERP data, cross-functional coordination and proactive supplier expediting to overcome supply bottlenecks and ensure manufacturing continuity.

B. Theoritical Background

Material planning and inventory control are essential for uninterrupted production and availability of materials on time, while keeping a hold of excess materials. At the heart of this process is Material Requirements Planning (MRP), which uses production plans, existing stock levels and order arrival dates to anticipate any material shortages. Today in modern manufacturing, these processes are well-integrated with Enterprise Resource Planning (ERP) systems such as SAP. SAP has integrated data from different functional areas and uses specific transactions to track stock availability (MB52, MMBE), material requirements (MD04), purchase orders (ME21N, ME2M) and goods receipt (MIGO).

In addition to internal planning, supply continuity is dependent on good supplier management and logistics. Supplier performance is strongly measured by On-Time Delivery (OTD) rates and regular expediting and follow-ups reduce production shortfalls. Additionally, by working with logistics firms such as DHL, ACPL, and Blue Dart, you can track both domestic and international shipments, providing visibility on incoming materials. But being physically in hand does not mean that the production is ready – materials need to be quality checked. There is a direct link between Quality holds and Non-Conformance Reports (NCRs) on rejected materials and the amount of usable inventory, and this requires a close watch on quality management and communication with suppliers to close the financial transaction. In conclusion, combining these theoretical concepts with continuous improvement techniques and Root Cause Analysis (RCA) enables companies to systematically determine the root causes of supply delays and quality holds, further optimizing their supply chains.

III. MATERIALS AND METHODS

A. Research Objectives

The overall objective of this research is to critically review and improve the material planning and inventory management process based on SAP to maintain Continuous Manufacturing Supply Chain.

(1) Study of the current material planning systems and business processes at Danfoss Systems Private Limited.

(2) Measurement of the effectiveness of SAP and Material Requirements Planning (MRP) systems in monitoring inventory levels, material needs and lack of materials.

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(3) Critical Analysis of Material Availability – Purchase Order Execution Evaluation, Supplier Delivery Commitment, Inbound Shipment Flow.

(4) Root Cause Analysis and classification for the root causes of the supply chain disruptions, particularly material shortages, supplier delays and quality related inventory holds.

(5) Data driven recommendations to optimize inventory control, supply continuity, and overall supply chain efficiency. Data Collection and Research Design.

B. Data Analysis

This study is project based, applied industrial research design with qualitative approach and quantitative approach. The research is undertaken over a period of two months from 15 May 2026 to 15 July 2026 at Danfoss Systems Private Limited, thus covering the entire material flow process. The primary data gathered consisted of direct process observation, supplier expediting activities and cross functional process discussion with Production Planning, Procurement and Quality departments. To analyze all the details, secondary data was systematically gathered from SAP ERP system comprising a purchase order, inventory report, shipment load, Goods Receipt documentation, Non Conformance Reports, *etc*.

C. Data Analysis and Quality Assessment

The method used in this research is using the SAP Materials Management (MM) module to evaluate the inventory visibility and procurement execution. MD04 (Requirement Planning) and MB52 (inventory monitoring) SAP transactions were used to analyze the difference between system-available inventory and material requirements. One of the most important parts of this evaluation is the inspection phase: the actual delivery of the product is not a measure of production readiness. All materials received are thoroughly checked for compliance, with non-conforming materials quarantined or recorded as Non-Conformance Reports (NCRs). Taking these temporary holds into consideration with the Root Cause Analysis (RCA), the study identifies these delays in inspections and materials rejection that temporarily affect the amount of inventory in use, forcing cross-functional resolution in a very short time.

IV. DATA ANALYSIS AND DISCUSSION

TABLE I.
COMPREHENSIVE ANALYSIS OF CURRENT MATERIAL PLANNING STAGES AND WORKFLOW

Process Stage	Core Activity	Purpose and Strategic Function
Production Planning	Production requirement identification	Identify and map exact material requirements based on OEM demand.
MRP	Material requirement analysis	Run MRP to identify potential material shortages automatically.
Inventory	Stock availability check	Verify currently available, usable stock within the plant.
Procurement	Purchase Requisition / PO processing	Arrange required material by generating official supplier orders.
Supplier Coordination	Confirmation and follow-up	Monitor supplier production status and verify delivery commitments.
Logistics	Shipment tracking	Track domestic/international shipments to monitor incoming material.
Goods Receipt	Material physical receipt (GRN)	Formally record the arrival of materials at the Danfoss facility.
Quality	Inspection / Quality Hold	Verify material quality before authorizing its use in manufacturing.
Production Support	Material release for production	Ensure quality-cleared material is immediately available for assembly.

The material planning process at Danfoss Systems Private Limited is analyzed and it is concluded that it is an integrated process in which different departments are involved instead of a process carried out in isolation. The workflow is sequential in nature, as described in the table, and starts with the production requirements and ends with the release of the quality-cleared material onto the manufacturing floor. Important to note from this observation is that the availability of materials is not a reflection of just stock-on-hand. Rather, it is very dependent on a cycle of incoming purchase orders, supplier commitments, tracking in shipment, and rigorous quality controls. As a result, if there are any delays or logistical issues at an earlier stage in the process, they will ripple down the production chain and reinforce the critical

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need for smooth collaboration between the production, procurement, logistics, and quality teams.

TABLE II.
THE STRATEGIC USE OF SSAP ERP TRANSACTIONS IN MATERIAL PLANNING.

SAP Transaction Code	Primary Function	Application in Shortage and Inventory Monitoring
MD04	Material Requirements	Provides real-time visibility into material requirements and overall availability.
MB52	Stock Information	Displays detailed current stock information across different storage locations.
MMBE	Stock Overview	Offers a comprehensive overview of stock availability and inventory status.
ME2M	Purchasing Documents	Tracks open Purchase Orders categorized specifically by material numbers.
ME23N	Purchase Order Details	Allows planners to drill down into specific Purchase Order details and terms.
MB51	Material Movements	Tracks historical and current material movements within the supply chain.
MIGO	Goods Receipt	Executes and records the formal receipt of goods entering the facility.

Material Planning department is the operational core of Enterprise Resource Planning tools and the most vital is the SAP Materials Management (MM) module. The observed SAP transactions are linked to a single point of view of the entire procurement and inventory lifecycle. For example, with tools such as MD04 planners can keep track of the materials needed at any given time using the production schedule, and with MB52 and MMBE they can get up-to-the-minute information about available materials. Moreover, the ME2M and ME23N can track purchase orders, so that the procurement status of critical components is always available.

The digital integration is crucial as it moves the planning team away from being reactive and into a proactive mode. The specific assignment of these transaction codes enables the material planners to quickly locate material shortages and to receive notification of material movement and goods receipt for materials quickly, thus reducing the risk of impendence of production.

TABLE III.
MULTI-VARIABLE ANALYSIS OF MATERIAL AVAILABILITY, PROCUREMENT, AND LOGISTICS

Category	Parameter / Status	Observation and Impact on Planning
Inventory	Available Stock	Immediately usable for production; represents true current supply.
Inventory	Quality Hold	Physically present but temporarily unavailable pending inspection.
Inventory	Rejected Material	Not available for production; requires NCR and credit note follow-up.
Category	**Parameter / Status**	**Observation and Impact on Planning**
Procurement	Open PO	Represents expected future supply; monitored strictly through SAP.
Procurement	Supplier Confirmation	Followed up regularly to ensure expected delivery aligns with demand.
Procurement	Critical/Delayed Material	Requires immediate expediting and direct supplier intervention.
Logistics	Domestic Shipments	Faster turnaround; requires consistent tracking via logistics partners.
Logistics	International Shipments	Longer lead times; requires distinct coordination and earlier follow-ups.

A detailed study of component availability, order status and logistics has shown that a component does not become

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available for production as soon as it is physically received. Being able to see inventory is a subtle issue – materials can be physically posted on site but in the process of a required quality hold or awaiting resolution of a Non-Conformance Report (NCR). The material planning team proactively follows up on open purchase orders and actively checks supplier confirmations to reduce these variables. Furthermore, strong logistics partner relationship management and international/external shipments ensure that any risk of shipment delay is identified early. This full end-to-end visibility of available inventory, procurement agreement and inbound logistics helps the organisation have a clear view of available hydraulic components so it can trigger the right expediting procedures when needed and prevent the production floor from receiving unnecessary components.

TABLE IV.

ROOT CAUSE ANALYSIS OF SUPPLY CONTINUITY CHALLENGES

Identified Issue	**Primary Challenge Category**	**Possible Root Causes and Contributing Factors**
Material Shortage	Supply Chain Disruption	Supplier manufacturing delays or insufficient incoming supply volume.
Delivery Delay	Logistics / External	Domestic or international logistics issues; transportation bottlenecks.
Material Unavailability	Internal Process Hold	Materials halted in the system due to mandatory quality inspection holds.
Rejected Material	Quality Non-Conformance	Parts failed specifications; initiates a complex NCR and credit process.
PO Pending	Procurement Bottleneck	Lack of initial supplier confirmation or delayed procurement follow-up.
Delayed Closure	Cross-Functional Gap	Poor coordination among suppliers, Procurement, and Quality teams.

The study, based on direct observation and cause analysis, found a number of interconnected issues commonly pose threats to supply continuity. The largest problems are with external factors such as late deliveries from suppliers or any uncertainty associated with incoming shipments. The major internal challenges are when received materials are quarantined during quality inspection holds and materials are turned down because they are not in conformance, thus reducing the materials available for use. Material planning is dependent on external vendor and internal departments such as quality and procurement having tasks completed in time and if that does not happen, then it has a knock on effect. The constant problems also show that material shortages seldom occur in isolation and usually result from previous coordination failures and the need for constant monitoring, proactive expediting, and speedy solution of the overdue purchase orders and NCRs.

There are strategic recommendations for improving supply chain efficiency listed below and summarized in TABLE V.

TABLE V

STRATEGIC RECOMMENDATIONS FOR ENHANCING SUPPLY CHAIN EFFICIENCY

Recommendation	**Underlying Reason**	**Implementation Approach**	**Expected Outcome**
Strengthen SAP Monitoring	Improves visibility of actual material status.	Regularly review MRP, stock data, and PO information via SAP.	Better planning and faster identification of shortages.
Improve PO Follow-up	Reduces uncertainty regarding incoming supply.	Track open POs and supplier commitments consistently.	Improved overall material availability.
Strengthen Shipment Tracking	Identifies potential delivery delays early.	Maintain regular domestic and import shipment tracking routines.	Better visibility of inbound materials.

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Improve Quality Coordination	Quality-held materials delay productio n.	Regularly review quality holds and NCR status with the Quality team.	More accurate mapping of usable inventory.
Standardize Shortage Tracking	Enables quicker action on critical materials.	Maintain a structured, uniform shortage tracking format.	Faster expediting and significant ly reduced supply risk.
Enhance Cross-Functional Sync	Material planning relies on multiple departme nts.	Schedule regular syncs between PPC, Procurement, Logistics, and Quality.	Better informatio n flow and overall planning efficiency.

The suggested improvements are aimed at boosting the system's visibility, streamlining tracking processes, and improving communication between different stakeholders to overcome the identified operational challenges. By regularly analysing data from stocks and stock orders, the use of SAP can be optimised to a great extent, which means that uncertainty about the materials to be received is minimised. In addition, having a consistent approach to tracking a shortage and following up with suppliers and incoming shipments will enable the planning team to alert to any potential delays, in advance of the effect on production. Improvements in coordination with the quality department to speed the processing of held or non-conforming materials are also essential. In the end, these practical and progressive measures from tracking every detail to aligning departments will help the organization to build a more resilient supply chain, better control stock levels and ensure materials are always available for production.

V. FINDINGS, CONCLUSIONS AND SUGGESSIONS

A. Findings

The study shows that material planning is a vital link function that helps to ensure continuity of supply and uninterrupted production at Danfoss Systems Private Limited. One of the main results is that Enterprise Resource Planning systems like SAP and Material Requirements Planning (MRP) offer valuable visibility on material requirements, current stock levels, and procurement statuses in real time. The research is a cautionary tale, however, that relying on system data alone is not enough: regular follow-up of open Purchase Orders (POs) and proactive follow-ups with suppliers are essential to ensure that material is available or that shortages are avoided. The analysis expressly states that the materials at the facility may not be immediately ready for production, as parts often have to be quality inspected, and are frequently placed in a "hold" while Non-Conformance Reports (NCR) are processed, thereby temporarily but significantly reducing usable materials. In addition, stringent shipment monitoring for both domestic and international supply chain partners was crucial for predicting delivery issues and possible supply shortages early on. In sum, the results demonstrate that to overcome complicated supply chain issues like delayed supplier deliveries, unpredictable shipping timelines, and quality concerns about materials, it is vital to have strong alignment across functions. The overall success of the material planning system is highly dependent on the effective, continuous flow of information and coordination between Production Planning and Control (PPC), Procurement, Quality, Logistics and supplier networks. If the operational approach is not integrated, the impact of the material shortages and keeping optimal inventory control is always a challenge.

B. Conclusions

Based on the results of the study, it can be concluded that material planning is a pivotal and central position between production requirements and available materials in Danfoss Systems Private Limited. The results show that using only physical stock is not enough for continuous manufacturing; a continuous supply only happens when SAP and Material Requirements Planning (MRP) tools are used in an effective and integrated manner, combined with strict external monitoring. The material planning department can effectively prevent production delays through systematic monitoring of open purchase orders, proactively coordinating with suppliers, tracking incoming shipment statuses, and keeping track of the status of quality checks. The project was successful Cin achieving its key objectives, which included: Promoting the practical implementation of theoretical operations and supply chain management concepts to address real-world industrial problems, including supplier delays, logistic uncertainties, and required quality holds. Finally the study suggests that to further improve supply chain resilience, the organization needs to strategically upgrade its work by standardizing the tracking of shortages, increasing cross-functional communication between the procurement, logistics and quality functions and maximizing the visibility of data in SAP. Implementing these practical recommendations will help with proactive planning decisions, reduce inventory carrying costs, reduce supply risks, and greatly improve the manufacturing supply chain's overall operational efficiency.

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C. Suggestions

There is a need for Danfoss to have a centralised, automated dashboard to track shortages, directly connected to SAP to boost supply chain efficiency. This practical digital improvement allows everyone concerned to have a real-time view, so that the Material Planning and Production Planning and Control (PPC) teams can match incoming stock with the production schedule. Further, Procurement needs to implement a standard weekly follow-up procedure with Suppliers to clearly validate their Purchase Orders and delivery agreements, which helps to avoid unpleasant delays. Logistics should have a proactive tracking procedure in place that is unique for domestic and overseas goods received. In addition, the Quality department should perform cross functional reviews of the quality-held items and Non Conformance Reports (NCRs) daily to expedite material release and avoid the potential of material becoming unusable because it has been held in quality. Creating these formal, inter-departmental communication processes helps to ensure that data moves correctly, reducing supply threats.

D. Conclusions of the study

The study's results have many implications for several actors in the Danfoss value chain. The Material Planning and Production (PPC) teams benefit from this by transforming their process from a reactive expediting approach to a proactive scheduling model, streamlining the manufacturing process and minimizing downtimes.

The Procurement department is heavily involved and the research has pointed out that issuing a PO is not enough, there must be continuous follow-ups with suppliers to ensure the On-Time Delivery (OTD). Stiffer checks on performance for Suppliers, and more open communication about their production statuses.

In addition, the Quality department is now more accountable for the effective processing of material in "hold" and Non-Conformance Reports (NCRs) – it is not enough to receive a material and the material has to be ready for production. In the end, these cross-functional, integrated practices ensure that Management and OEM Customers can expect lower inventory holding costs, lower supply chain risk and product on time and in full for their customers.

E. Future Scope of the study

There are several opportunities to further digitize and optimize material planning framework at Danfoss Systems Private Limited in the future. Future research could explore the creation of integrated Power BI dashboards that would improve the accessibility of material and inventory tracking in real-time. It also seems like there is a lot of opportunities to leverage automated monitoring of Open Purchase Orders and stock shortages to limit manual expediting. Further research might then look into the direct incorporation of supplier delivery data into primary planning systems to further analyse supplier performance and delivery trend. Moving forward, future projects are required to involve increased digital integration between cross-functional teams, namely Production Planning and Control (PPC), Procurement, Quality and Logistics. Last but not least, a more detailed analysis of inventory optimisation with the use of larger inventory data sets can give more detailed and data-driven insights into how to optimise carrying costs while keeping the supply chain going.

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