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Original Article

ERP-Driven SKU Location Control to Eliminate Warehouse Transactions and Reduce Line Downtime in a Manufacturing Plant

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Abstract - This analysis investigates the implementation of the SAP Warehouse Management System (WMS) in a manufacturing environment, specifically assessing its effects on internal material replenishment, inbound receiving, and inventory management procedures. Prior to the WMS's introduction, the facility's operations were characterized by manual item transfers between storage bins, the utilization of unstructured pallet storage, and the need for redundant data entry. This led to inaccurate inventory counts, longer search times, and more frequent production interruptions. The new system, however, included specific storage areas for each stock-keeping unit (SKU), simplified the goods receipt process in SAP, and set minimum and maximum inventory levels. The implementation, which lasted over six and a half months and was tested across three busy production lines, led to significant improvements. Inventory accuracy surged from approximately 60% to 98%, while material-related downtime was reduced from 32% to a range of 2–3%. Consequently, the amount of transactional labor needed in the warehouses diminished by a quarter. These findings suggest that enhancements in layout optimization, the application of ABC-based slotting techniques, and the refinement of ERP configurations can substantially elevate operational efficiency, even in the absence of sophisticated automation technologies.

Keywords - Warehouse Management, ERP, Sap WMS, Inventory Control, ABC Analysis, Min–Max Policy, Manufacturing Logistics, Material Flow.

1. Introduction

Efficient internal material flow is crucial for sustaining uninterrupted production and fulfilling delivery obligations within manufacturing settings. Warehouse Management Systems (WMS), frequently integrated with Enterprise Resource Planning (ERP) systems, are indispensable for ensuring inventory visibility and precision (Frazelle, 2016). Conversely, systems that depend significantly on manual transactions for routine movements can engender inefficiencies, encompassing non-value-added activities, data discrepancies, and production delays (Richards, 2018). This research investigates a manufacturing facility where an overabundance of manual transactions and non-standardized storage methods contributed to diminished inventory accuracy (approximately 60%) and considerable production downtime (around 32%).

To address these challenges, the organization implemented a revised material flow system, which was based on:

- Specific storage locations for each SKU
- Min-max inventory management
- Simplified ERP transaction processes

This paper provides a comprehensive overview of the design, implementation, and outcomes of this transformation.

2. Literature Review

Warehouse management systems are widely recognized for their ability to improve in ventory accuracy, operational efficiency, and the effectiveness of order fulfillment processes (Gu, Goetschalckx, & McGinnis, 2007). Technologies such as barcode scanning and RFID help reduce human error and improve traceability (Kembro, Selviaridis, & Näslund, 2017). ABC classification is a common method for improving warehouse storage, categorizing items based on how often they're needed or their value (Silver, Pyke, & Thomas, 2017). Items that are in high demand are placed in easily accessible locations. This reduces the time spent moving around and speeds up the picking process. Min-max inventory systems are useful for balancing service levels and inventory costs, especially when demand patterns are fairly stable (Zipkin, 2000). These policies ensure timely replenishment while preventing overstocking.

Recent studies emphasize that while Industry 4.0 technologies (e.g., IoT and automation) enhance warehouse performance, significant improvements can still be achieved through process standardization and data accuracy (Winkelhaus & Grosse, 2020).

This case study adds to the current knowledge by showing how basic methods, without using complex automation, can lead to significant operational benefits.

3. Background and Problem Context

3.1. Manufacturing and Warehouse Environment

The facility has ten manufacturing lines, and its warehouse is about 56,900 square feet. The warehouse provides 7,504 pallet locations across 24 aisles and 938 racks. It is organized into zones with rack lines in the middle, flanked by racks on the left, right, and front, and a rear area for finished goods and shipping. SAP WMS is the primary system for recording receipts, internal movements, and line-side replenishments. Buyers use demand information for finished goods and components to place orders that feed this internal flow.

3.2. Legacy Material Flow and Transactions

Under the legacy process, materials arrived at the receiving docks, where a forklift driver or material handler completed paperwork, printed an internal label, attached it to the pallet, and staged the pallet in a receiving area. The pallet was then moved to the warehouse racks and placed wherever space could be found. After physically placing the pallet, the operator executed a bin-to-bin transaction in SAP to update the system with the chosen location and quantity. Because storage was based on available space, the same SKU frequently occupied multiple locations.

When production required material, a line-side material handler searched SAP to identify available quantities and locations for the desired SKU, retrieved material from one or more locations, transported it to the line, and performed another bin-to-bin transaction to move inventory to the line-side location. After a production run, the remaining material was returned from the line to any available space in the warehouse, and another transaction was used to record the move and new quantity.

This pattern meant that almost every physical movement—into racks, to the line, and back—generated a manual SAP transaction. The large number of pallet movements each day created a significant transactional burden, which then increased the chance of various potential errors.

3.3. Pain Points and Impacts

The legacy process generated multiple error types: operators could enter incorrect locations, wrong quantities, or wrong SKUs, and some transactions were simply forgotten. The existence of the same SKU in many locations made searching difficult and impeded FIFO. The result was inventory records that often did not match physical stock, with inventory accuracy at about 60%. Material handlers spent significant time searching for pallets across multiple potential locations.

These weaknesses had direct business consequences. Lines experienced downtime while teams located material or corrected discrepancies, with material-related downtime estimated at around 32%. Excess material and scrap accumulated due to poor FIFO control. Additional headcount was needed to manage the transaction volume and reconcile errors, and audit processes were complicated by inconsistent records. Overall, the facility incurred shipping delays, rework, material loss, and broader financial impacts.

4. Project Objectives and Scope

4.1. Objectives

The project aimed to simplify internal material flow and improve inventory accuracy by:

- Eliminating routine bin-to-bin SAP transactions associated with internal pallet movements.
- Reducing manual data entry and errors, targeting a substantial error reduction.
- Improving inventory accuracy from roughly 60% to near-complete alignment with physical stock.
- Reducing process time and travel for material handlers.
- Decreasing production line downtime due to material unavailability.

An additional goal was to make the process easier to learn and execute consistently for warehouse staff and material handlers.

4.2. Scope and Constraints

The scope covered the entire internal flow from order placement to delivery of materials at production lines, including ordering policies, warehouse layout and slotting, SAP WMS configuration, and line-side replenishment practices. All ten lines and the supporting warehouse were included, with phased implementation.

SAP WMS remained the only system of record; no new external systems or custom interfaces were added. Company identity and SAP screens needed to be anonymized in external publications. The design worked within existing warehouse space and rack infrastructure.

4.3. Organization and Timeline

An industrial engineer led the project end-to-end, supported by a cross-functional team of the warehouse manager, supervisors, team leads, and material handlers. The project lasted about 6.5 months, including data collection and analysis, layout design, SAP master data updates, physical relabeling and inventory rearrangement, pilot implementation on three high-demand lines, and roll-out to the remaining lines.

5. Methods: Analysis and Design

5.1. Data and ABC Analysis

The initiative started with collecting SKU-level data on demand, lead times, and pallet needs, along with reviewing past transaction patterns. The analysis shows that the daily pallet movements, which are in the thousands, necessitated manual bin-to-bin transactions, thereby contributing to a significant error rate. Subsequently, an ABC analysis was employed to classify SKUs according to demand, with high-frequency "A" items designated for the most readily accessible storage locations, followed by "B" and "C" items. Furthermore, baseline metrics concerning inventory accuracy, operational downtime, and staffing levels were established to inform the formulation of improvement objectives.

5.2. Layout Redesign and Slotting

Using a computer-aided design (CAD) model of the 56,900 square foot warehouse, undertook a comprehensive redesign of both the layout and the slotting strategy. The warehouse was then divided into separate areas, with a focus on the racks closest to each production line. Each stock-keeping unit (SKU) was assigned a designated storage location, a determination guided by ABC classification methodologies and the SKU's proximity to the lines it supported. As a result, SKUs experiencing high demand were deliberately located near their respective primary lines, thus reducing both travel distances and the likelihood of congestion.

Each SKU was given a minimum and maximum number of pallets, determined by demand, lead time, and available space. Dedicated locations were sized to fit the maximum pallet quantity, ensuring that physical capacity matched the planned min–max policy. This produced a fixed location scheme in which each SKU had a defined “home” location rather than being scattered.

5.3. SAP WMS and Master Data

SAP WMS remained the single source of truth. Location master data and inventory balances were cleaned so that each SKU’s dedicated location in SAP matched its physical rack position. No new interfaces or custom modules were developed; the project used existing SAP functionality for goods receipt and label printing.

At goods receipt, the SAP transaction posted the material to the dedicated location and triggered printing of an internal label containing the SKU and assigned location. The label was attached to the pallet at receiving. Because stock was already recorded at the correct location, later movements between warehouse and line no longer required bin-to-bin transactions.

5.4. Redesigned Material Flow

Under the new process, min–max parameters controlled replenishment. When on-hand stock reached the minimum, the buyer placed an order to raise it back to the maximum. For example, if a SKU’s min and max were two and four pallets, an order for two pallets was placed when stock fell to two. This ensured that incoming pallets could be stored in the dedicated location without overflow.

At receiving area, operators posted the goods receipt in SAP, printed the internal label with SKU and location, attached it, and staged the pallet. A forklift driver then moved the pallet to its dedicated rack location, as indicated on the label. When production required material, a forklift driver retrieved pallets from this location and delivered them to the line, returning any remaining material to the same location after the run. No additional SAP transactions were needed for these internal moves.

Because each SKU occupied a single location and min–max control prevented overflow into other racks, FIFO became much easier to enforce. Operators consumed open pallets sequentially at the dedicated location rather than searching among multiple partial locations. Barcodes on bins and SKUs remained available for audits and cycle counts, but were not central to the redesigned control logic.

6. Implementation

6.1. Phases and Physical Changes

Implementation proceeded through distinct phases. First, data collection and ABC analysis clarified demand profiles and movement volumes. In parallel, the CAD-based layout redesign placed SKUs according to ABC class and line proximity. SAP master data and inventory balances were then updated to reflect the new locations, and racks were labeled with SKU numbers. Inventory was rearranged to match the new scheme.

Standard operating procedures documenting the new flow from order placement through receiving, storage, line delivery, and returns were created. These SOPs served as the basis for training and ongoing guidance.

6.2. Pilot and Rollout

A pilot on three fast, high-demand lines tested the new process while other lines continued under the legacy approach. During the pilot, the team monitored inventory accuracy, material-related downtime, and user feedback. The absence of major issues and the observed performance improvements supported a progressive rollout to the remaining lines, implemented one line at a time until all ten lines used the new process.

6.3. Training and Risk Management

The warehouse crew quickly understood the new label definitions, the assigned areas, and the simplified transaction process described in the standard operating procedures. The operators found the system intuitive, and they appreciated the reduced workload related to their transaction duties. To preempt any possible issues, we performed extra cycle counts both during and after the transition. This allowed us to verify that the SAP records were in sync with the physical inventory. Whenever we spotted discrepancies, we took action by relocating items and updating the master data as needed. The cutover went off without a hitch, avoiding significant disruptions like delayed shipments or prolonged downtime.

7. Results

7.1. Quantitative Improvements

The project delivered substantial improvements:

- Inventory accuracy increased from about 60% to approximately 98%.
- Line downtime due to material availability issues decreased from around 32% to roughly 2–3%.
- Thousands of daily pallet movements no longer require manual bin-to-bin transactions.
- Transactional and rework-related headcount saw a roughly 25% decrease.

While it didn't pin down the exact financial impact here, the interplay of less downtime, fewer labor hours, better accuracy, and less scrap suggests substantial cost advantages.

7.2. Qualitative Outcomes

Operator and supervisor feedback was favorable. The new process was perceived as simpler by staff, primarily because each SKU was assigned a designated home location, which subsequently diminished both search duration and cognitive burden. Supervisors noted improvements in material flow, a reduction in the frequency of urgent searches, and a decrease in the need for reactive problem-solving. Furthermore, audit procedures were streamlined, attributable to the implementation of consistent locations and enhanced inventory accuracy.

7.3. Interpretation

The case suggests that, in suitable environments, fixed-location storage combined with min–max control and clean master data can outperform more flexible but less structured storage strategies. Through the alignment of physical layout, inventory policy, and ERP configuration, the project successfully diminished both the incidence of errors and the labor required to manage. The enhancements, generally linked to more sophisticated WMS or Industry 4.0 implementations, were realized via relatively simple process and configuration adjustments.

8. Lessons Learned and Implications

Successful implementation depended on a few key factors: full responsibility for both process and system changes, a design approach based on data analysis using ABC analysis and min–max parameters, and close collaboration with warehouse staff. Testing on three high-demand production lines allowed for validation before the full implementation, which reduced potential risks. This method is adaptable to other situations, provided there's enough storage space, a consistent level of demand, and the ability to connect ERP master data with the physical layout. In more dynamic environments or where space is tight, a hybrid strategy may be required, with some SKUs using fixed locations and others using dynamic slotting. However, the principles of removing unnecessary transactions, clarifying location control, and using simple inventory policies are broadly transferable.

9. Conclusion

This case study described the redesign of internal material flow and inventory control in a manufacturing plant using SAP WMS. By introducing dedicated SKU locations, min–max replenishment, and simplified goods-receipt-driven transactions, the facility eliminated most internal bin-to-bin postings while improving operational performance. Inventory accuracy rose from roughly 60% to 98%, line downtime due to material fell from about 32% to 2–3%, and related headcount was reduced by about 25%. The project also simplified work for operators and improved audit readiness.

This case study highlights the importance of thoroughly examining transaction needs and integrating physical and digital systems, a perspective that proves beneficial for employees. Researchers can observe the effective combination of traditional methodologies, such as ABC analysis, min–max control, and fixed slotting, with ERP functionalities, leading to considerable performance enhancements, all without necessitating additional technological expenditures. Future investigations might explore the application of these strategies within multi-warehouse networks or in the context of more dynamic product lines.

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