REDUCTION IN MATERIAL PREPRATION TIME THROUGH CHANGE OVER OF FLOW ORIENTED LAYOUT

RUTVIK RAJENDRA PAWAR - 202201090039

SUMEET KULKARNI -ASSISTANT MANAGER

MIT ACADEMY OF ENGINEERING, ALANDI-412105

Introduction:

The primary aim of this project is to implement **flow-oriented layout (FOL) modifications** within a logistics warehouse to achieve better utilization of space and to create a systematic approach that significantly reduces material preparation time. Warehousing operations play a crucial role in the overall supply chain, as they directly influence the speed, accuracy, and efficiency of material delivery to production or customer points. However, in the existing setup, the warehouse lacked standardized storage guidelines, leading to inconsistencies in material placement. For instance, a single part number could be stored across multiple locations, and bins often contained a mix of different components. This flexible yet unstructured approach introduced complexity into the picking process, caused frequent confusion among operators, and ultimately increased the lead time for preparing materials.

Such inefficiencies not only delayed the delivery of materials to the value stream but also created additional non–value-adding activities such as repeated handling, longer travel distances, and unnecessary verification steps. To address these issues, the **Material and Information Flow Analysis (MIFA) tool** was adopted. MIFA provides a structured way to visualize and evaluate both material and information flows within the warehouse system. By mapping the current state and identifying points of waste, the project team was able to highlight redundant handling steps, the need for repeated decanting, and the inefficiency of storing parts in random locations.

Through systematic waste elimination, a redesigned flow-oriented layout was proposed where materials are placed at fixed, logical storage positions aligned with their usage frequency and demand. This new arrangement not only simplifies the material handling process but also shortens preparation time, reduces operator fatigue, and minimizes the overall lead time. In essence, the project demonstrates how structured layout planning supported by analytical tools like MIFA can transform a warehouse into a more organized, efficient, and reliable hub for supporting downstream supply chain activities.

Objective:

The primary objective of this project is to design and implement a flow-oriented layout (FOL) in the logistics warehouse that enhances operational performance while reducing inefficiencies. The goals are multi-dimensional and address cost, productivity, time, safety, and overall process control:

- **Cost Reduction:**
  By minimizing unnecessary material handling, avoiding redundant movements, and utilizing storage space more effectively, the warehouse can significantly lower its operating expenses. The reduction of wasted floor area and unnecessary handling steps directly translates into measurable cost savings.
- **Increased Efficiency and Productivity:**
  The new flow-oriented layout creates a seamless connection between receiving, storage, picking, and shipping activities. This streamlined design reduces interruptions and ensures that goods move continuously through the process, enabling staff to achieve higher throughput with less effort.
- **Reduced Lead Times:**
  One of the critical aims is to shorten the time taken to prepare materials for delivery to the value stream. By eliminating bottlenecks, reducing waiting times, and removing repetitive handling, the system supports faster order fulfillment and quicker response to customer or production requirements.
- **Improved Resource Utilization:**
  The project seeks to make better use of both physical resources (space, racks, material handling equipment) and human resources. Optimizing workflows ensures that resources are always engaged in value-adding activities, minimizing idle time and enhancing overall productivity.

- **Enhanced Safety and Compliance:**
  A structured and organized warehouse layout naturally reduces risks associated with random or overlapping movement of goods. Clear pathways, logical storage

arrangements, and smoother flows contribute to a safer working environment, while also ensuring compliance with workplace safety standards.

- **Improved Visibility and Control:**
  The redesigned system provides greater transparency in how materials are received, stored, and dispatched. This visibility makes it easier for managers to track inventory, monitor material flow, and make informed decisions. Enhanced control reduces errors, improves accuracy in order preparation, and supports long-term process standardization.

Collectively, these objectives aim to transform the warehouse from a space of disorder and inefficiency into a strategic logistics hub that maximizes efficiency, reduces waste, and creates long-term value for the entire supply chain.

Scope:

The scope of introducing a flow-oriented layout (FOL) in a logistics environment extends across multiple dimensions of warehouse and supply chain operations. It not only focuses on the physical arrangement of resources but also integrates processes, information, and networks to create a holistic system of efficiency.

- **Facility Design:**
  A major part of the scope involves designing and arranging warehouses, distribution centers, and other storage facilities in a manner that promotes smooth and uninterrupted material flow. The physical layout should ensure logical sequencing of activities, reduce congestion, and maximize available space. Attention is given to selecting between different layout types—such as U-shaped, straight-flow, or T-shaped configurations—depending on the product profile, available area, and operational goals.

- **Materials Handling:**
  The project includes the development of efficient handling practices for the movement of goods from receiving through storage, picking, and shipping. The objective is to minimize unnecessary transfers, double-handling, and long travel

distances by aligning equipment, racks, and pathways with natural process flows. This scope may also extend to evaluating automation tools such as conveyors, automated guided vehicles (AGVs), or material trolleys to further enhance efficiency.

- **Inventory Control:**
  Proper inventory placement and control mechanisms form another critical aspect. The scope covers adopting methods such as ABC/XYZ analysis, defining fixed storage locations, and using FIFO/LIFO strategies where appropriate. This ensures that

  frequently required items are positioned closer to picking zones while optimizing the overall use of storage space and minimizing search time.

- **Information Flow:**
  Beyond the movement of goods, equal importance is given to the flow of information. The project scope includes integrating digital tools and warehouse management systems (WMS) that provide real-time visibility of stock levels, locations, and order statuses. A robust information flow supports better coordination, accurate decision-making, and reduces manual errors.

- **Reverse Logistics:**
  Handling returns, rejections, and repairs is an integral part of warehouse operations. The scope extends to designing clear pathways and defined storage zones for reverse logistics activities so that they do not interfere with forward material movement. This improves efficiency, reduces clutter, and enhances customer satisfaction by managing returns more effectively.

- **Network Design:**
  Finally, the scope is not limited to a single facility but extends to the broader logistics and distribution network. By applying flow-oriented principles across interconnected warehouses, suppliers, and distribution points, the supply chain can achieve end-to-end optimization—from the point of origin to final consumption.

This ensures consistency, reduces lead time variability, and strengthens the resilience of the overall network.

In summary, the scope of this project covers both the micro level (facility and process improvements within a warehouse) and the macro level (integration across the wider supply chain), ensuring that material and information flow are aligned to create a streamlined, cost-effective, and future-ready logistics system.

Theoretical Perspective:

The theoretical foundation of **flow-oriented layouts (FOL)** in logistics is built on the principle of achieving **continuous, efficient, and waste-free flow of materials**, information, and resources throughout the supply chain. The idea is to design warehouse and distribution systems in such a way that every step—from receiving goods to their final dispatch—adds value, while non-value-adding activities are minimized or eliminated. This approach emphasizes not only the physical arrangement of facilities but also the synchronization of information systems, financial flows, and strategic decision-making.

By aligning with **lean principles** and adopting **Just-in-Time (JIT)** practices, FOL helps organizations reduce unnecessary inventory, minimize waste, and respond quickly to demand fluctuations. At its core, the perspective advocates for creating a seamless, integrated system where material movement is predictable, resources are optimally utilized, and operational costs are kept under control.

Material Flow and Information Flow Integration

- **Material Flow:**
  The physical movement of goods forms the backbone of logistics. A flow-oriented layout seeks to minimize travel distances, avoid cross-traffic, and ensure smooth transfer of materials between storage, picking, and shipping areas. Understanding the **pathways, velocity, and frequency** of material flows allows managers to design layouts that reduce handling steps and shorten lead times.

- **Information Flow:**
  Efficient logistics cannot exist without robust information systems. Information flow provides visibility and control over the entire supply chain by tracking stock levels, material movements, and order statuses. When information and material flows are

  integrated, decision-making becomes faster, errors are minimized, and resources are allocated more effectively.

Lean Logistics and Waste Reduction

Flow-oriented layouts are inherently connected to lean thinking, which identifies and eliminates the seven types of waste (overproduction, waiting, transport, over-processing, excess inventory, motion, and defects).

- **Just-in-Time (JIT):**
  JIT practices ensure that materials are supplied exactly when needed, in the right quantity and quality, thereby reducing storage requirements and lowering carrying costs. In the context of a warehouse, this means designing layouts that support quick replenishment, efficient staging, and smooth dispatch with minimal idle time.

Systemic and Strategic Decision-Making

- **Network Structure:**
  Logistics efficiency is influenced by how facilities such as warehouses, ports, or distribution centers are arranged within the supply chain network. A flow-oriented design takes into account the **number, type, and interconnections** of these nodes to optimize material flow.
- **Facility Location:**
  The placement of a warehouse or distribution center is not merely a geographical choice but a **strategic decision** that impacts transport costs, service levels, and responsiveness. Flow-oriented perspectives emphasize locations that minimize overall logistics costs while ensuring proximity to demand centers.
- **Process Re-engineering:**
  Beyond physical layout, organizations may need to **redesign their processes**—for example, moving from batch-based picking to continuous flow systems. This systemic approach ensures that improvements are not superficial but address the root causes of inefficiency.

Cost Minimization

A central theoretical goal of flow-oriented layouts is the reduction of **total supply chain costs,** not just localized savings. By optimizing material handling, reducing unnecessary storage, and improving transport efficiency, organizations can achieve significant savings across procurement, operations, and distribution. This holistic perspective ensures that improvements in one area do not create hidden costs in another.

Automation and Technology

Modern theories of flow-oriented logistics also highlight the importance of **automation and digitalization**. Incorporating technologies such as **conveyors, robotic picking systems, Automated Guided Vehicles (AGVs), drones, and AI-driven warehouse management systems** can drastically improve accuracy and speed while reducing labor costs. These tools also support real-time decision-making by providing continuous visibility of material and information flows.

Methodology and Procedure of Work:

A **flow-oriented layout (FOL)** in logistics represents a systematic planning approach designed to ensure the smooth, continuous, and efficient movement of materials across all warehouse functions. Its main objective is to minimize transport distances, reduce unnecessary handling, and align material flow with operational requirements. The methodology is grounded in **lean logistics and process re-engineering principles**, combining both analytical tools and practical implementation strategies.

The process begins by thoroughly analyzing existing material flows, identifying inefficiencies, and establishing clear objectives such as reducing cycle time, improving productivity, or optimizing resource use. Based on this understanding, tools like **Material Flow Matrices**, **Value Stream Mapping**, and **Sankey Diagrams** are applied to quantify material and information flows, highlight bottlenecks, and visualize inefficiencies. This provides a strong data-driven foundation for designing an **ideal layout**. Once the theoretical design is developed, the layout undergoes multiple iterations to incorporate real-world constraints such as available space, equipment limitations, and workforce considerations.

The methodology can be broken down into three main stages:

1. Process and Organization Planning

- **Process Segmentation:**
  All operations within the warehouse are analyzed in detail, and similar processes or product groups are clustered together. For example, high-frequency components may be grouped to reduce travel time and handling effort.
- **Organizational Units:**
  These segmented processes are assigned to dedicated organizational units. This ensures better accountability, simplifies monitoring, and enhances process control across the facility.

2. Layout Planning

- **Material Flow Matrix:**
  A structured matrix is developed to record and quantify the volume, frequency, and direction of material movements between different operational zones (e.g., dock to storage, storage to picking). This helps prioritize areas with the heaviest flows.
- **Ideal Layout Design:**
  Using the insights from the flow matrix, an optimal warehouse design is created, where functional areas are dimensioned and arranged in a way that supports logical, direct material flows.
- **Real Layout Iteration:**
  The ideal plan is then adapted to fit existing building constraints, safety requirements, and resource availability. This iterative adjustment ensures that the design remains both efficient and practically implementable.

3. Resource Planning

- **Resource Selection:**
  The next step is identifying the resources required for smooth operation. This includes human resources, equipment (e.g., forklifts, conveyors, AGVs), storage systems, and supporting IT tools such as Warehouse Management Systems (WMS).
- **System Integration:**
  Resources are aligned with the designed flow to ensure they complement each other. For example, an auto-replenishment system may be integrated with storage racks to maintain FIFO rules automatically.

Detailed Procedure of Work

1. **Define Objectives:**
   Establish the primary goals of material flow planning, such as reducing preparation time, minimizing travel distances, or optimizing space utilization. Clearly stated objectives serve as a reference point for evaluating improvements.

2. **Map Material Flows:**

   - **Visualization:** Tools like value stream maps are used to capture the current state of all transport and handling processes within the warehouse.
   - **Quantification:** Data is collected on transport intensity, material volumes, batch sizes, and travel distances to provide a measurable basis for analysis.

3. **Analyze Data:**

   - **Transport Effort Calculation:** The total transport effort is determined by multiplying material flow intensity with distance traveled.
   - **Visualization Tools:** Sankey diagrams and other flow charts are employed to highlight areas of high transport effort and identify critical bottlenecks.

4. **Identify Action Potential:**

   - **Structural Modifications:** Potential improvements in facility layout, such as re-positioning docks, racks, or staging areas, are identified to shorten routes and simplify flows.
   - **Transport Technology Optimization:** Evaluate opportunities to reduce costs and handling effort by introducing better equipment or advanced transport systems.

5. **Design and Implement the Layout:**

   - **Refine Layout:** Based on identified opportunities, a refined flow-oriented layout is created. This emphasizes orderliness, minimum movements, and efficient use of floor space.

- **Simulation (Optional):** Before physical implementation, digital simulation tools may be used to validate the new design under various demand and resource scenarios, helping to predict performance and reduce risks.

Analysis of Data:

The analysis of data for this project was carried out using the **Material and Information Flow Analysis (MIFA)** tool. MIFA serves as a structured methodology to capture and visualize both the **physical movement of materials** and the **associated flow of information** across the warehouse system. By mapping these flows in detail, the tool provides clarity on how processes are currently executed and highlights inefficiencies that contribute to longer preparation times.

The primary purpose of MIFA is to establish transparency in the end-to-end supply chain—from the **customer demand signal** all the way back to the supplier—ensuring that both material and information flows are aligned, synchronized, and free of unnecessary complexity.

Key Elements of MIFA Used in the Analysis

1. **Forecast Level:**
   Captures demand signals and forecasted requirements, which drive the need for materials to move through the warehouse.

2. **Order Level:**
   Represents the actual orders received, linking customer requirements to internal processes.

3. **Material Flow Level:**
   Tracks the movement of physical goods, including transportation between docks, storage areas, and picking zones.

4. **Information Boxes:**
   Highlight the supporting information exchanges (such as GRN creation, put-away instructions, or replenishment signals) that accompany physical movements.

5. **Lead Time:**
   Records the time taken for each process or movement, providing insight into delays, bottlenecks, and overall throughput.

6. **Additional Information:**
   Captures supporting data such as batch sizes, transport distances, or resource utilization that affect material preparation time.

Approach to Data Collection and Mapping

- Each activity within the warehouse was represented using **standard MIFA symbols**, ensuring consistency in the visualization of flows.
- A **time study** was conducted for each process step, and the results were recorded in a stability (stab) sheet. This provided accurate data on cycle times, waiting times, and transport efforts.
- Processes were classified into **value-adding (VA)** and **non-value-adding (NVA)** activities. This categorization allowed for a clear identification of wasteful steps, which later formed the basis for targeted **Kaizen improvements**.
- The mapping process was carried out from the **customer end backwards to the supplier**, thereby providing an **end-to-end view** of the supply chain rather than a limited, warehouse-only perspective. This holistic approach ensured that interdependencies between material and information flows were fully captured.

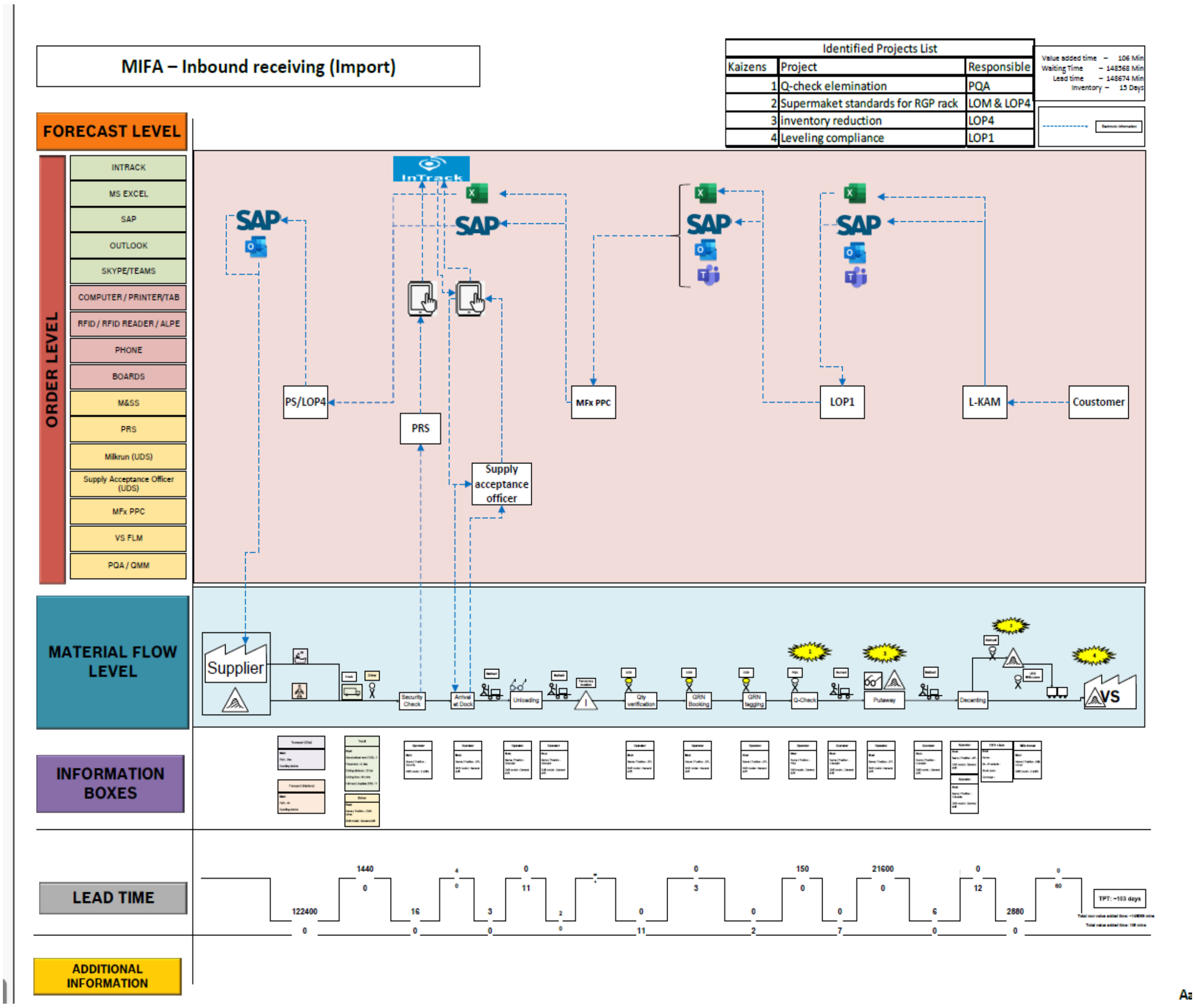


Figure 1 MIFA- Inbound receving (Import)

- The **Material and Information Flow Analysis (MIFA) diagram** plays a central role in visualizing the existing processes within the warehouse and highlighting areas of inefficiency. By mapping both **material flows** (physical movement of goods) and **information flows** (data exchanges and signals that guide these movements), the diagram provides a clear, end-to-end picture of how operations function.
- Through this mapping exercise, several forms of **waste** were systematically identified within the process. These included unnecessary material handling steps, repetitive decanting activities, multiple touch points during quality checks, and excessive lead times for picking operations. Once these inefficiencies were made visible, they became the foundation for targeted **Kaizen improvements**.

- The strength of MIFA lies in its ability to capture not only the **movement of materials**—from docks to storage, and eventually to the value stream—but also the **flow of supporting information**, such as order processing, goods receipt notes (GRNs), and replenishment instructions. This dual perspective ensures that the analysis is comprehensive, as material delays often result from gaps or inefficiencies in information flow.
- The diagram therefore acts as both a **diagnostic tool** and a **decision-making aid**. By combining quantitative data (such as lead times, transport distances, and handling frequency) with qualitative insights (such as clarity of information exchange), the MIFA diagram highlights precisely where improvements are needed. The identified wastes were then systematically addressed using **Kaizen initiatives**, ensuring that the redesigned layout eliminates redundant steps, shortens preparation time, and enhances overall efficiency.
- In short, the MIFA diagram served as the **visual roadmap** for identifying problems and driving continuous improvement, ultimately bridging the gap between analysis and actionable solutions.

Following is list of Kaizen :

The analysis conducted through the **MIFA tool** revealed several inefficiencies within the warehouse processes, each contributing to increased preparation time and unnecessary complexity. These inefficiencies were categorized as **waste** and subsequently addressed through targeted **Kaizen initiatives**. The following areas were identified for improvement:

- **Multiple Handling Steps for Picking of Material:**
  The existing system required operators to handle the same item multiple times before it reached the final stage of preparation. This redundant activity not only consumed valuable time but also increased the risk of errors and material damage. Kaizen measures aimed at simplifying the picking process by standardizing storage locations and reducing the number of touchpoints.

- **Decanting Process:**
  Decanting, or transferring material from one type of packaging into another, was

identified as an additional non-value-adding step that delayed preparation. In many cases, decanting occurred more than once for the same material. Through Kaizen, this process was restructured so that decanting was completed immediately after quality inspection, eliminating repeated handling and ensuring materials were ready for direct use.

- **Multiple Handling Steps after Quantity Check:**
  After materials were verified for quantity, they were often subjected to repeated transfers before reaching their designated storage or preparation area. This was a clear source of waste, as the same component was unnecessarily moved from one place to another. The improvement initiative focused on creating a direct flow from the quality check area to the assigned storage location, reducing intermediate handling.
- **Long Lead Time for Picking Materials:**
  Due to scattered storage locations and lack of standardization, operators needed excessive time to locate and pick materials. This extended lead time not only slowed down preparation but also caused delays in the entire supply chain. Kaizen efforts were directed toward reorganizing storage based on frequency of use (ABC analysis), implementing FIFO racks, and minimizing the travel distance per pick.
- **Redundant Steps in Handling One Type of Material:**
  Certain materials, especially those with higher demand, were being handled in multiple stages even though a single streamlined process could have sufficed. These extra steps did not contribute any value but increased workload and cycle time. The Kaizen initiative sought to redesign workflows so that each type of material followed a **standardized, single-flow process**, thereby eliminating unnecessary actions.

Old Layout:

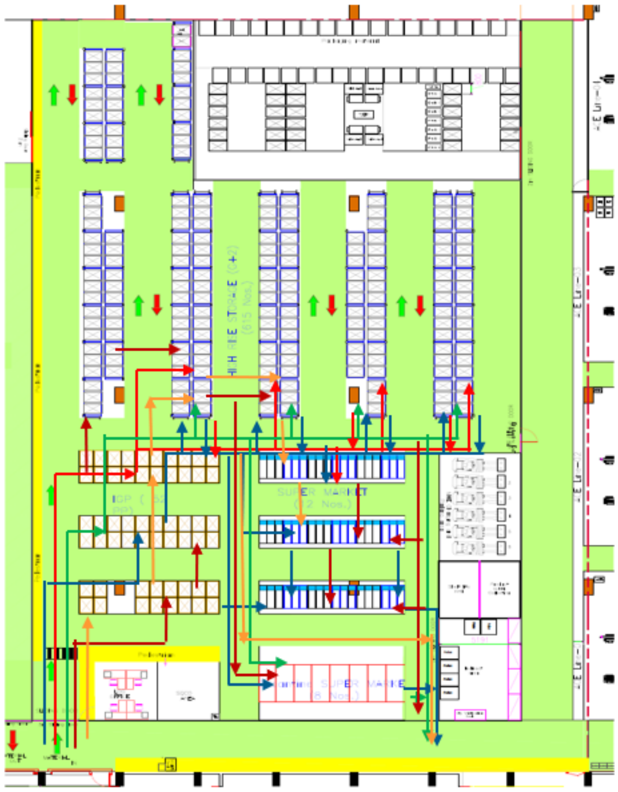


Figure 2 Old Inbound Layout

The analysis of the existing warehouse layout revealed a number of operational challenges that significantly affected efficiency, accuracy, and safety. The absence of a structured flow design led to several forms of waste and created barriers to achieving smooth material preparation. The major issues observed were:

- **Crisscross Movement of Material:**
  Materials frequently moved in overlapping and intersecting paths, creating congestion and confusion on the shop floor. This crisscross movement not only increased travel distances but also caused delays in material handling and posed risks of collisions between operators and equipment.

- **Lack of Standard Layout Selection:**
  The warehouse layout had not been designed based on proven configurations such as U-flow, T-flow, or straight-line layouts. Without a standardized approach,

material flow was irregular and lacked rhythm, leading to inefficiencies in the movement of goods from receiving to storage and dispatch.

- **High Throughput Time:**
  The time taken for materials to move through the system—from unloading to storage, preparation, and final dispatch—was significantly higher than industry benchmarks. This was primarily due to scattered storage locations, unnecessary handling steps, and poor flow alignment.

- **Multiple Handling of Materials:**
  A single material often had to be handled several times before reaching its final location. This repetitive activity increased workload for operators, consumed additional time, and created opportunities for errors and product damage.

- **Repetitive Decanting of Material:**
  Materials were frequently transferred from one packaging type to another more than once during the process. This repeated decanting not only wasted time but also added unnecessary complexity, increasing the likelihood of misplacement or contamination.

- **Safety Risks Due to Non-Rhythmic Movements:**
  The absence of a structured flow created irregular and unpredictable movement patterns. Forklifts, trolleys, and workers often shared the same congested pathways, resulting in safety hazards and near-miss incidents.

- **Inconsistent Packing Types:**
  Different suppliers used varied packing materials and sizes, which complicated the storage and decanting processes. The lack of standardization made stacking and organizing materials difficult, consuming more space and increasing handling effort.

Overview of Process

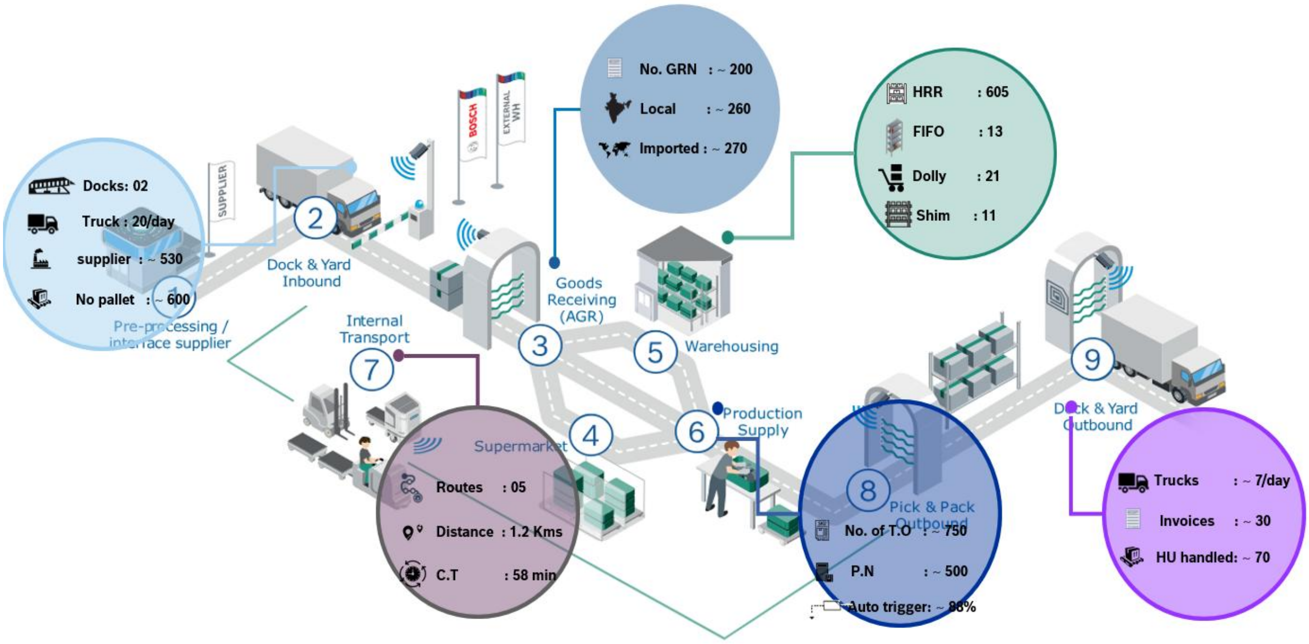


Figure 3 Overview of Process

Pre-Processing Analysis:

Before implementing changes to the warehouse layout, a detailed **pre-processing analysis** was carried out to assess the current operating conditions and the scale of daily activities. This baseline study provided critical insights into the volume of materials handled, the level of supplier interactions, and the overall workload on the facility. The findings are summarized as follows:

- **Total Number of Docks – 2:**
  The warehouse is equipped with only two active docks for loading and unloading operations. With limited dock availability, inbound and outbound activities often overlap, creating congestion and waiting times for vehicles. This constraint directly influences the flow of materials into the facility and increases the pressure on material handling resources.

- **Total Number of Trucks per Day – 20:**
  On average, the warehouse handles 20 truck movements daily. This includes both inbound shipments from suppliers and outbound transfers to production lines or distribution centers. Given the restricted dock capacity, managing this level of traffic requires efficient scheduling and rapid material movement; otherwise, delays cascade into longer preparation and lead times.
- **Total Number of Suppliers – 530:**
  The warehouse manages materials from a large and diverse supplier base, with 530 suppliers contributing to the inbound flow. Such a wide supplier network increases the complexity of operations, as packaging standards, shipment sizes, and delivery schedules vary significantly. This diversity also demands more robust systems for goods receipt, quality checks, and decanting, as the variability can disrupt flow and storage uniformity.
- Number of pallet position- 600

Good Receipt Analysis:

An important part of evaluating the warehouse's operational performance lies in understanding the **goods receipt process**, as it directly influences material availability, preparation time, and storage efficiency. The analysis of current receipts revealed the following:

- **Total Number of Goods Receipt Notes (GRNs) – 200:**
  On average, the warehouse generates around 200 GRNs during its operations. Each GRN represents the formal acknowledgment of incoming goods, covering details such as supplier information, quantity received, and quality verification. The high number of GRNs reflects the complexity of managing diverse material inflows on a daily basis, adding pressure on documentation, inspection, and storage processes.

- **Total Number of Local Suppliers – 260:**
  Out of the total supplier base, 260 suppliers are domestic. Local suppliers typically operate with shorter lead times and more frequent deliveries, often in smaller lot sizes. While this improves responsiveness, it also results in frequent handling and higher transactional volume in terms of receipts and inspections, thereby increasing the workload on the warehouse staff.

- **Total Number of Imported Suppliers – 270:**
  A nearly equal number of 270 suppliers are international. Shipments from imported sources generally arrive in bulk and involve longer lead times. These deliveries often come with larger packaging units or pallets, requiring additional processes such as decanting, customs clearance, and more stringent quality checks. The variability in shipment sizes and conditions from global suppliers further complicates the receipt and storage process.

New Layout :

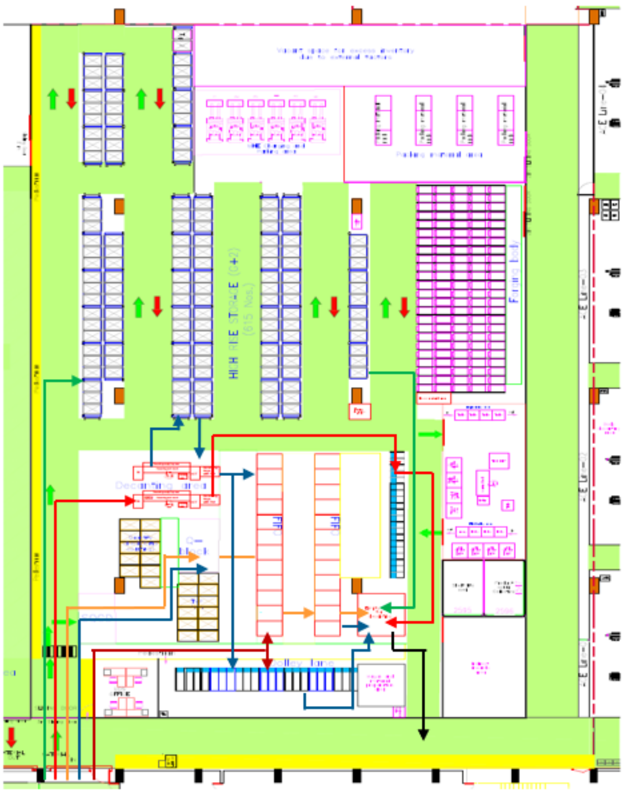


Figure 4 New Inbound layout

Based on a detailed analysis of product usage patterns, available warehouse space, and local geographical conditions, a **U-shaped layout** was selected as the most suitable configuration for the redesigned warehouse. This decision was guided by its ability to create a continuous, structured flow of materials while maximizing space utilization and improving overall efficiency. The redesigned layout introduced the following improvements:

- **No Crisscross Movement of Material:**
  In contrast to the old layout, the new U-shape arrangement ensures that material moves in a clear, uninterrupted flow. By eliminating crisscross paths, congestion is reduced, and operators follow a predictable and orderly movement pattern.

- **Standardized Layout Selection:**
  The adoption of a U-shaped design provides a standard and structured approach tailored to the nature of the products handled. This not only brings consistency to material flow but also establishes a rhythm in daily operations, making the process more repeatable and reliable.

- **Reduced Throughput Time:**
  By streamlining storage locations and minimizing redundant steps, the new layout significantly lowers the overall throughput time. Materials now move from receiving to quality check, decanting, storage, and finally to dispatch in a direct and efficient manner.

- **Elimination of Multiple Handling:**
  Each material is handled only once at each required stage, avoiding unnecessary transfers. This reduces operator fatigue, prevents damage, and shortens preparation cycles.

- **Immediate Decanting after Quality Check:**
  To remove inefficiencies caused by repeated decanting, the process is now completed directly after inspection. This ensures that materials are stored in a ready-to-use condition, making them easily accessible for subsequent processes.

- **Improved Safety through Rhythmic Flow:**
  The structured design enforces a rhythmic and predictable flow of both materials and personnel. This minimizes unsafe overlaps between equipment and workers, reducing the risk of accidents and improving compliance with safety standards.

- **Standardization of Packing Types:**
  The new layout eliminates the complications caused by multiple packaging types. Materials are decanted and organized according to a consistent strategy, simplifying stacking, handling, and retrieval.

Supporting Strategies for the New Layout

- **ABC and XYZ Analysis of Active Part Numbers:**
  To optimize storage and retrieval, active parts were classified based on **12 months of consumption data** (ABC analysis) and **six months of demand variability** (XYZ analysis). High-priority and frequently used parts were placed closer to picking areas, while less frequently required items were stored further away, reducing travel distance and improving picking efficiency.
- **Receipt Condition Management:**
  Materials were categorized according to their packaging levels—**primary, secondary, and tertiary**—to standardize storage and handling practices. This ensured that materials were received, decanted, and stored in a structured manner without unnecessary repacking.
- **Decanting Strategy:**
  A clear and standardized decanting policy was implemented, with materials transferred into uniform storage containers immediately after inspection. This eliminated the earlier need for repeated decanting and improved consistency in material handling.

Flow no	Material Flow					Receipt & Issue condition				Example	No. of part No
	Receipt	Storage location1	Storage location2	Storage location3	Customer	MPQ	Plallet Size	Primary packing condition	Decanting		
1	Dock	TMP	NA	Shim Rack	MFC1	Low	Low	Bottles	No	Shims	298
2	Dock	TMP	NA	RGP	MFC1	High	Low	Packets	Yes	Bush,Sealing washer , spring etc (Q check)	42
3	Dock	NA	NA	RGP	MFN1&MFN2,MFC1	Low	NA	Arranged	No	Needle , Nz body, IC stud(Skip lot)	75
4	Dock	TMP	IGP	RGP	MFC1 , MFC4	Low	High	Boxes(bigger)	Yes	Valve Spool,Protection cap(Decanting)	74
5	Dock	NA	IGP	NA	MFC	Low	High	Boxes(bigger)	No	Body,Magnet (Auto Putaway)	5
										Total PN	494

Figure 5 Proposal for storage of parts in warehouse

To ensure smooth and efficient movement of materials from the point of unloading to their final storage locations, a structured storage strategy has been designed. This proposal establishes a clear sequence of activities, supported by defined storage areas, to reduce confusion, standardize processes, and align with the flow-oriented layout. The strategy integrates both physical storage zones and system-based controls in SAP, ensuring visibility, consistency, and FIFO (First-In-First-Out) compliance.

The major storage points in the redesigned layout include:

- **Dock – Unloading Area:**
  This is the initial entry point for all incoming materials. Goods are unloaded from trucks and subjected to primary checks before being directed to their respective next-stage storage or processing zones.
- **TMP – Intermediate Storage Location:**
  Acting as a temporary buffer, the TMP area allows materials to be staged before final allocation. It is particularly useful when there is a mismatch between inbound arrival and immediate space availability at the designated racks. TMP ensures continuous flow without blocking the dock area.
- **Shim Rack – Specialized Rack for Shims:**
  Materials such as shims, which require dedicated and organized storage, are directed here. This prevents mixing with other components and makes retrieval easier during production needs.
- **RGP – FIFO Rack (Storage Defined in SAP):**
  The RGP zone is digitally controlled through SAP and follows a strict **FIFO policy**. Materials stored here are systematically rotated to ensure older stock is issued first, minimizing the risk of obsolescence or quality deterioration.
- **IGP – High-Rise Rack Storage:**
  Designed for bulk storage, the IGP high-rise racks provide vertical space utilization for larger consignments or slower-moving items. Integration with SAP ensures that replenishment from IGP to RGP is automated, based on minimum and maximum stock levels.

Storage Flow Strategies

Based on the material type, demand pattern, and packaging condition, materials follow one of the following defined storage flows:

1. **Dock → TMP → Shim Rack**
   Materials requiring special storage, such as shims, are first unloaded at the dock, held briefly in TMP if needed, and then transferred to the Shim Rack for organized storage.
2. **Dock → TMP → RGP**
   Materials are staged at TMP before being moved into the FIFO-controlled RGP racks. This ensures smooth unloading at the dock while maintaining systematic storage in SAP-defined locations.
3. **Dock → RGP**
   In cases where materials can be directly placed into FIFO racks without requiring staging, goods move straight from dock to RGP. This flow reduces handling steps and improves efficiency.
4. **Dock → TMP → IGP → RGP**
   For bulk deliveries or slower-moving items, materials are first staged at TMP, then placed into the IGP high-rise racks. As demand arises, items are replenished from IGP into RGP racks to maintain FIFO order for picking.
5. **Dock → IGP**
   Certain bulk or less frequently required items bypass TMP and RGP, moving directly from dock to IGP racks. This direct flow saves staging space and ensures efficient use of vertical storage.

Project Execution :

The execution of this project followed a structured and systematic approach, combining analytical tools, lean practices, and collaborative problem-solving methods. The goal was to ensure that the transition to a **flow-oriented layout (FOL)** was not only effective in theory but also practical and sustainable in real operations. The execution strategy included the following key steps:

- **Application of the MIFA Tool:**
  The project began with a comprehensive analysis of material and information flows using the **Material and Information Flow Analysis (MIFA)** tool. This helped in mapping the current state of operations, highlighting non-value-adding activities such as multiple handling, unnecessary decanting, and excessive lead times. By visualizing these inefficiencies, the team was able to identify specific areas of waste that required elimination.
- **Elimination of Waiting Time through Process and Information Optimization**:
  One of the major findings of the analysis was unnecessary waiting, caused either by unclear information flow or poor synchronization between material handling activities. The project addressed this issue by streamlining communication channels, standardizing storage locations, and aligning processes so that materials moved seamlessly without idle time.
- **Benchmarking with Standard Market Solutions:**
  Before finalizing the layout, the team reviewed existing best practices and standard **flow-oriented solutions available in the industry**. This benchmarking exercise ensured that the proposed layout was aligned with modern warehouse practices and incorporated proven methods for material handling and storage.
- **Gemba Walks and Workshops for Idea Generation:**
  A series of **Gemba walks** (on-site observations) were conducted to directly study the workflow and identify challenges faced by operators in real time. In addition, collaborative workshops were held with employees, supervisors, and managers to gather ideas and suggestions. This bottom-up approach encouraged participation, built ownership among the workforce, and generated practical insights for layout improvement.
- **Implementation through A3 Systematic Methodology:**
  The execution was carried out using the **A3 problem-solving framework**, which provided a structured pathway to move from problem identification to solution deployment. The A3 approach ensured that each stage of the project—problem definition, root cause analysis, countermeasure planning, implementation, and follow-up—was documented, evaluated, and continuously improved.

Process Implementation:

To translate the redesigned flow-oriented layout into practice, a series of process-level improvements were introduced. These enhancements combined **digital automation, standardized storage strategies, and supplier integration**, ensuring that material flow within the warehouse was seamless, efficient, and well-coordinated. The following measures were implemented:

- **In-Track System for Vehicle Movements:**
  An **in-track monitoring system** was deployed to track the movement of vehicles inside the warehouse premises. This ensured better visibility of inbound and outbound logistics, reduced idle time at docks, and improved scheduling accuracy. By providing real-time data on vehicle positions, congestion was minimized, and dock utilization was optimized.

- **Automated Goods Receipt (GRN):**
  To eliminate manual errors and reduce paperwork, an **auto-GRN system** was implemented. As soon as goods were unloaded and verified, the system automatically generated a Goods Receipt Note in SAP. This not only saved time but also ensured accuracy in stock records and improved the speed of the goods receipt process.

- **Automated Put-Away Strategy:**
  A standardized **auto put-away system** was introduced so that each part number is assigned a fixed and predefined storage location. This eliminated confusion caused by storing the same part at multiple locations and reduced search time during picking. The system also improved traceability and supported FIFO principles.

- **Automated Replenishment from High-Rise Racks to FIFO Racks:**
  To maintain uninterrupted picking operations, an **auto-replenishment mechanism** was set up. When stock in FIFO racks reached a minimum threshold, the system automatically triggered replenishment from high-rise racks. This ensured a continuous supply of parts without manual intervention, reducing downtime and improving flow reliability.

- **Implementation of Supplier Pull Loop:**
  A **pull-based replenishment system** was established with suppliers, replacing the

earlier push-based approach. By sharing consumption data and setting inventory levels, suppliers delivered materials in smaller, more frequent lots based on actual demand. This reduced excess inventory, minimized storage requirements, and smoothed the overall supply chain flow.

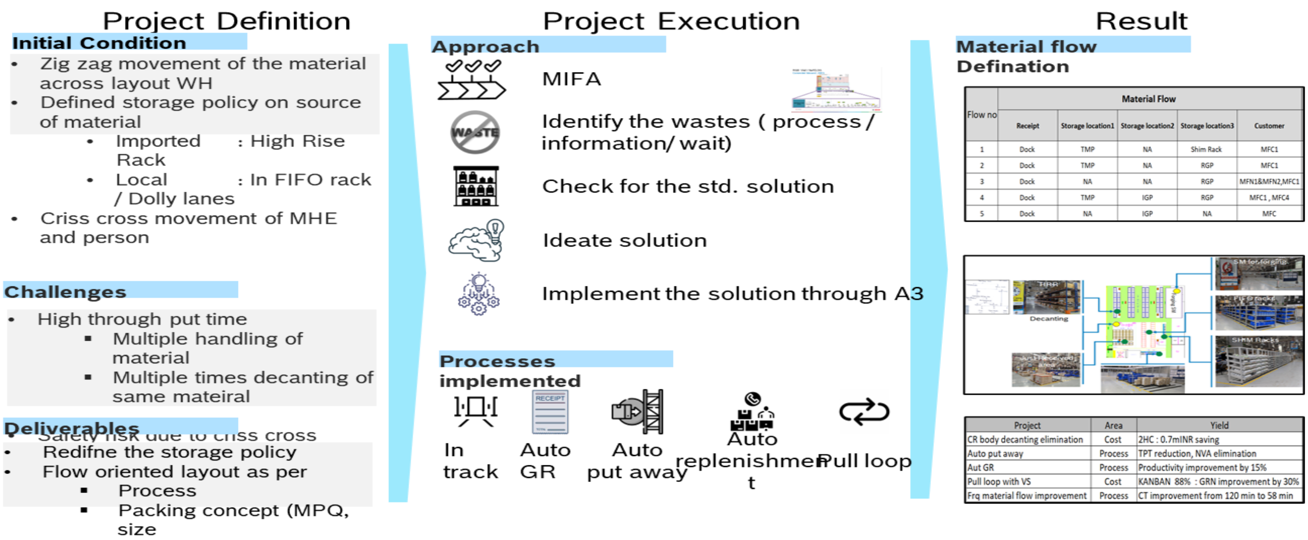


Figure 6 Overview of changes

1. Project Definition

- Warehouse operations faced inefficiencies due to **zig-zag material flow**, repeated handling, and crisscross movement of people and MHE.
- Storage was based on **material source (local vs. imported)** rather than process needs, leading to delays and safety risks.
- Objective: **Redefine storage policy, standardize material flow, and implement a flow-oriented layout (FOL)** to reduce throughput time and optimize space.

2. Project Execution

- Applied **MIFA tool** to identify wastes and design standardized flows.
- Conducted **Gemba walks, workshops, and A3 systematic problem-solving** to generate ideas.

- Implemented key processes: **Auto GRN, auto put-away, pull loop with suppliers, in-track vehicle monitoring, and immediate decanting after quality check**.

3. Results

- **Space Optimization:** 362 sq.m freed and 162 pallet positions optimized.
- **Time Efficiency:** Material preparation time reduced from **110 min → 15 min (86% improvement)**; distance per pick cut by 79%.
- **Cost & Productivity:** Eliminated 2 headcount, saved 0.7M INR, and improved productivity by 15%.
- **Digitalization:** Introduced automated solutions for GRN, put-away, and replenishment, improving accuracy and control.

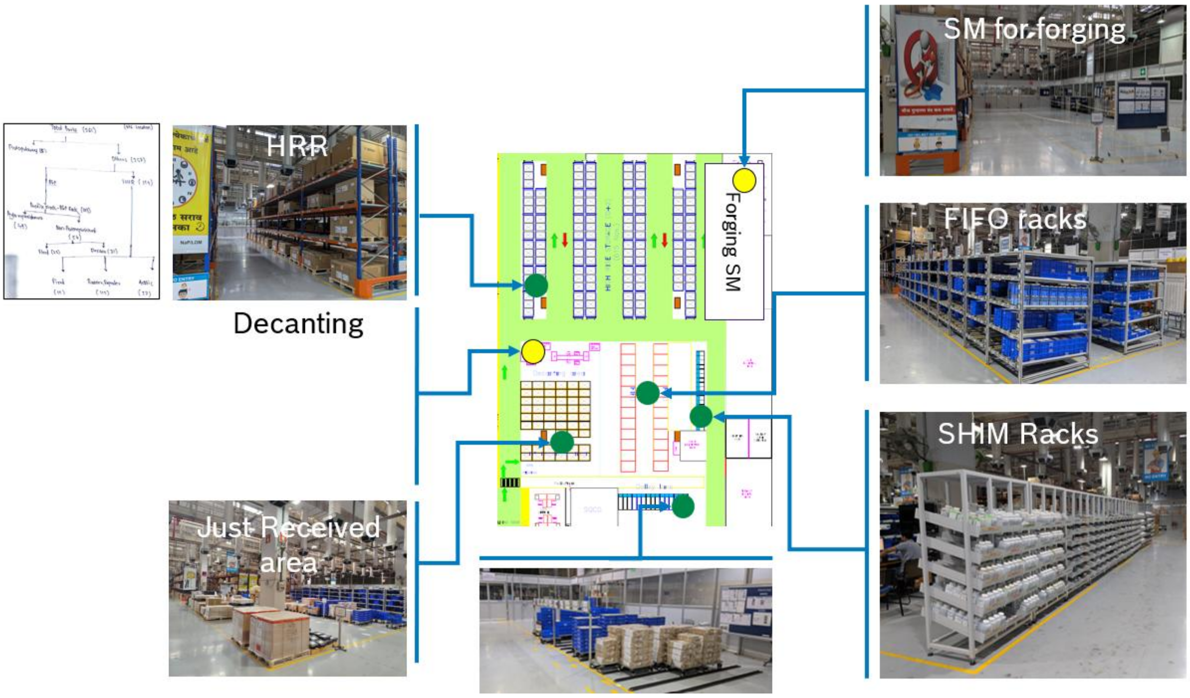


Figure 7 Warehouse Layout Visualization

Warehouse Layout Visualization

➢ **Just Received Area:** Materials first arrive here for unloading and initial checks.

- **Decanting Zone:** Materials are immediately decanted after quality checks to avoid re-handling.
- **HRR (High-Rise Racks):** Used for storing imported or bulk materials.
- **FIFO Racks:** Dedicated for local supply, ensuring *first-in-first-out* movement.
- **SHM Racks:** Specialized racks for small or frequently used parts.
- **SM for Forging:** A designated storage and supply area supporting forging operations.

Major Outcomes:

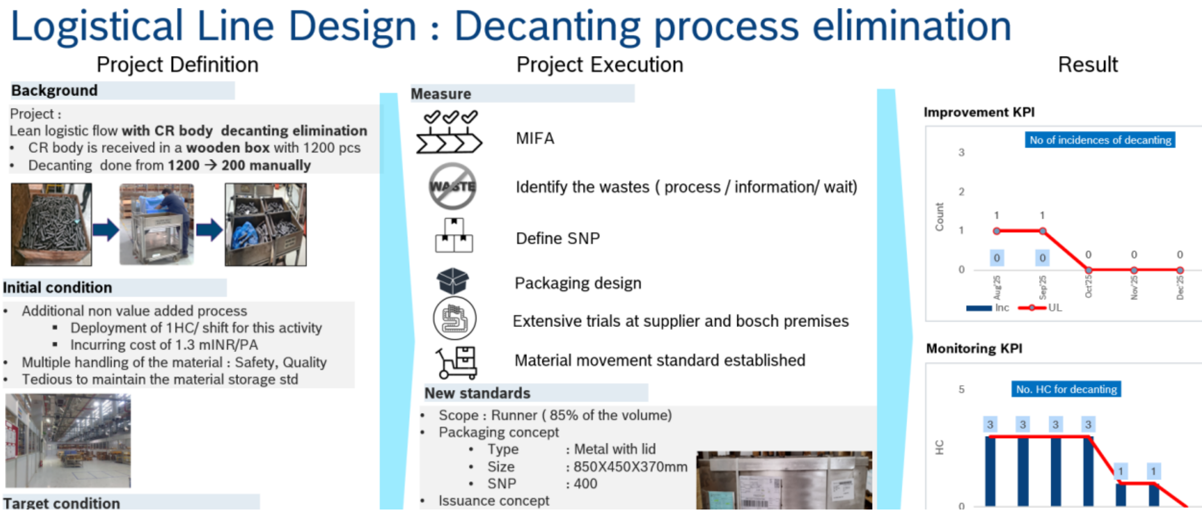
The implementation of the flow-oriented layout, along with digital integration and process optimization, led to substantial improvements in warehouse performance. The measurable outcomes of the project demonstrate how systematic planning and lean practices can transform material handling operations. Key achievements include:

- **Optimization of High-Rise Racks:**
  Three high-rise racks, amounting to **162 pallet positions**, were fully optimized. This ensured better vertical space utilization, reduced congestion at floor level, and allowed for more organized and accessible storage of bulk or less frequently used items.
- **Adoption of Digital Solutions:**
  The introduction of digital tools such as **auto-GRN, automated put-away, and replenishment systems** improved visibility and accuracy in warehouse operations. These digital solutions not only reduced manual workload but also enhanced the overall reliability of inventory management.
- **Space Optimization – 362 sq. m:**
  By reorganizing storage and eliminating redundant material flows, a total of **362 square meters of warehouse space** was freed up. This optimized floor utilization allows the facility to handle higher volumes of materials without requiring additional infrastructure investment.
- **Reduction in Workforce Requirement:**
  Process simplification and automation enabled the elimination of **two manual headcounts**, leading to lower labor costs. At the same time, the remaining

workforce could focus on value-adding tasks rather than repetitive or redundant activities.

- **Reduction in Throughput Time:**
  Streamlined material flows and elimination of waste resulted in a significant **reduction in overall throughput time**. Materials now move more quickly and directly through the warehouse, supporting faster order fulfillment and production readiness.
- **Material Preparation Time Improvement:**
  One of the most notable achievements was the reduction of **material preparation time from 110 minutes to just 15 minutes**, representing an **86% improvement**. This drastic reduction not only boosts responsiveness but also strengthens the efficiency of the value stream.
- **Reduction in Travel Distance:**
  The distance traveled by operators per pick reduced from **230 meters to 43 meters**, a **79% improvement**. This improvement directly lowers operator fatigue, increases picking speed, and contributes to higher productivity.
- **Reduction in Handling Steps:**
  The number of handling steps required to process one material dropped from **12 steps to 3 steps**, amounting to a **75% improvement**. By minimizing redundant handling, the process became safer, faster, and less error-prone.

Decanting Process Elimination: Driving Lean Logistics:



1. Project Definition

- Earlier, CR bodies arrived in wooden boxes with **1200 pieces** that had to be **manually decanted into 200-piece lots**.
- This created an additional **non-value-adding process**, requiring **1 headcount per shift** and costing **1.3M INR annually**.
- Multiple handling led to **safety, quality, and storage issues**.

2. Project Execution

- Used **MIFA** to identify waste.
- Defined **Standard Number of Pieces (SNP)** and designed new **metal packaging with lids** (400 pcs capacity).
- Conducted trials at supplier and plant, and standardized material movement.

3. Results

- **Eliminated decanting completely** → no incidences from Oct onwards.
- **Headcount reduced** from 3 to 1 (saving manpower and cost).
- Improved **safety, quality, and storage standardization**.

Limitation in FOL:

While flow-oriented layouts bring significant benefits in terms of efficiency, space utilization, and reduced preparation time, they are not without limitations. The adoption of such layouts in the logistics industry requires careful consideration of cost, flexibility, and operational constraints. Some of the key challenges are as follows:

- **High Setup and Conversion Costs:**
  Designing and implementing a flow-oriented layout involves substantial initial investment. Specialized equipment such as high-rise racks, conveyors, or automated guided vehicles (AGVs) may be required, along with modifications to the facility infrastructure. Additionally, converting an existing warehouse into a flow-based system often demands redesign of floor space, racking, and IT integration, which can be capital-intensive.
- **Inflexibility to Demand Changes:**
  Flow-oriented layouts are highly effective in stable, predictable environments. However, when there are sudden fluctuations in demand or frequent changes in product volumes, the system may struggle to adapt. This rigidity makes it less suitable for industries where product mixes or order profiles shift regularly.
- **Difficulty in Accommodating Product Variance:**
  Warehouses that handle a wide variety of products—differing in size, weight, or packaging—may find it challenging to maintain efficiency under a fixed flow-oriented design. Layouts optimized for standard product flows may not perform as well when handling irregular or non-standard materials, leading to inefficiencies.
- **Risk of Bottlenecks at Central Hubs:**
  Since flow-oriented layouts typically rely on centralized pathways or hubs, any disruption at these points can cause bottlenecks. A breakdown in equipment, a sudden surge in volume, or delays in a particular zone can halt the movement of goods through the entire system.
- **Constraints of Existing Buildings:**
  Many warehouses operate in pre-constructed buildings with fixed dimensions, column placements, or floor layouts. These structural constraints can restrict the

ability to design an ideal flow-oriented system. As a result, compromises often need to be made, and the full benefits of FOL may not be realized.

- **Need for Continuous Monitoring and Adaptation:**
  Flow-oriented layouts require ongoing supervision to ensure they continue to function efficiently. Changes in order patterns, supplier practices, or customer demands must be continuously evaluated, and processes need to be adjusted accordingly. Without active monitoring and adaptation, the system may revert to inefficiencies over time.

Key Limitations:

Although flow-oriented layouts improve efficiency and material handling in many scenarios, they also come with inherent limitations. These challenges can reduce their effectiveness, particularly in dynamic or large-scale operations. The key limitations are as follows:

- **Inflexibility and Lack of Variety:**
  Flow-oriented layouts are most effective in environments where material movement is standardized, product types are limited, and demand patterns are stable. However, in warehouses that handle **a wide mix of products with varying sizes, shapes, or handling requirements,** this rigidity can become a disadvantage. When demand changes frequently or product variety is high, the system may not adapt easily, resulting in inefficiencies and delays.
- **High Initial and Conversion Costs:**
  Establishing a flow-oriented layout requires significant investment in **infrastructure, racking systems, specialized equipment, and IT solutions**. Converting an existing facility into a flow-based system can be even more costly, as it often involves major modifications such as re-arranging docks, installing automation, and restructuring storage systems. For organizations with budget constraints, these costs can act as a barrier to implementation.

- **Vulnerability to Disruptions:**
  In a flow-oriented system, processes are highly interconnected. This means that a disruption at any single point—such as equipment failure, delay in quality inspection, or material shortage—can cause a **bottleneck that halts the entire flow**. Unlike more flexible layouts, flow-oriented systems often lack alternative pathways, making them more exposed to shutdowns if one link in the chain fails.
- **Complexity in Design:**
  Designing a systematic flow-oriented layout is not straightforward. It requires balancing multiple factors, such as product characteristics, space availability, equipment capabilities, and safety requirements. The wide range of possible configurations (U-flow, straight-line, T-flow, etc.) adds further complexity. Selecting the **optimal design for a given business case** often demands expert analysis, simulation studies, and iterative adjustments, making it a time-consuming process.
- **Fixed Layout for Existing Structures:**
  Many warehouses operate within pre-existing buildings that come with structural constraints such as **limited floor space, column placements, ceiling height, or geographical limitations**. These restrictions often make it impossible to achieve the "ideal" flow-oriented design. In such cases, compromises must be made, and the resulting layout may not deliver maximum efficiency.
- **Limitations in Large-Scale Facilities:**
  While FOL works well for medium-sized operations, its effectiveness reduces in very large warehouses. For example, a **U-shaped layout** may become inefficient when the central receiving and dispatch area is located far from storage zones at the extremities. Workers and material handling equipment may end up traveling long distances, negating the efficiency benefits intended by the layout.
- **Expansion Challenges:**
  Flow-oriented layouts, particularly U-shaped designs, often face limitations when facilities need to expand. Unlike straight-line layouts, which can be extended relatively easily, U-flow or T-flow structures require significant redesign to

accommodate new capacity. This lack of scalability makes it difficult to adapt to future growth without major disruptions.

Finding the Right Flow-Oriented Layout:

Designing an effective **flow-oriented layout (FOL)** is not a one-size-fits-all exercise. Each business has unique characteristics in terms of product variety, order fulfillment requirements, supplier base, and available infrastructure. To identify the most suitable flow type, a structured approach must be followed:

1. **Understand Operations:**
   The first step is to gain a thorough understanding of the business environment. This includes analyzing the **volume of material flow**, the **types of components handled**, the **frequency of inbound and outbound activities**, and the **order fulfillment strategy** (e.g., bulk distribution, just-in-time supply, or high-frequency small orders). Additionally, constraints such as available floor space, dock positioning, and workforce capacity must be considered. Without this foundational knowledge, layout selection risks being misaligned with operational needs.

2. **Analyze Workflows:**
   Once operational requirements are clear, the next step is to **map the journey of materials** across the warehouse, from unloading at the dock to storage, picking, packing, and dispatch. Tools such as **value stream mapping, Sankey diagrams, or MIFA analysis** can be used to highlight bottlenecks, unnecessary handling, and non-value-adding steps. A detailed workflow analysis ensures that inefficiencies in the current system are visible and can be eliminated in the new layout.

3. **Choose the Appropriate Flow Type:**
   Based on the insights gathered, businesses must select the layout type that best matches their operational profile:

   - **Straight Flow:** Suitable for high-volume warehouses where large consignments need to move quickly from one end to another. With receiving and dispatch zones at opposite ends, congestion is minimized and throughput is maximized.

   - **U-Flow:** Best suited for operations involving smaller components or frequent order fulfillment. In this design, both receiving and dispatch occur at the same dock, reducing unnecessary travel and streamlining processes in compact spaces.

- **T-Flow:** A hybrid approach that combines features of both straight and U-flows. Typically, storage and order preparation are on one side, while receiving and dispatch occur on opposite sides. This design balances efficiency with space optimization and is particularly effective in medium to large facilities.

4. **Map the Layout:**
After selecting the most suitable flow type, a **detailed warehouse diagram** is created. This blueprint must clearly define the placement of docks, racks, staging zones, and picking areas, while prioritizing **proximity of high-use items** to reduce travel distance. The mapping process also ensures that material handling paths are logical, efficient, and aligned with safety regulations.

5. **Incorporate Space and Safety Measures:**
Space utilization and safety are equally critical in layout design. The flow should allow maximum use of vertical and horizontal space while maintaining **wide, obstacle-free pathways for equipment and workers**. Incorporating features such as designated pedestrian zones, fire exits, and emergency access points ensures compliance with safety standards while enhancing overall operational reliability.

Inference and Recommendation:

- **Inferences:**
From the analysis, it is evident that there is **no universal best layout**. The effectiveness of a flow-oriented design depends heavily on **specific operational requirements, storage needs, product characteristics, and the overall logistics strategy** of the business. While standardized flow types such as straight, U, or T layouts provide a structural framework, the final design must be tailored to match real-world conditions and long-term goals.

Recommendations:

To achieve a sustainable and efficient warehouse layout, the following steps are recommended:

- **Begin with Data:**
  Make all layout decisions based on comprehensive data collection and analysis. Metrics such as transport distances, handling frequency, cycle times, and inventory profiles should be evaluated before finalizing the design.
- **Consider Technology:**
  Integrate **digital solutions and automation tools** such as Warehouse Management Systems (WMS), Automated Guided Vehicles (AGVs), RFID tracking, and real-time dashboards. These not only optimize material handling but also improve accuracy, visibility, and control over inventory.
- **Prioritize Flexibility:**
  Since demand patterns and product mixes often change over time, it is critical to design layouts that can be **adapted and scaled**. Modular racking systems, flexible docking arrangements, and expandable zones ensure that the warehouse remains responsive to future growth.
- **Test and Iterate:**
  The new layout should not be treated as permanent immediately. Instead, it should be **implemented, monitored, and tested** over a defined period (e.g., six months). Continuous evaluation of key performance indicators (KPIs) such as throughput time, space utilization, and picking efficiency allows for fine-tuning and iterative improvements.

Conclusion and your suggestions forimprovement in the organization:

The organisation has built a strong operational base and continues to demonstrate steady growth through its structured processes and dedicated workforce. Over the past cycle, significant improvements—such as optimising the flow of materials, refining packaging standards, and incorporating data-driven tools—have resulted in measurable gains in efficiency and reliability. These achievements reflect a proactive culture that is open to innovation and continuous enhancement. By adopting modern technologies and encouraging collaboration across departments, the company has positioned itself to respond effectively to market changes and customer demands. The progress made so far provides a solid platform for scaling operations and strengthening its competitive advantage in the industry.

Suggestions for Improvement

- **Deepen Data-Driven Decision Making:** Expand the implementation of advanced analytics and reporting tools such as Power BI to capture real-time performance data, forecast demand variations, and identify potential bottlenecks early. A broader data strategy will support quicker, evidence-based decisions.
- **Promote Cross-Functional Collaboration:** Establish regular interdepartmental meetings and shared digital workspaces where procurement, production, quality control, and logistics teams can exchange updates. This structured communication will reduce delays, avoid duplication of effort, and create a unified approach to problem-solving.
- **Invest in Continuous Skill Development:** Introduce ongoing training programs focused on emerging technologies, lean manufacturing principles, and sustainability practices. Upskilling employees will not only enhance productivity but also improve retention by showing a commitment to professional growth.
- **Strengthen Sustainability Initiatives:** Move beyond compliance by adopting energy-efficient machinery, exploring renewable energy sources, and transitioning

to eco-friendly packaging materials. This will reduce environmental impact, cut long-term costs, and appeal to environmentally conscious customers and partners.

- **Implement a Robust Feedback System:** Create a structured platform—such as periodic employee surveys and customer feedback loops—to capture valuable insights. A transparent mechanism for gathering and acting on feedback will encourage innovation, quickly highlight operational inefficiencies, and foster a culture of continuous improvement.

Summary:

This project focused on **streamlining the inbound logistics of CR body components** by removing a time-consuming manual decanting step.

Previously, CR bodies arrived in large wooden boxes containing **approximately 1,200 pieces each**. Before these parts could enter production, operators had to **manually repack them into 200-piece lots**, a process known as decanting. This activity required **one full headcount per shift**, incurred an annual cost of roughly **1.3 million INR**, and created multiple safety and quality risks due to repeated handling and inconsistent storage practices.

To address these inefficiencies, the team adopted a **structured, lean-logistics approach**:

- **Waste Identification:**
  Using the **Material and Information Flow Analysis (MIFA)** tool, the team mapped the entire process to expose non-value-adding activities and waiting periods.
- **Standardization and Design:**
  A **Standard Number of Pieces (SNP)** was established, and a new **metal container with a secure lid** (dimensions 850 × 450 × 370 mm, capacity 400 pieces) was developed to replace the wooden boxes.
- **Validation and Trials:**
  Extensive pilot runs were carried out at both supplier facilities and the Bosch warehouse to ensure the new packaging protected product quality and fit seamlessly into existing handling systems.
- **Implementation:**
  After successful trials, the new packaging and handling standards were rolled out across the entire supply chain, and clear material-movement protocols were documented.

The results were significant:

- **Complete removal of the decanting operation**, with **zero incidents** reported after implementation.
- **Headcount reduction from three to one**, cutting labor requirements and eliminating an annual cost of **1.3 million INR**.
- **Improved safety and product quality** by reducing manual touches and simplifying material storage.
- Enhanced overall logistics efficiency and created a foundation for future automation.

By **replacing a repetitive manual activity with a standardized, supplier-integrated packaging solution**, the project delivered measurable financial savings, improved operational safety, and reinforced lean principles throughout the warehouse network.