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# Title:

**“Optimizing The Material Handling System: Transitioning To AGVs And Conveyor Solutions”**

# Problem statement:

The growing demands of the market to make an organization globally competitive require the implementation of CIM concepts In this context, students are advised to select a discrete product manufacturing industry/assembly line of their own choice Students have to carefully analyze the parts/products being manufactured/assembled using the appropriate concepts/techniques of CIM to improve the throughput of the organization. Analysis should be supplemented with the necessary evidence.

# Objectives:

Our objectives are;

* To Analyze the manufacturing processes within the chosen industry by using CIM concepts
* To Automate the Manufacturing Processes aiming to enhance operational efficiency

# Theory/ literature review:

Applying Computer Integrated Manufacturing (CIM) principles has become more and more important for businesses looking to stay competitive in the fast-paced industry of today. CIM uses computer technology to seamlessly coordinate and optimize production activities by integrating many manufacturing processes .

The automation of industrial processes, which attempts to increase operational efficiency and decrease human intervention, is a crucial component of CIM. Conveyor solutions and automated guided vehicles are two examples of automated material handling systems that are essential in this context vehicles that can move materials throughout a facility without the need for human help. They are outfitted with sensors and navigation systems. Similar to this, conveyor systems minimize manual handling and streamline productivity by enabling the continuous circulation of products throughout production lines.

Research has indicated that implementing and conveyor systems can result in notable enhancements to manufacturing productivity, such as decreased cycle times, higher throughput, and improved safety. In addition, the incorporation of CIM ideas facilitates proactive decision-making and optimal resource use through real-time production process monitoring and control .Research emphasizes how critical it is to use CIM principles and automation technologies like and conveyor systems in order to maximize material handling systems and improve operational effectiveness in manufacturing settings.

# Selected industry details:

Enhancing the quality of healthcare in the medical sector through the use of precise and discreet products.



*Figure 1 Style textile (PVT) LTD*

# Introduction:

Style Textile is a vertically integrated textile manufacturer based in Pakistan, renowned for its commitment to excellence, sustainability, and technological advancement. With a legacy of over three decades, Style has grown into a globally recognized apparel producer, supplying some of the world’s leading sportswear and fashion brands. The company’s operations span across knitting, dyeing, finishing, printing, and garment manufacturing, making it a one-stop solution for high-performance and fashion-forward apparel.

## Industry Focus:

Style Textile operates at the intersection of fashion and functionality, serving international clients with a focus on sportswear, casualwear, and performance apparel. The company is a key player in the textile and garments industry, leveraging its deep expertise in synthetic and natural fiber blending, activewear innovation, and trend-driven designs. By aligning itself with global fashion and performance markets, Style Textile ensures it meets the evolving demands of both athletic and lifestyle brands.

## Innovation and Quality Assurance:

Innovation lies at the core of Style Textile’s business strategy. The company has consistently invested in cutting-edge technologies such as digital printing, sustainable fabric development, and automation solutions like RFID tracking systems for enhanced operational efficiency. Their in-house R&D and design teams work closely with clients to develop customized solutions, while the integration of lean manufacturing practices ensures a responsive and agile production environment.Style Textile maintains stringent quality assurance protocols across all stages of production, from raw material sourcing to final garment inspection. The company is ISO-certified and adheres to globally recognized quality and compliance standards. Advanced testing laboratories and real-time monitoring systems are in place to ensure consistency, durability, and customer satisfaction. Their commitment to quality is reflected in long-standing partnerships with global brands that demand excellence in every stitch.



*Figure 2 Threads*

# Selected Area & Approach:

Material handling system analysis is the key to increasing efficiency and productivity in any operation. In this process, it's vital to carefully examine the current setup's strengths and flaws to identify places for improvement. From there, proposing a new system using Automated Guided Vehicles (AGVs) might revolutionize material handling dynamics.

## Existing Material Handling System Analysis:

At Style Textile, the current material handling system is primarily manual, involving paper slips for bundle identification, physical tracking of WIP (Work-in-Progress), and human-dependent sorting and verification processes. This leads to common issues such as misplaced bundles, workflow interruptions, and record inaccuracies — collectively resulting in a daily time loss of over 175 minutes per shift and reduced operational efficiency

# **Ideal cycle time per delivery per vehicle**

# Tc = TL + Ld /Vc + TU + Le /Vc

# Using layout,

# TL = 3.3 minutes=198sec TU = 1.1minute=66sec

# Ld = 27 x 2=54 Le =27 x 1.1=29.7

# Vc = 1.5 meter/min

# The ideal cycle time is:

# Tc = 105minutes

# **workload WL = Rf\*Tc**

# Where, Rf is the number of deliveries per hour that are 15 deliveries/hr

# WL = 15\*105

# WL = 1575 min/hr

# **Availability of Time (AT)**

# AT = 60AFtEw

# Availabilty = A = 90%

# Trafic Factor = Ft = 90%

# Worker efficiency = Ew = 1.0

# AT = 60(0.9) (0.9) (1.0)

# AT = 48.6

# **Number of Vehicles:**

# Number of vehicles (nc)

# nc = WL /AT

# nc = 1575/48.6

# nc = 32 vehicles

# Cost Analysis:

# Labor Cost for handling:

# No of workers = 16

# Labor’s Salary = PKR 35,000

# Total Labor Cost = 16\* 35,000

# =560,000

# **Labor Cost for handling:**

# No of workers =12

# Labor’s Salary = PKR 35,000

# Total Labor Cost = 12\* 35,000

# =4,200,000

# annual Labor Cost = 12\* 420000=5040,000/-

# **AGVs cost for handling:**

# No of forklifters =32

# AGVS COST = 1.7 lacs

# Total Labor Cost = 32\* 1.7

# =5440,000

# Annual maintenance cost= 35,000

# annual Total labour cost=420,000

# Total AGV cost for year=580,000

# ROI time= 1.38 years.

## CIM Material Handling System Proposal:

To address these inefficiencies, Style Textile proposes implementing a Computer Integrated Manufacturing (CIM) system with RFID technology for automated material handling and tracking. The system would enable real-time bundle tracking, operator performance monitoring, and seamless WIP flow across stitching units. The integration is expected to significantly reduce manual intervention, eliminate delays, and increase overall productivity

## CIM Material and Quantity Requirements:

The proposed RFID-enabled CIM system will require:

* RFID tags for each bundle or garment unit
* RFID readers and antennas at key checkpoints (cutting, stitching, finishing)
* Integration software and middleware to sync with existing ERP/MES systems
* Operator terminals or handheld devices for scanning and monitoring
* Training modules and IT infrastructure upgrades

## Analysis of Cost:

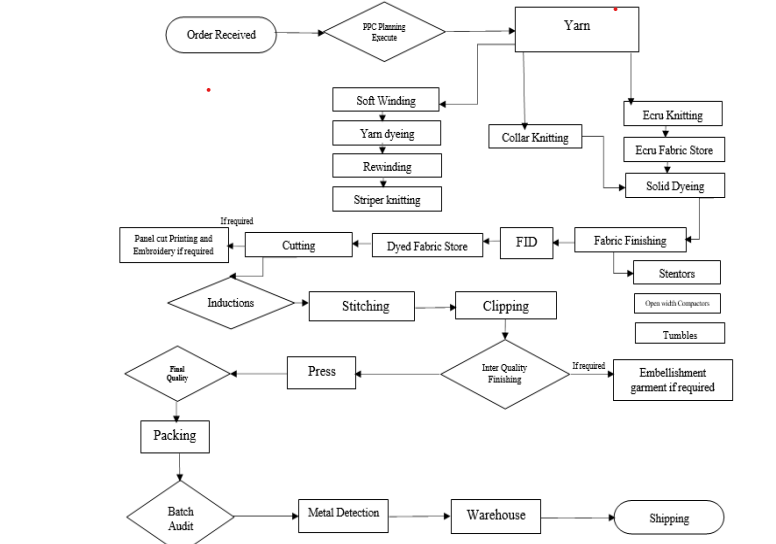
Initial costs include the procurement of RFID hardware, system integration, and setup expenses, along with training. However, based on current inefficiencies, Style Textile loses approximately 175 minutes per shift in production delays. Post-RFID, this is expected to drop to 28 minutes, reflecting a significant cost-saving potential. The projected increase in throughput from ~1163 to ~1500 pieces per shift further reinforces the financial viability of the investment.

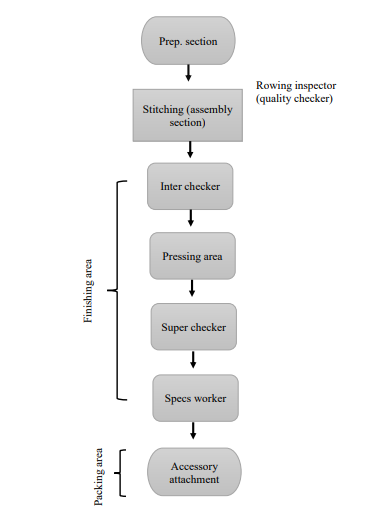
## Return on Investment:

The ROI for the RFID-CIM integration is promising. With significant time savings, enhanced tracking accuracy, and increased throughput, Style Textile stands to recover the initial investment within a short time frame through reduced labor dependency, minimized rework, and improved delivery timelines. Moreover, long-term strategic benefits include better production planning, quality assurance, and higher customer satisfaction.

## Factory Layout:

The layout ensures a smooth and seamless flow of operations from raw material intake to finished product assembly. This will enhance productivity, minimize material handling, and facilitate easier monitoring of the manufacturing process.





## Autonomous Guided Vehicles (AGVs)

Autonomous guided vehicles, or AGVs, are a cutting-edge approach to material handling and transportation in production and logistics. Numerous advantages come with these self-driving cars, such as increased productivity, safety, and efficiency. Modern technology allows AGVs to function independently around-the-clock, reducing downtime and streamlining production schedules. For a variety of industrial environments, AGVs offer a versatile and affordable option. Their autonomy lessens the need for manual intervention, improving safety and productivity, and their versatility enables them to blend in seamlessly with current workflows. AGVs provide a comprehensive response to the problems associated with transportation and material handling in manufacturing and logistics. In today's world, their adaptability, effectiveness, and safety features make them an invaluable asset for optimizing processes and boosting production.

# 

*Figure 3 automated guuided carts*

# 

*Figure 4 Forklifter*

A forklift is a powered industrial truck used to lift and move materials over short distances. Commonly found in warehouses, manufacturing plants, and shipping yards, forklifts are essential for transporting heavy pallets and bundles efficiently. They are operated by a human driver and come in various types such as counterbalance forklifts, reach trucks, and pallet jacks.

**Key Features:**

* Manual or electric drive
* Hydraulic lifting mechanism
* Load capacity ranging from 1 to over 50 tons
* Ideal for vertical stacking and confined space navigation

**Limitations:**

* Dependent on skilled operators
* Risk of human error or injury
* Higher operational cost over time (fuel, maintenance, labor)

# Bills of Quantity for AGVs:

Below are explaining each item listed in the Bills of Quantity for AGVs:

1. Autonomous Guided Vehicle (AGV): Self-driving vehicle designed for material handling and transportation tasks within industrial settings.
2. AGV Charging Station: Dedicated station equipped with charging infrastructure to ensure uninterrupted operation of AGVs.
3. Navigation System: Advanced technology enabling precise positioning and navigation of AGVs within the facility.
4. Safety Sensors: Integrated sensors detecting obstacles and ensuring safe operation in dynamic environments.
5. Communication Equipment: Equipment facilitating real-time communication between AGVs and central control systems.
6. Installation and Integration Services: Professional services for the setup, installation, and seamless integration of AGV systems into existing infrastructure. [12]

# Justification of implementing AGVs:

The Company want to move toward industry 4.0 which is actually automation and artificial Intelligence. Based on our literature review, we have explored various material handling methods, with a specific focus on Automated Guided Vehicles (AGVs). clearly superior than traditional conveyor or pallet systems and also in the company space is aloso not available for conveyor system that’s why we want to implement AGVs in the company for the required of Company. AGVs are selected for deployment because of their adaptability, versatility, and capacity to satisfy changing industrial standards. AGVs also offer increased maneuverability in intricate manufacturing settings, guaranteeing best use of available space and resources. Thus, empirical data supporting AGVs' superiority in industry-wide material handling process optimization supports our advice to deploy them.

**Proposed Solution**

Style Textile currently faces multiple operational inefficiencies in its cutting and stitching units due to a manual material handling system. Daily time losses occur due to piece location errors (75 mins), manual sorting and matching (35 mins), workflow interruptions (35 mins), record inaccuracies (25 mins), and WIP tracking (70 mins). These issues collectively result in approximately 175 minutes of lost time per shift, affecting overall throughput, traceability, and productivity

### ****RFID-Based CIM Proposal****

To address these inefficiencies, the introduction of an **RFID-based CIM system** is proposed. The system involves tagging each bundle with **reprogrammable UHF RFID tags** containing data such as lay number, size, and fabric type. These tags will be scanned by **RFID readers** (like Zebra FX7500 or Impinj R700) placed at critical process points, particularly the stitching unit's entry. This automation eliminates the need for manual bundle checking, improves tracking, and provides real-time visibility across operations.

### ****System Infrastructure and Equipment****

The proposed setup includes a complete infrastructure: **directional antennas** (e.g., Times-7 A6031 with 6–9 dBi gain) for focused signal transmission, **PoE switches and LAN cabling** for network connectivity, and integration with an **SQL Server or ERP dashboard** for centralized data management. The system is designed to be fabric-safe and durable for textile operations, and the entire hardware setup will support both real-time updates and historical analysis.

### ****Pilot Project Scope****

As a starting point, a pilot implementation is recommended in **Style Manga B or C sub-unit**, where **1200–1500 bundles per day** are processed. A single RFID reader will be installed at the stitching intake point to evaluate improvements in bundle traceability, time savings, and error reduction. Key metrics for evaluating the pilot will include reduction in bundle misplacements, savings in handling time, and throughput improvements.

### ****Cost and ROI Analysis****

The **initial investment** includes RFID tags (₨ 189,900), readers (₨ 759,510), software and integration (₨ 281,300), and training/installation (₨ 140,650), totaling approximately **₨ 1.37 million**. Despite the upfront cost, the system can lead to a **30% increase in throughput per line**, improved data accuracy, and a major reduction in lost time. For example, throughput can rise from **41 to 54 bundles per shift**, meaning over 120 additional bundles handled daily

### ****Long-Term Benefits and Recommendations****

Implementing an RFID-enabled CIM system at Style Textile promises significant improvements in operational control, accuracy, and production efficiency. With automated tracking and instant data access, loss investigations become quicker, and manual errors are minimized. The system also supports long-term scalability by reprogramming RFID tags for future shifts or orders. It is recommended to fully evaluate the pilot results and consider phased expansion across all stitching lines for maximum benefit

|  |  |  |
| --- | --- | --- |
| Problem Area | Refined Description (Style Textile) | Time Impact per Day |
| Piece Location Errors | Time lost searching for bundles misplaced across multiple stitching units | 75 mins |
| Manual Sorting & Matching | Delays from manually verifying bundle details using paper slips | 35 mins |
| Workflow Interruptions | Production pauses while waiting for the next bundle to arrive | 35 mins |
| Record Inaccuracies | Errors during manual entry of size, lay data, and subsequent corrections | 25 mins |
| WIP Movement Tracking | Time spent manually updating progress and preparing end-of-day reports | 70 mins |

|  |  |  |
| --- | --- | --- |
| **Metric** | **Without RFID** | **With RFID** |
| Time Lost per Shift | ~175 mins | Reduced to ~28 mins |
| Pieces Tracked per Shift | ~1163 | Up to ~1500 |
| Operator Tracking Accuracy | Manual Estimation | Real-time Data |

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Estimated Unit Cost (PKR/USD)** | **Quantity Needed** | **Estimated Total** |
| RFID Tags (per garment) | PKR 10 (or USD ~0.03) | 1500/day x 30 | PKR 450,000/month |
| |  |  |  |  | | --- | --- | --- | --- | | **Component** | **Estimated Unit Cost (PKR/USD)** | **Quantity Needed** | **Estimated Total** | | RFID Tags (per garment) | PKR 10 (or USD ~0.03) | 1500/day x 30 | PKR 450,000/month | | RFID Readers | PKR 100,000 each | 4-6 units | PKR 400,000–600,000 | | RFID Software & Integration | PKR 300,000 – 600,000 | One-time | PKR 300,000–600,000 | | Training + Maintenance (annual) | PKR 100,000 | One-time | PKR 100,000 |   RFID Readers | PKR 100,000 each | 4-6 units | PKR 400,000–600,000 |
| RFID Software & Integration | PKR 300,000 – 600,000 | One-time | PKR 300,000–600,000 |
| Training + Maintenance (annual) | PKR 100,000 | One-time | PKR 100,000 |

.

A single shift = 8 hours = 480 minutes

So, productive time without RFID = 480 - 175 = 305 minutes

productive time with RFID = 480 - 28 = 452 minutes

**Throughput Rate Without RFID:**

1163 pieces/305 minutes

​ ≈3.81 pieces/minute

**Throughput Rate With RFID:**

1500 pieces/452 minutes ≈3.32 pieces/minute

Interesting Note: Even though the throughput rate per minute slightly decreases, the overall number of pieces tracked increases because more productive time is available

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Estimated Unit Cost (PKR/USD)** | **Quantity Needed** | **Estimated Total** |
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| RFID Software & Integration | PKR 300,000 – 600,000 | One-time | PKR 300,000–600,000 |
| Training + Maintenance (annual) | PKR 100,000 | One-time | PKR 100,000 |

Estimated Initial Setup Cost

RFID Readers + Software + Training=400,000+400,000+100,000=PKR 900,000 (one-time)

Monthly Operational Cost

RFID Tags for 1500 pieces/day×30=PKR 450,000/month

# Conclusion:

By applying the principles of Computer Integrated Manufacturing (CIM), we have conducted a comprehensive analysis of our manufacturing processes. Through this analysis, we have identified opportunities for optimization and efficiency enhancement. As part of our proposed solution, we have developed a framework for an Automatic Material Handling System. This system leverages cutting-edge technology to streamline material handling processes, improve productivity, and ensure operational excellence. By embracing CIM concepts and implementing innovative solutions like the Automatic Material Handling System, we are poised to achieve significant improvements in manufacturing efficiency and competitiveness.

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