REDESIGNING OF A WAREHOUSE FACILITY LAYOUT FOR IMPROVING THE INVENTORY MANAGEMENT SYSTEM: A CASE STUDY

Supervised By
Prof. Dr. Shamsuddin Ahmed

Performed By
Syed Muqsit Razee (121422)

Department of Mechanical and Chemical Engineering (MCE)
Islamic University of Technology (IUT)
Organization of Islamic Cooperation (OIC)

ABSTRACT

Warehouse layout is a classical production problem in engineering environment. Warehouse design often has a significant impact on the performance of a manufacturing plant. In modifying the warehouse floor layout, main issue that needs to be concerned is the impact on system performance due to the changes made. Improvements in terms of time delays, frequency of material flows and efficiency of line will contribute to the reduction of production cost.

Neither an algorithmic nor a procedural layout design approach is usually an effective way in solving a practical layout problem. This paper applied the simple procedural methodology for the generation of suggested system, namely Systematic Layout Planning (SLP) approach. This approach analyses the layout problems through the usage of easy understanding analytical tools.

The suggested system focuses on the redesigning of the workstations for more visible value adding workstation arrangement in the warehouse. The system was evaluated through the line balancing issue and space distribution. Changing material handling equipment and space arrangement of all the equipment directly improves of flow within the warehouse.

Implementation of a new layout is a time consuming process and a big investment is required for making the changes. Even no practical analysis is possible for observing the improvement(s) made, hence the improvement was proved through a heuristic way in this project.

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Lastly, I would like to thank my parents and all my fellow friends who have been helping me throughout the completion of this project. Thanks for their willingness in sparing their precious time with me.

Thank You.

DECLARATION

This is to declare that the project "Redesigning Of A Warehouse Facility Layout For Improving The Inventory Management System: A Case Study" and related audit were carried out by the authors under the supervision of PROF. DR. SHAMSUDDIN AHMED, Department of Mechanical and Chemical Engineering, Islamic University of Technology (IUT).

_____

PROF. DR. SHAMSUDDIN AHMED

Professor

Department of Mechanical and Chemical Engineering

Islamic University of Technology (IUT)

_____

SYED MUQSIT RAZEE

Student ID - 121422

Phone- +88 01752 614 319

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CHAPTER 1 : INTRODUCTION

1.1 IMPORTANCE OF THE STUDY

Flexible facility layout is essential for competitive advantage in many manufacturing settings. When manufacturing companies find themselves are in rushing to keep in pace with the rising of demands, this is the moment for them to improve their production system. In order to increase the throughput, companies need to address to the issues of improving the resource's capability and flexibility. This study attempts to identify how such a system is going to benefit a real-life manufacturing industry.

Continuous improvement in the manufacturing performance is attainable when the plant used has value analysis and is adoptable for future requirements. The enhancement is necessary because:

i) Material handling cost allocates large fraction of total manufacturing costs and

ii) Rearrangement are always costly in terms of both time and money.

Facility layout has a dramatic effect on the productivity of a manufacturing company. In this study, areas listed below will be further focus on:

i) Improvement on workflow through a coherent task planning

ii) Ease of material handling

iii) Highlight bottlenecks and reduce them

iv) Reduce production time, maintenance and man power needed

v) Make production activities more visible

1.2 PROBLEM STATEMENT

A case study is carried out in a mid-sized Warehouse. The existing discrete storing space influences the movement of workers and thus delay in the distribution performance.

Besides, the current settings on limited floor area hinder the smooth material movement. The space availability for the warehouse activities is limited due to the size of racks and work-in process(WIP). The narrow aisle promoted for the movement of carts is 1.7 times of the width of unit load size. Furthermore, there are two ways flows occur. Thus, the aisle width should equal to the sum of aisle widths required in each direction. Proper aisle helps to avoid facilities congestion and reduce the occurrence of accidents. Types of material handling used also need to be considered for optimizing the capacity of resources.

Rapid rising of customer demand is a big challenge for the company's production scheduling. The existing management system which is based on rigid sequence and traditional understanding limits the growth of production. Thus, the company needs to improve the plan of storage in a warehouse for keeping pace with the dynamic market.

1.3 OBJECTIVES

- To evaluate the performance of the current warehouse layout in terms of performance delay, non-value adding activities and movements, and frequency of right material handling in a warehouse.

- To identify the factors which affect the effective and efficient arrangement of workstations and production flow pattern.
- To modify the new rules and patterns for effective traffic flow by generating alternative layouts with methodological approach.

1.4 SCOPES AND LIMITATIONS

- Ability to analyze the impact of distance, cycle time and material handling cost on proposed layouts.
- Ability to examine the facility design problems with methodological approaches.
- Constraints of man power limitation exists.
- It requires large amount of time and money to reconfigure the fixed warehouse.
- Fixed position of some equipment arrangements due to the wiring and maintenance issues.

1.5 METHODOLOGY AND WORK PLAN

The work schedule is presented in Figure 1.1 in the form of flow chart. Below is the summary of the methodology.

1. Literature review on the published work such as journals, books and articles.
2. Preparation of an implementation framework.
3. A manufacturing plant is chosen to conduct a case study.
4. Data collection from the plant through observation, questionnaire and interview with the operation manager and employees.

1.6 CONTRIBUTION OF THE STUDY

Redesigning facility layout is a long term approach for improving the performances of a company. Good layout helps to improve the business performance of a company by providing the competitive advantages in industry.

The major concerns for redesigning the new facility system are to reduce the production cost and increase the production rate at the same time. Several techniques and management tools used in facility planning aimed to improve the manufacturing activity, through reducing of time delays and distance travelled for the movement; improving product's quality by reducing damages, defects and wastage generated; increasing the efficiency and effectiveness of machines and labors; more flexibility for the material handling system.

1.7 ORGANIZATION OF THE THESIS

The text consists of five chapters. A standard format is used throughout the thesis. Each chapter begins with an introduction of the chapter. Chapter one covers the importance of this study, the objectives and scope of the study. Chapter two discusses the literature review for this thesis. Chapter three covers the details on research design. Chapter four deals with the data collected and data analysis. Chapter five provides discussions on the findings of chapter four and draws conclusion.

1.8 PARAMETERS OF A WAREHOUSE FACILITY CONSIDERED FOR THIS THESIS PROJECT

1) Shape of Warehouse Facility
2) Warehouse Storage System
3) Material Handling Process
4) Material Picking Strategies
5) Type of Inventory Being Stored
6) Inventory Management System

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

Facility planning is an iterative process for continuous improvement. By reviewing the facility as a dynamic entity, there is a challenge for the facilities planner to come out with an adaptability layout. Along the process, the characteristics of layout, material handling requirements, size of unit load, storage strategies and overall building impact need to be taken into account. A need for warehouse rearrangement is a must when there is a changing requirement of product, process of management philosophies. The new flexible layout must be ale to adapt to changes for future requirements.

Facility problem can be solved by algorithmic or procedural approaches. Algorithmic approaches are mainly focusing on the minimization of flow distance and thus the material handling costs. As Procedural approaches are extremely dependent on the experience of designer or experts [4], SLP is one of the most popular procedural approach which is used in designing process layout.

Generally, there are three types of Warehouse Layout, namely U-Shaped, L-Shaped & I-Shaped warehouse layouts. The suitability of each type is dependent on material flow process, space available and activity relationship [1].

Material handling is an important function in facility planning. In fact, material handling is one of the first places to look for cost reductions and quality improvements. Minimize or even eliminate the material handling means reducing the production cost. Thus, the design and layout of warehouses must be integrated with the design of the materials to be stored.

2.2 DEFINITION OF SUPPLY CHAIN MANAGEMENT

A “Warehouse” is a facility that ensures the availability of products, as per the sales requirements through efficient channel management at a right product, right model, right place, right time, offering at a lowest price, procuring from the cheapest source available in the world through maintaining the best possible relationship with the suppliers and finally by maximizing the profit margins to the organization through reducing the cost in every possible channels (From sourcing up to reaching customer) through breaking all ugly inter-departmental walls in an organization and through minimizing the level of inventories.

2.3 DEFINITION OF WAREHOUSE

A large storage facility where raw materials, manufactured goods, unfinished goods, equipment, parts and all other logistical accessories are stored before their export or distribution for sale (Islam S. , 2015).

2.4 WAREHOUSE OPERATIONS

A. Receiving

1) Schedule Carrier
2) Unload Vehicle
3) Inspect for Damage
4) Compare to P/O

B. Warehouse Processes

Put Away

1) Identify Product
2) Identify Storage Location
3) Move Product
4) Update Product

Storage

1) Equipment
2) Stock Location
3) Stock Popularity
4) SKU size
5) Cubes requires

Order Picking

1) Information
2) Walk & Pick
3) Batch Picking
4) AS/R

Shipping Preparation

1) Packaging
2) Labelling
3) Staging

C. Shipping

1) Schedule Carrier

2) Load Vehicle

3) Record Update

Shown in the figure below, is a typical warehouse process flow.

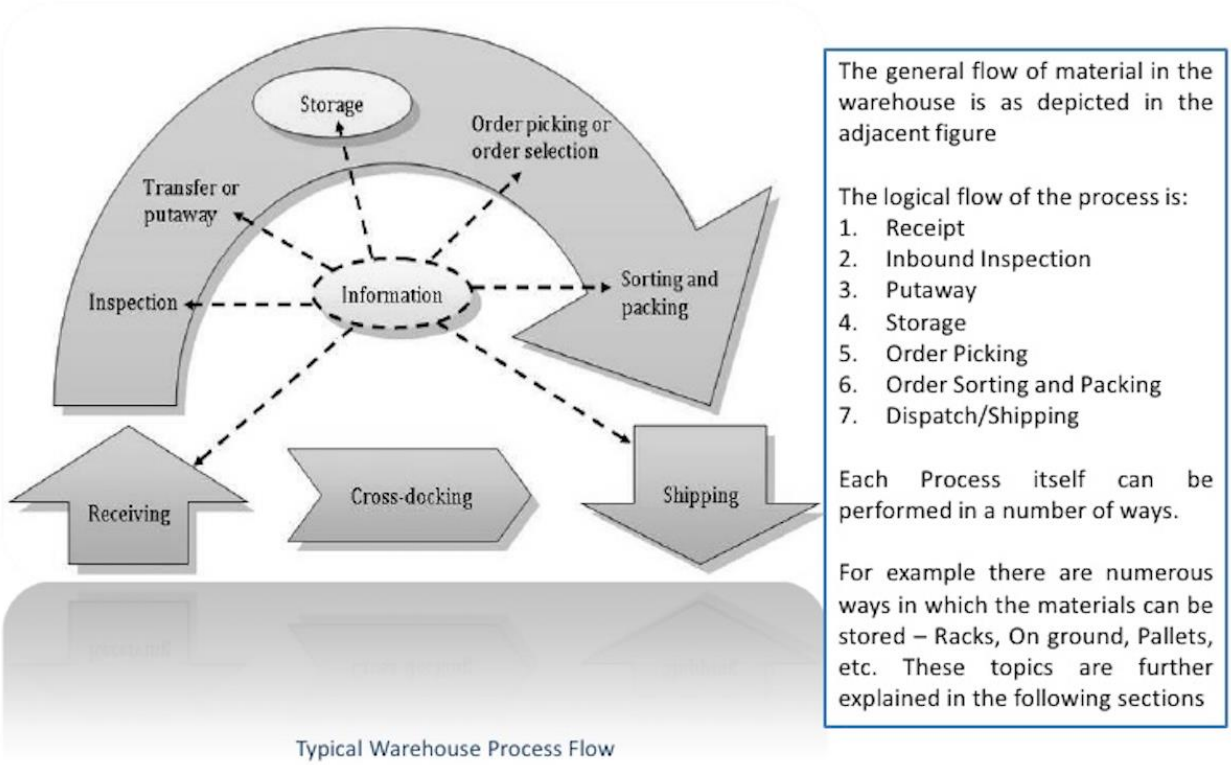


Figure 2.1 Typical Warehouse Process Flow

2.5 BASICS OF WAREHOUSE MANAGEMENT

A. Role of a Warehouse

1) Execute more, smaller transactions
2) Handle and store more items
3) Provide more product service and customization
4) Offer more value-added services

B. Objectives of Warehouse Management

1) Ensure the appropriate resources (labor, equipment, facilities etc.) made available to meet business requirements.
2) Organize daily in-out movement of goods defined by purchase and delivery requirements.
3) Plan, monitor and maintain utilization of all resources to provide an on-going cost effective service within the financial and business volume criteria

C. Accountabilities & Responsibilities Of A Warehouse Manager

1) Effective use of manpower, equipment and space.
2) Efficient operation of the flow of goods from receipt to dispatch.
3) Maintenance of systems for operational management and control.
4) Inventory value, accuracy and volume.
5) Safe conduct of operations.
6) Prompt goods receipts and put-away to appropriate locations.
7) Prompt retrieval and dispatch of goods to meet service level.
8) Continuous review of stock location to optimize travel distances.
9) Continuous review of space to maximize utilization.
10) Maintaining all operating procedures and standards.

2.6 WAREHOUSE FACILITY PLANNING

Facility planning determines how an activity's tangible fixed assets best support achieving the activity's objectives [1]. The two major steps in planning process are determination of facility's location and design. Facility location addresses the macro issues whereas facility design focuses on the micro elements. In fact, the facility location acts as an interface for the customers, suppliers and other facilities. The hierarchy of warehouse planning is shown as in Figure 2.1

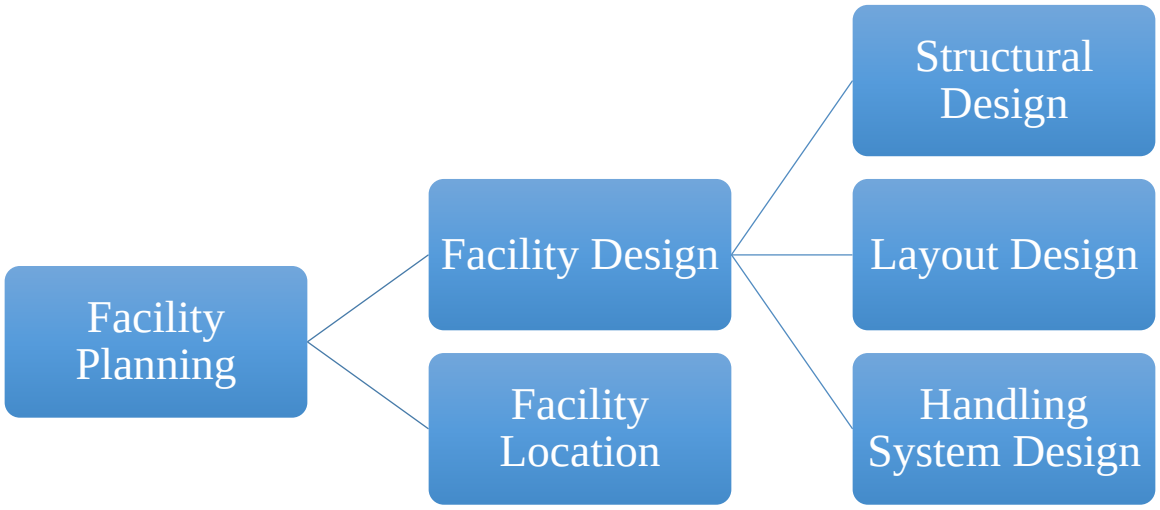


Figure 2.2 : Facility Planning Layout

2.7 TYPES OF WAREHOUSE FACILITY LAYOUTS

1) I-Shaped Warehouse Facility
2) L-Shaped Warehouse Facility
3) U-Shaped Warehouse Facility

2.8 CENTRALIZED AND DECENTRALIZED WAREHOUSE FACILITIES

Table 2.1 Comparison Between Centralized and Decentralized Warehouse Facilities

	Centralized	Decentralized
Inventory Position	↓	↑
Economy of Scale	↑	↓
Operating Cost	↓	↑
Customer Satisfaction Level	↓	↑
Inbound Transportation Cost	↓	↑
Outbound Transportation Cost	↑	↓
Level of Efficiency	↑	↓
Level of Responsiveness	↓	↑

2.9 CLASSIFICATION OF INVENTORIES STORED IN A WAREHOUSE

Table 2.2 Classification Of Inventories

Inflammable Requirements	Special Security Items
Perishable Items	General Commodities

2.10 TYPES OF INVENTORY MANAGEMENT SYSTEMS

1) Fixed Order Quantity/Q-System
2) Fixed Order Interval System/P-System

2.11 CLASSIFICATION OF STORAGE SYSTEM

A. Common Types

1) Block Stacking
2) Drive-Through Stacking
3) Drive-In Pallet Racking
4) Adjustable Pallet Racking
5) Push Back Pallet Racking

Block Stacking

Table 2.3 Advantages and Disadvantages of Block Stacking

Advantages	Disadvantages
Lower Capital Cost as no storage equipment required	Limited stacking height – if building higher than 6m, then the space use is inefficient
Good use of floor area	LIFO stock control in a row
Simple to control and manage	Access is limited to facing pallets
Suitable for high storage volume SKUs	Increased fire or contamination risk
Flexibility to re-layout the storage space if required	Increased risk of product damages
	Limited access to scan pallet labels during inventory checks

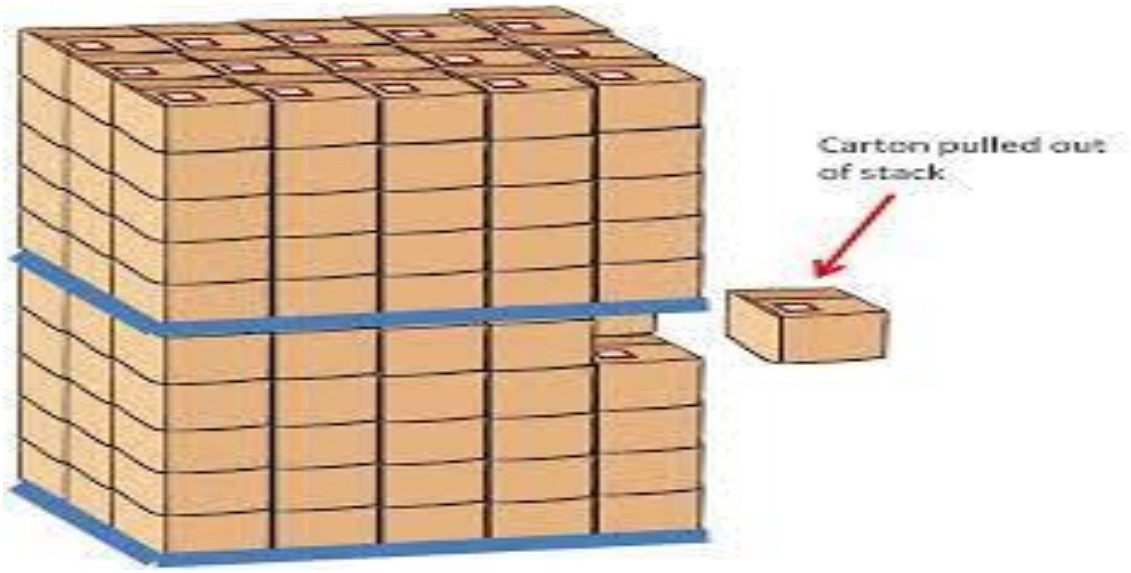


Figure 2.3 Block Stacking

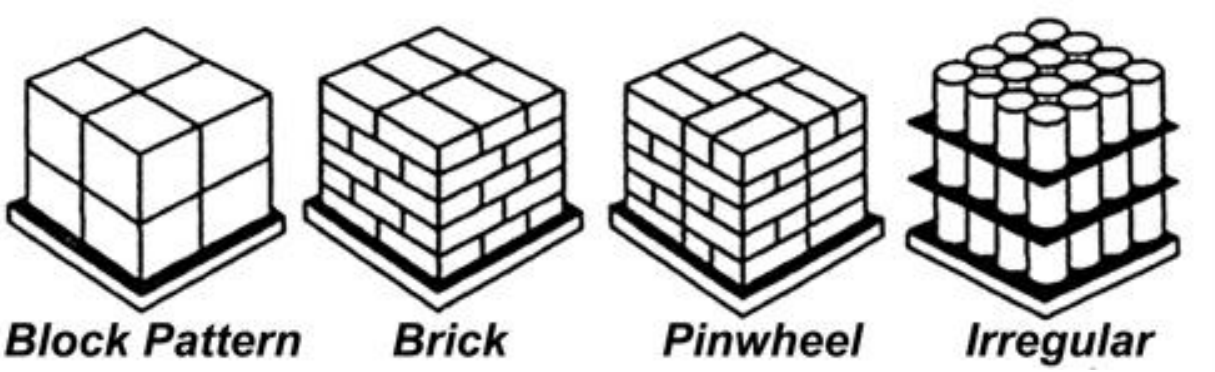


Figure 2.4 Block Stacking Types

Drive Through Stacking

"Drive Through" racking is similar to the "Drive-In" racking concept; The key difference is that pallets are retrieved from the opposite end of the rack. FIFO can be ensured, but more space is required inside the warehouse due to the additional aisle that is required

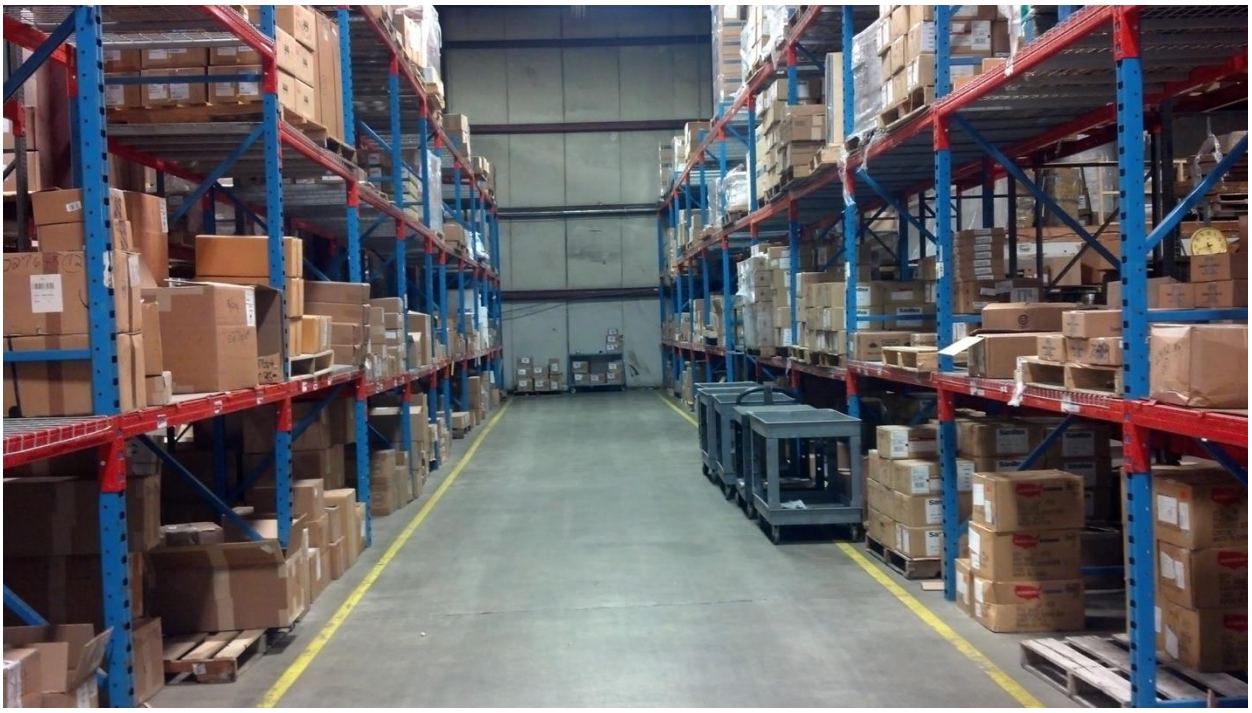


Figure 2.5 Drive Through Stacking

Table 2.4 Advantages & Disadvantages of Drive Through Stacking

Advantages	Disadvantages
Good use of floor area	Capital costs are higher than for block stacking due to racking equipment.
Efficient use of building height	LIFO stock control in a row for “drive in” racks
FIFO stock control allowed for “drive through” racks	Access is limited to facing pallets
Simple to control and to manage	Limited access to scan pallet labels during inventory checks
Suitable for high storage volume SKUs	Less flexibility to redesign layout
	Slower put away and retrieval than block stacking

Drive-In Pallet Racking

Using minimal space for access aisles and lanes, Drive-in racking provides a high-density and very space-efficient bulk storage system

With the first pallet into a lane being the last out, stock selectivity is restricted, but when loads are delivered and dispatched in batches, this is not a difficulty. Pallets are stored on runners in the depth of the racking and trucks enter to deposit or retrieve loads.

For maximum utilization of both cubic and floor space by providing pallet storage at up to 11m, Drive-In system has unsurpassed structural strength and stability, with single-section uprights and rails and double bolt rail fixing into each upright.

Figure 2.6 Drive-In Pallet Racking

Adjustable Pallet Racking

Easily installed, cost effective and versatile, adjustable beam racking is the most widely used pallet storage system and allows 100% direct access to each pallet stored.

With adjustable beams, racking can be reconfigured to accommodate changes in the type of goods stored and wide aisles allow access by all types of trucks, making specialized handling

equipment unnecessary. Although racking is adjustable, once the beams are slotted into position in the frame upright, an interlocking structure of grate strength and rigidity is maintained.

Figure 2.7 Adjustable Pallet Racking

Push Back Pallet Racking

Push-Back racking is amongst the most space and time and time efficient pallet storage systems available.

Pallets are loaded in sequence on to wheeled carts or rollers and are pushed back along inclined beds. Pallets can be stored up to 10 deep and when a load is retrieved, the remaining pallets roll forward into position at the picking phase. Selectivity is “FILO” and with each product

having a dedicated lane, dynamic push back racking is particularly useful in marshalling areas and for bulk storage and handling.

Figure 2.8 Push Back Pallet Racking

Table 2.5 Advantages & Disadvantages of Push-Back Pallet Racking

Advantages	Disadvantages
The lower positions can be used for case picking with a reserve pallet	Beam on bottom disturbs action while picking
Easy to manage	Second pallet is not accessible for label scanning
Relatively cheap	LIFO of 2 pallets
Relatively good use of space	

B. Specific Types

(As per business requirement)

1) Push back Racks
2) Satellite Cart Racking
3) Live / dynamic storage also called flow through racks
4) Mobile racks

C. Design aspects for selection of Storage Type

1) No. of SKUs to be stored
2) Requested throughput
3) Product and packaging stack-ability and resistance
4) Pallet stacking ability
5) Order profile (full pallets versus picked pallets)

6) Stock rotation policy and management
7) Operation and investment costs such as costs and availability of land, cost of capital, cost of labor (depends on local know-how/expertise)

2.12 PICKING STRATEGIES

1) Man-to-goods
2) Goods-to-man
3) Pick-to-belt
4) Automatic picking

2.13 PICKING EQUIPMENTS

Manual Hand Pallet Trucks

These are cheap and suitable for light loads and short distances. They can carry one pallet or one roll.

Electric Pedestrian Operated Operated Pallet Trucks

These are recommended for heavy products and long distances. If the truck is equipped with long forks, it can carry 2 pallets or 3 rolls.

Powered Pallet Trucks

These are recommended for picking with long distances, although they are more expensive.

Horizontal Order Pickers

These are recommended for heavy products and long distances. Equipped with long forks, it can carry 2 pallets or 3 rolls.

High-Level Order Pickers

These (Man-Up Turret Truck) are used for picking at high level from pallets in racks (Narrow Aisles)

Rolls

These can be used for the picking and are mostly used for picking ice-cream and chilled products

2.14 WAREHOUSE MATERIAL HANDLING PROCESS

The recommended material handling process is as follows:

Receiving

- Vendor arrival and attend as per serial
- Document Checking (PO, Bill, Challan etc.)
- Unload and move to receiving area
- Physical verification of Quantity, Expiry, Getup, Item Description with PO, Importer Sticker, BSTI Seal, Country of Origin etc.
- If any mismatch found with system MRP/TP and Barcode, communicate with procurement and product to move to quarantine till update the information or reject.
- Prepare final correction of Challan (quantity) & Bill (quantity and amount) based on procurement feedback
- Complete system GRN/Manually receive
- Take corrective measure through instant return in cash of wrong GRN (if any)

Shelving/Storage

- Shelving of received SKUs should be done by next working days.
- FIFO method must be followed.
- SKUs which are carrying shelf life, must follow First Expiry First Out (FEFO) method during shelving.
- SKUs which have inactive/conflicting Body Barcode, Paste MB Internal Barcode.
- Do not paste internal barcode on the top of the product name.
- If bulk breaking is not possible, then insert same quantity of printed barcode inside the box/pack.

Order Receive, Picking and Shipping

- CWH receive requisition from outlet as per delivery schedule.
- Prepare distribution route plan and update the “Route Plan Notice Board”.
- Manually check the on – hand stock availability based on requisition and verify site listing.
- Prepare final list for picking and print it category wise.
- Distribute print copy to concerned supervisor of related section.
- Outlet-wise physical product picking (weight/count) from shelf.
- Pick “Promotional Free Items” as per required quantity.
- Prepare System Stock Transfer Order (STO) and print system pick list.
- Prepare new box for picking items (Bulk-Break) as per outlet requisition.
- Verify/re-count as per final pick list quantity and put serial number on the new box.
- Mark with special security tape (Red Tape) on sensitive items.
- Prepare system transfer Challan/manual Transfer Challan and print.

- Post the system transfer Challan and do the system outbound for data synchronization.
- Update manual transfer into system (if any).
- Write the box serial number on printed transfer Challan.
- Collect printed transfer Challan (with box number) and “Free Item Manual Challan” from concerned section and verify system posting.
- Communicate CWH-MIS to complete the system Post (If posting is pending).
- If outside Dhaka distribution, purchase and process ice. Prepare the frozen box with ice. Also need to prepare a “Gomon Adesh” (Common) for in transit authorization.
- Load prepared boxes into trolley and move to outbound area.
- Recheck on-hand availability based on recently SKUs (Zero Stock Checking) and do the above process to send those (if any).
- Assign driver, escort and confirm vehicle route plan.
- Compile all transfer documents (Tranfer Challan, Vehicle Gate Pass, Manual Challan for Free Items etc.)
- Load the vehicle (Category-wise)
- Handover the product to outlets. Attempt queries and problem solving.

2.15 U-SHAPED WAREHOUSE FACILITY

This is the most optimum layout shape of a Warehouse Facility

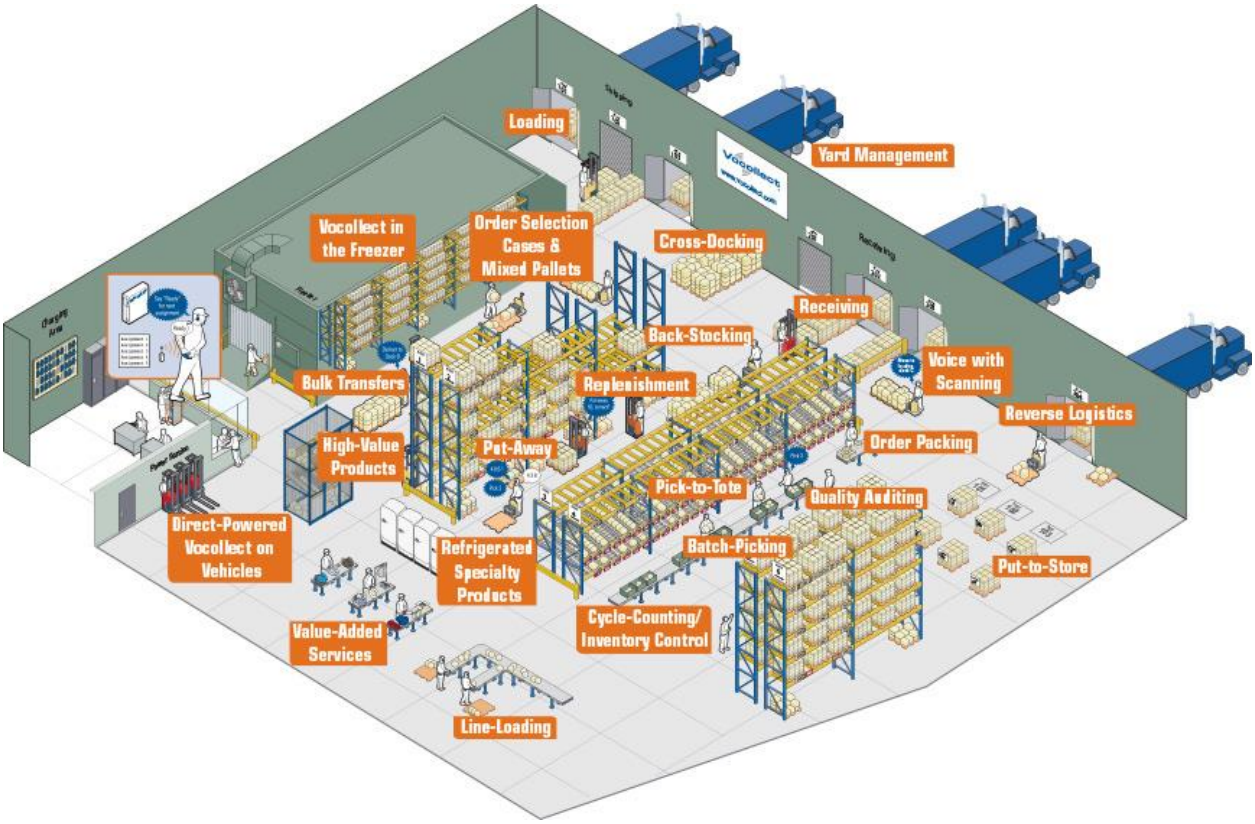


Figure 2.9 U-Shaped Warehouse Facility Layout

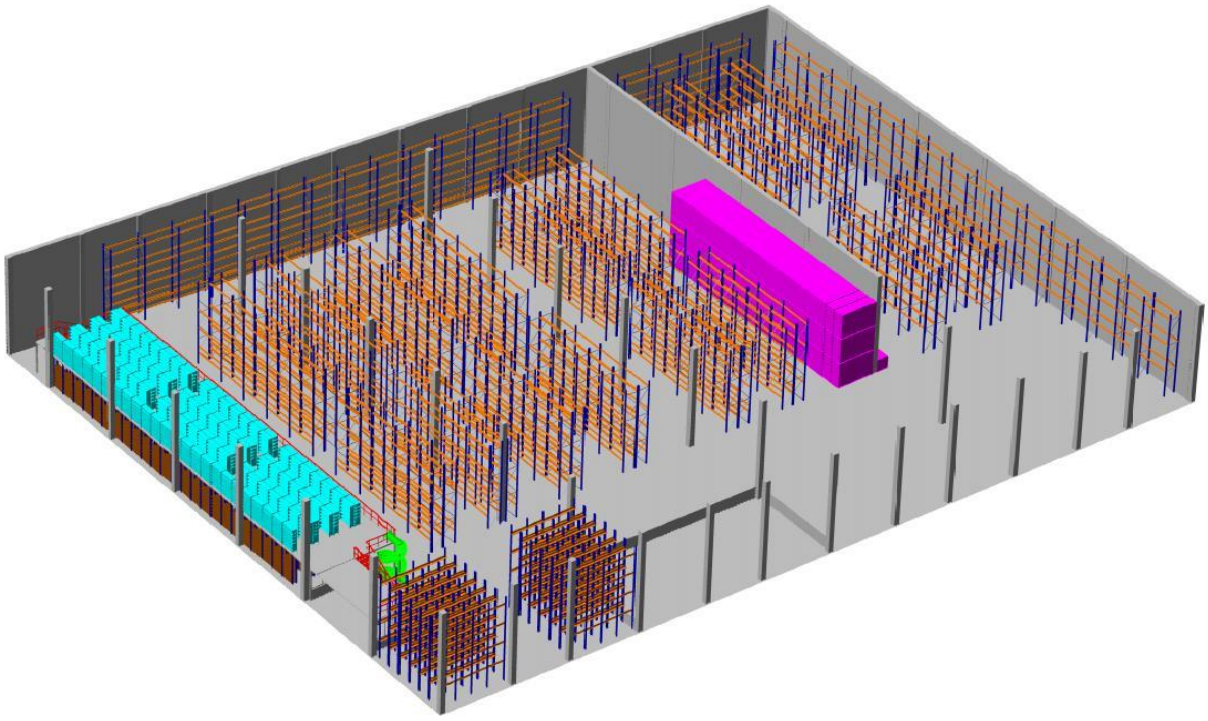


Figure 2.10 U-Shaped Warehouse Facility Layout Schematic

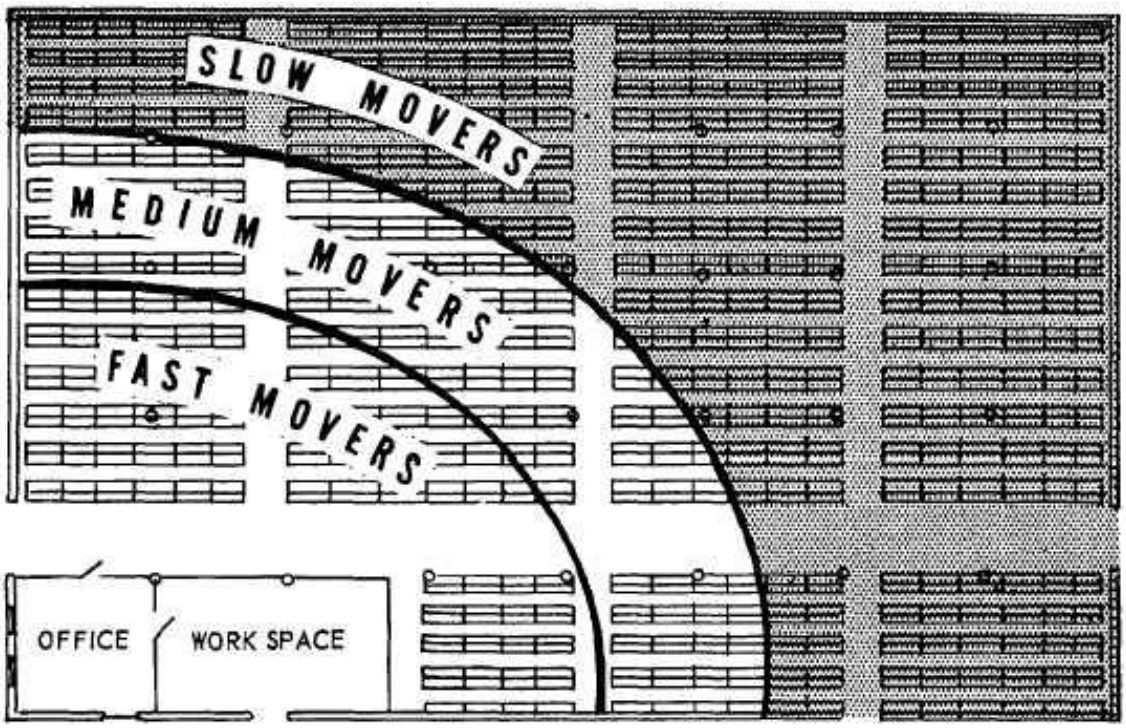


Figure 2.11 Inventory Grouping Schematic In A Warehouse Facility

2.16 5S STRATEGY

The 5S is an effective management tool which can improve housekeeping, environmental conditions and health and safety standards. Results of 5S are visible within short period of time. Besides Employees in the organization become more active and self disciplined.

The 5S are as follows:

1) Seiri (Sort)
2) Seiton (Set in Order)
3) Seiso (Shine)
4) Seiketsu (Standardize)
5) Shitsuke (Sustain)

The working environment can be improved by applying a good housekeeping, 5S in the warehouse. ‘5S’ is a Japanese term describing five basic principles in housekeeping. ‘Seiri’ means the removal of unnecessary things. ‘Seiton’ means putting everything in order. ‘Seiso’ means cleanliness. ‘Seiketsu’ stands for standardization. Lastly, ‘Shitsuke’ means commitment to the other four. Besides a good housekeeping, ergonomics should be taken to account.

Documentation is required to describe appropriate procedures in order to ensure a system of standard procedures is applied to the quality control of the product. Types of documentation includes work instructions, control procedures & quality manual. These documents are to be controlled so that everyone needs to use a document has easy access to it and only the current version of that document is available at any time. This is to avoid confusions and mistakes.

The cooperation & teamwork between departments can be improved by having cross functional team or applying concurrent engineering. Both of this methods allow the employees from different departments to work together. This way the conflicts and misunderstandings could be avoided.

2.17 TOTAL PRODUCTIVE MAINTENANCE (TPM) STRATEGY

Productive maintenance carried out by all employees through small group activities and can be viewed as equipment maintenance performed on a company-wide basis. TPM allows one to reorganize the company as a whole, to achieve maximum production efficiency while minimizing losses. It's the best, proven, structured change management system for a manufacturing company. Following are the steps involved by the implementation of TPM in an organization (Nakajima, 1988)

- Initial evaluation of TPM level
- Introductory Education and Propaganda (IEP) for TPM
- Formation of TPM committee
- Development of master plan for TPM implementation
- Stage by stage training to the employees and stakeholders on all eight pillars of TPM
- Implementation preparation process
- Establishing the TPM policies and goals and development of a road map for TPM implementation

  The goal is to hold emergency and unscheduled maintenance to a minimum.

CHAPTER 3 : RESEARCH DESIGN

3.1 INTRODUCTION

This case study was conducted in a small, make to order (MTO) export-oriented garments industry. The plant chosen for case study had not applied any modern production system for waste reduction and hence justify the need of this research.

The research design was divided into four phases.

1. Reviewing literature for selecting area of work, generating problem statement and setting preliminary objectives.
2. Investigating and collecting data along with reviewing literature for selected topics.
3. Analyzing the collected data.
4. Providing solutions and recommendation according to findings.

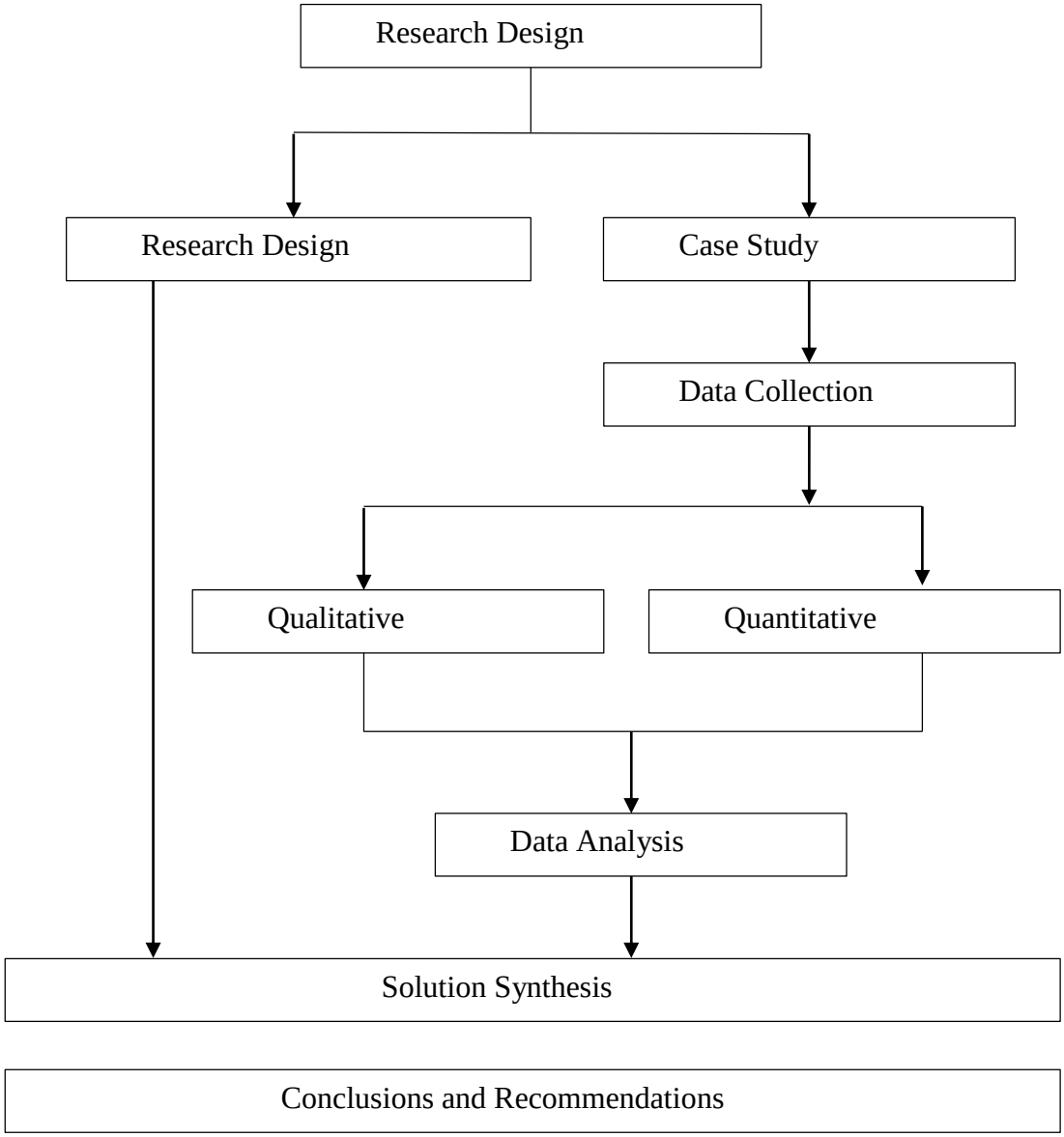


Figure 3.1 : Research Methodology Flow Chart

3.2 RESEARCH DESIGN

Phase One

The first stage was the research design phase. In order to identify a research need and finding a suitable research strategy, a review of literature was done. During this empirical enquiry, the strategy adopted was twofold comprising literature review and case study.

The literature review begins with examining the definitions of warehouse. Following this, different categories of warehouses are studied in details. Then, literature review was done for realizing the scenario of warehouses in Bangladesh in general.

Single fieldwork case study was the research strategy. The usage of case study for testing theory is strongly advocated by Yin (Case Study Research: Design and Methods, 2013). The fieldwork case study was to be done in a garments factory without implantation of modern manufacturing techniques like TQM, Lean manufacturing, JIT, TPM etc.

Phase Two

Mostly qualitative data was acquired from the fieldwork case study. This was due to the lack of available quantitative data in the company.

The research method for collecting qualitative data comprised of semi-structured interviews, open interviews and observations. Using semi-structured interview, respondents were asked to describe the overall work process of their respective divisions and were asked about the current situation. Open interviews were used to see the insight of the garments factory. Observation was to inspect activities and nature of some processes without eliciting anyone's attention.

On the quantitative side, some numerical data were collected. Since the organization did not put much emphasis on Industrial Engineering aspects, relevant quantitative data was scarce and data were collected as extensively as possible at the time.

Phase Three

At this stage, all data that were collected in the previous phase were cleaned and analyzed. This analysis phase took place my means of using different tools and techniques along with personal judgment for comprehensive outlook.

Phase Four

In this last phase, the interpretation and conclusion from qualitative and quantitative analysis of the available data was used to determine suitable solutions and provide guidelines and recommendations. Finally, conclusions of this research was drawn.

3.3 FACILITY PLANNING PROCESS

The strategies involved in the facility planning process are listed as following:

1) Formulate the problem such as determine the bottleneck division.
2) Analyze the problem and find out the reasons for it.
3) Generate alternative designs
4) Evaluate the design alternatives
5) Select the preferred design
6) Implement the design if possible

3.4 WAREHOUSE MATERIAL HANDLING PROCESS

The recommended material handling process is as follows:

Receiving

- Vendor arrival and attend as per serial
- Document Checking (PO, Bill, Challan etc.)
- Unload and move to receiving area
- Physical verification of Quantity, Expiry, Getup, Item Description with PO, Importer Sticker, BSTI Seal, Country of Origin etc.
- If any mismatch found with system MRP/TP and Barcode, communicate with procurement and product to move to quarantine till update the information or reject.
- Prepare final correction of Challan (quantity) & Bill (quantity and amount) based on procurement feedback
- Complete system GRN/Manually receive
- Take corrective measure through instant return in cash of wrong GRN (if any)

Shelving/Storage

- Shelving of received SKUs should be done by next working days.
- FIFO method must be followed.
- SKUs which are carrying shelf life, must follow First Expiry First Out (FEFO) method during shelving.
- SKUs which have inactive/conflicting Body Barcode, Paste MB Internal Barcode.
- Do not paste internal barcode on the top of the product name.

- If bulk breaking is not possible, then insert same quantity of printed barcode inside the box/pack.

Order Receive, Picking and Shipping

- CWH receive requisition from outlet as per delivery schedule.
- Prepare distribution route plan and update the “Route Plan Notice Board”.
- Manually check the on – hand stock availability based on requisition and verify site listing.
- Prepare final list for picking and print it category wise.
- Distribute print copy to concerned supervisor of related section.
- Outlet-wise physical product picking (weight/count) from shelf.
- Pick “Promotional Free Items” as per required quantity.
- Prepare System Stock Transfer Order (STO) and print system pick list.
- Prepare new box for picking items (Bulk-Break) as per outlet requisition.
- Verify/re-count as per final pick list quantity and put serial number on the new box.
- Mark with special security tape (Red Tape) on sensitive items.
- Prepare system transfer Challan/manual Transfer Challan and print.
- Post the system transfer Challan and do the system outbound for data synchronization.
- Update manual transfer into system (if any).
- Write the box serial number on printed transfer Challan.
- Collect printed transfer Challan (with box number) and “Free Item Manual Challan” from concerned section and verify system posting.
- Communicate CWH-MIS to complete the system Post (If posting is pending).

- If outside Dhaka distribution, purchase and process ice. Prepare the frozen box with ice. Also need to prepare a “Gomon Adesh” (Common) for in transit authorization.
- Load prepared boxes into trolley and move to outbound area.
- Recheck on-hand availability based on recently SKUs (Zero Stock Checking) and do the above process to send those (if any).
- Assign driver, escort and confirm vehicle route plan.
- Compile all transfer documents (Tranfer Challan, Vehicle Gate Pass, Manual Challan for Free Items etc.)
- Load the vehicle (Category-wise)
- Handover the product to outlets. Attempt queries and problem solving.

CHAPTER 4 : DATA COLLECTION & ANALYSIS

4.1 INTRODUCTION

A case study was conducted in a small, export-oriented make to order (MTO) garments factory. The plant chosen for case study had not applied any modern warehouse management system and hence justifies the need of this research. The profile of the factory is given in the next section.

Following the profile of the plant, is the description of the plant's warehouse management process. The warehouse management process is presented in the form of a flow chart for easy understanding. The analysis of the data collected qualitatively and quantitatively is presented behind this section.

4.2 PROFILE OF FIELD TRIP WAREHOUSE

Table 4.1 Profile of Field trip Warehouse

Name	**:** Shine Fashion Co. (Pvt.)
Established	**:** 2005
Company Type	**:** Foreign owned Export-oriented Composite knit garments
Production Environment	**:** Make to order
Product Varieties	**:** T-Shirts, Sweaters, Hoodies
Exporting Countries	**:** Australia, Germany, Italy, Japan, UK, USA, Spain

Figure 4.1 Shine fashion Co. (Pvt.) Ltd.

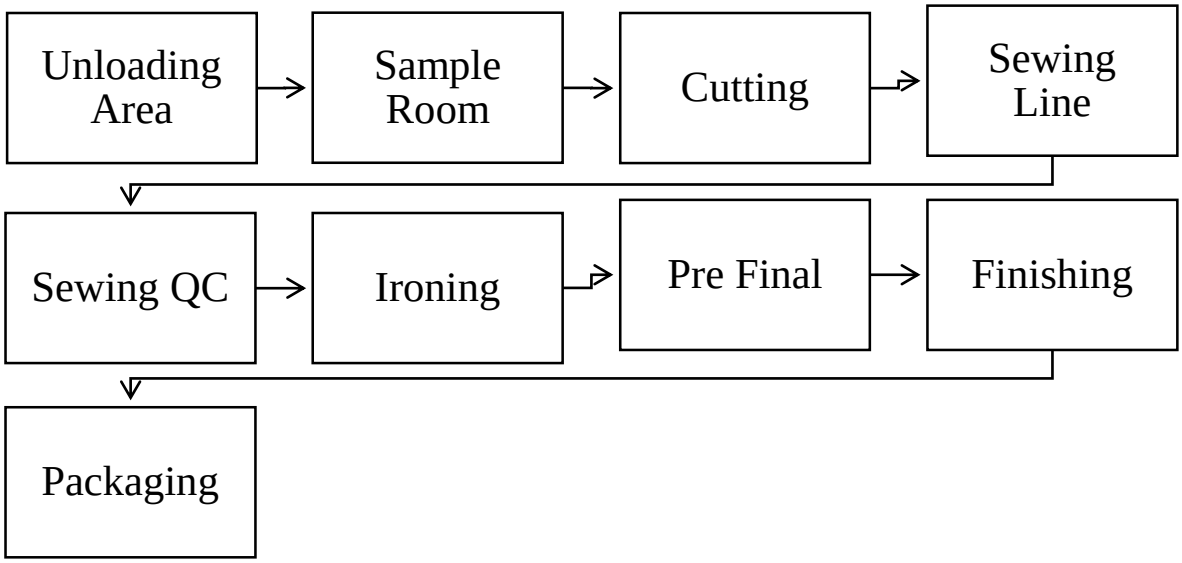
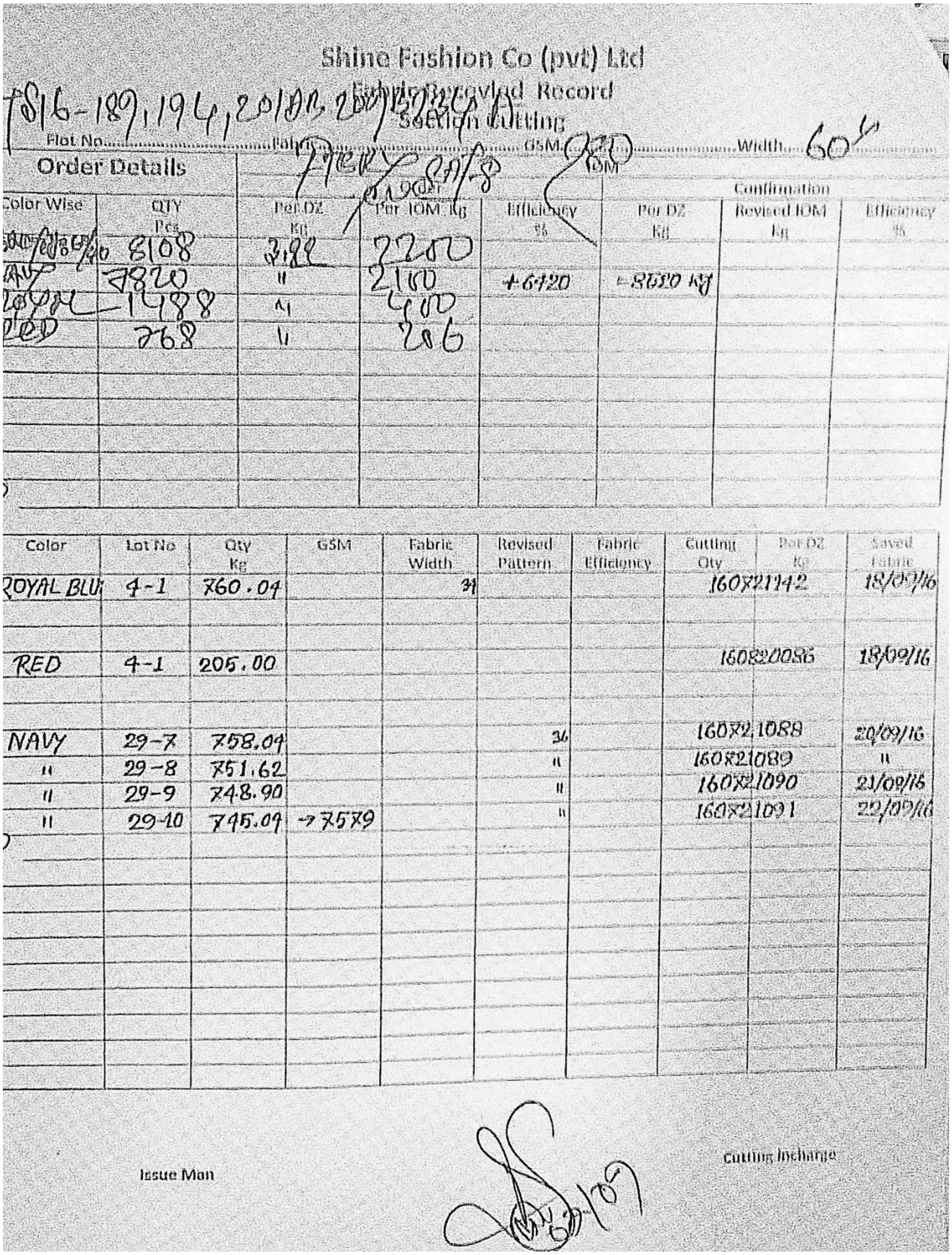


Figure 4.2 Process Flow Diagram



Shine Fashion Co (pvt) Ltd

Fabric Received Record

Section Cutting

Plot No. [illegible] Fabric [illegible] GSM [illegible] Width 60"

Order Details

Color Wise	QTY Pcs	Per DZ Kg	Per 10M Kg	Efficiency %	Per DZ Kg	Confirmation Revised 10M Kg	Efficiency %
[illegible]	8108	3.82	2280				
NAVY	7820	"	2100	+6420	=8620 kg		
[illegible]	1488	"	400				
RED	768	"	206				

Color	Lot No	Qty Kg	GSM	Fabric Width	Revised Pattern	Fabric Efficiency	Cutting Qty	Per DZ Kg	Saved Fabric
ROYAL BLU	4-1	760.04		31			160721142		18/09/16
RED	4-1	205.00					160820086		18/09/16
NAVY	29-7	758.04			36		160721088		20/09/16
"	29-8	751.62			"		160721089		"
"	29-9	748.90			"		160721090		21/09/16
"	29-10	745.04	→7579		"		160721091		22/09/16

Issue Man

Cutting Incharge

Figure 4.3 Warehouse Inventory Sample List

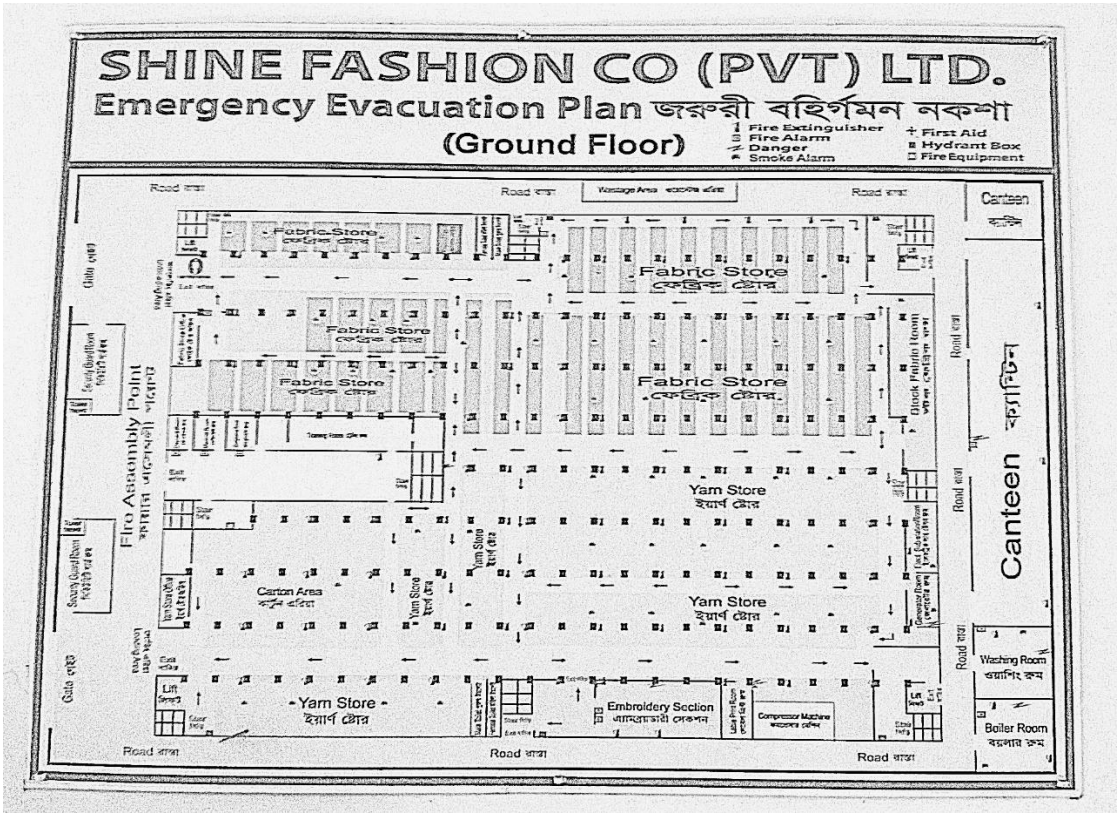
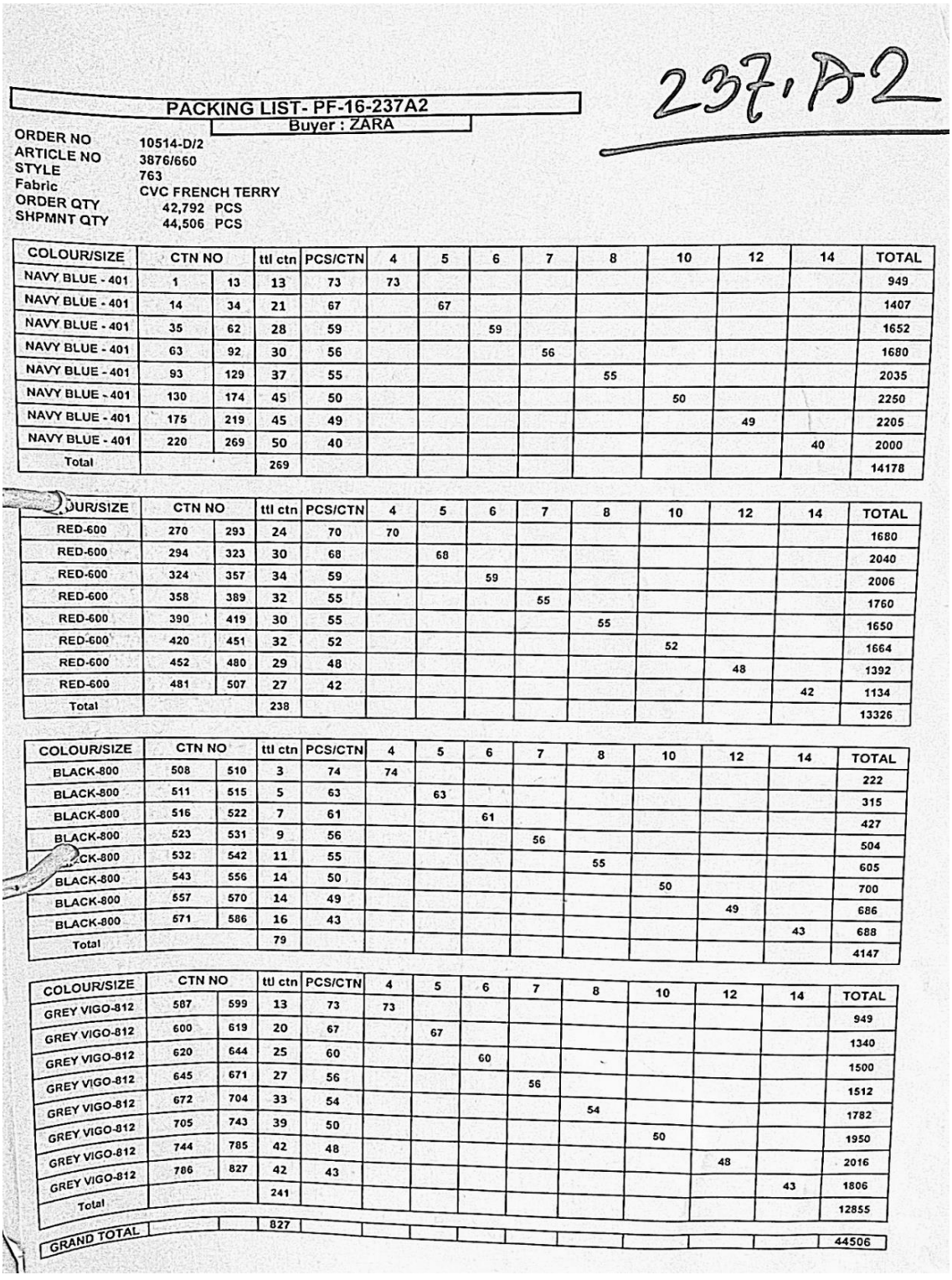


Figure 4.4 Warehouse Facility layout

Acceptable quality limits (AQL s) have been set as follows.
Zero for CRITICAL faults, 1.5 & 2.5 for MAJOR faults & 4.0 for MINOR faults;
Inspection level : 2, For Inspection , AQL level subject to Carrefour brands;

Lot size	Sample size	Classify as reject able if defective are equal to or exceed					
		For No name & Tex 1st price			For License & all other brands.		
		Critical	Major: 2.5	Minor: 4.0	Critical	Major: 1.5	Minor: 4.0
51 to 90	13	0	1	1	0	0	1
91 to 150	20	0	1	2	0	0	2
151 to 280	32	0	2	3	0	1	3
281 to 500	50	0	3	5	0	2	5
501 to 1200	80	0	5	7	0	3	7
1201 to 3,200	125	0	7	10	0	5	10
3201 to 10,000	200	0	10	14	0	7	14
10,001 to 35,000	315	0	14	21	0	10	21
35,001 to 150,000	500	0	21	21	0	14	21
150,001 to 500,000	800	0	21	21	0	21	21
500,001 and Over	1250	0	21	21	0	21	21

Figure 4.5 Warehouse Inventory AQL



PACKING LIST- PF-16-237A2

237-A2

Buyer : ZARA

ORDER NO 10514-D/2
ARTICLE NO 3876/660
STYLE 763
Fabric CVC FRENCH TERRY
ORDER QTY 42,792 PCS
SHPMNT QTY 44,506 PCS

COLOUR/SIZE	CTN NO		ttl ctn	PCS/CTN	4	5	6	7	8	10	12	14	TOTAL
NAVY BLUE - 401	1	13	13	73	73								949
NAVY BLUE - 401	14	34	21	67		67							1407
NAVY BLUE - 401	35	62	28	59			59						1652
NAVY BLUE - 401	63	92	30	56				56					1680
NAVY BLUE - 401	93	129	37	55					55				2035
NAVY BLUE - 401	130	174	45	50						50			2250
NAVY BLUE - 401	175	219	45	49							49		2205
NAVY BLUE - 401	220	269	50	40								40	2000
Total			269										14178

OUR/SIZE	CTN NO		ttl ctn	PCS/CTN	4	5	6	7	8	10	12	14	TOTAL
RED-600	270	293	24	70	70								1680
RED-600	294	323	30	68		68							2040
RED-600	324	357	34	59			59						2006
RED-600	358	389	32	55				55					1760
RED-600	390	419	30	55					55				1650
RED-600	420	451	32	52						52			1664
RED-600	452	480	29	48							48		1392
RED-600	481	507	27	42								42	1134
Total			238										13326

COLOUR/SIZE	CTN NO		ttl ctn	PCS/CTN	4	5	6	7	8	10	12	14	TOTAL
BLACK-800	508	510	3	74	74								222
BLACK-800	511	515	5	63		63							315
BLACK-800	516	522	7	61			61						427
BLACK-800	523	531	9	56				56					504
CK-800	532	542	11	55					55				605
BLACK-800	543	556	14	50						50			700
BLACK-800	557	570	14	49							49		686
BLACK-800	571	586	16	43								43	688
Total			79										4147

COLOUR/SIZE	CTN NO		ttl ctn	PCS/CTN	4	5	6	7	8	10	12	14	TOTAL
GREY VIGO-812	587	599	13	73	73								949
GREY VIGO-812	600	619	20	67		67							1340
GREY VIGO-812	620	644	25	60			60						1500
GREY VIGO-812	645	671	27	56				56					1512
GREY VIGO-812	672	704	33	54					54				1782
GREY VIGO-812	705	743	39	50						50			1950
GREY VIGO-812	744	785	42	48							48		2016
GREY VIGO-812	786	827	42	43								43	1806
Total			241										12855
GRAND TOTAL			827										44506

Figure 4.6 Warehouse Inventory Packages List

CHAPTER 5 : DISCUSSION, RECOMMENDATION & CONCLUSION

5.1 INTRODUCTION

Important findings throughout this project are discussed in this chapter. Significance of the heuristic study method used in warehouse analysis was brought out. Through the layout analysis, the problems which restrict the improvement on current settings were defined. After analyzing the activity flow within the factory, factors that affect the effectiveness of the production performance were found out.

The balancing of area allocation in each department is a crucial issue in designing a new layout. The ability of the suggested system to accommodate in the space provided was a main concern in this case study. In fact, changes made on the current layout have a direct impact on the material handling used. Line Balancing is another issue that needs to be concerned in facility planning. Comparison was made on the methods used in calculating the efficiency of system performance. Lastly, comments were given on the design criteria selected for the evaluation of proposed layouts.

5.2 DISCUSSION

The tools used in this project for analyzing the system performance are relationship diagrams and chart. Such tools are easy to use and have good interpretation of information. However, in most situations, the reliability of the information provided by this diagram and chart are not so high, since it is mainly based on the analytical skill of the observer.

5.3 IDENTIFIED PROBLEMS

1) Limited Storage capacity
2) Limited Number of Extension Racks
3) Inefficient Default Design Features (aisle, geometry etc.)

5.4 RECOMMENDATION

1) Redesign warehouse facility layout as per Systematic Layout Planning (SLP) approach standards.
2) Redesign the warehouse facility layout to one which complies with U-Shaped Warehouse format.
3) Select appropriate Storage System.
4) Select appropriate Material Handling System.
5) Inventory management should be maintained according to Fixed Quantity Q-System.
6) Implementation of 5S Strategy.
7) Implementation of TPM Strategy.

5.5 CONCLUSION

This paper presented the parameters, standards and optimum design layout for a Warehouse. The apparel industry was chosen to do this work on because

1. It is one of the most fast-growing industry of Bangladesh.
2. Base of our (Bangladesh) economy.
3. In most cases, still using old techniques.
4. Options of improving the overall system are available.

The objective of this study was to find out the important characteristic parameters which needs to be considered for designing an optimum warehouse facility.

Another objective was to reduce time delays and misappropriations inventory storage. But the implementation of this model couldn't be done as the company was not willing to implement the system.

For collecting field data, a visit was done to Shine Fashion CO (PVT) Ltd. And British American Tobacco, Bangladesh. Data related to production & quality control, as well as IE was taken from the main information center of the company.

There are several interesting avenues for further research on this issue. One avenue would be to conduct a field study to collect empirical data for the implementation of the developed assessment model. Finally, this paper can be the back bone to optimum warehouse facility layout design if empirical relations between different parameters can be evaluated.

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