DETERMINING FACTORS HAMPERING THE IMPLEMENTATION OF TECHNIQUES FOR THE REDUCTION OF PROMINENT WASTES IN EXPORT-ORIENTED GARMENTS FACTORIES: A CASE STUDY

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ABSTRACT

In the competitive global market, the position of garments industry, the most important remittance-earning industry, is deteriorating by day due to numerous reasons one of which being increase in cost. To keep up with challenges like increased compliance enforcement and quality demand, the traditional ways are failing to keep a sustainable production environment in this industry. For maintaining a sustainable production environment, it has become an absolute necessary to reduce waste in production system to the minimum. This study concerns with a case study that attempts to address different factors standing in the way of waste reduction in garments industry, the prevalent categories of wastes in the industry and practical measures and guidelines for the solution. Since the study was limited to a single export-oriented garments factory, the findings may not prove accurate for making generalized conclusions. Further study is necessary for determining comprehensive measures.

AKNOWLEDGEMENT

First of all we would like to thank our classmate Shamsul Arefin who saved us a lot of hardship by introducing us to the company on which the case-study was conducted. He, being a relative to an assistant manager of the company, enabled us to have an almost unrestricted access to the company.

Next, we would like to thank A.T.M. Kawsar, Asst. Manager (HR & Admin) of Shine Fashion Co (Pvt.) Ltd., the aforementioned assistant manager who made our experience of visiting the factory a pleasant one by his kind hospitality and eagerness to help. He made sure that all our requirements for the study were fulfilled and he, himself, provided us with a lot of information and insights for the study.

We would also like to thank the numerous employees of the company who aided us by answering our questions, participating in the interviews and providing relevant documents. They were the main sources of data based on which we have conducted the study.

Lastly and most importantly, we would like to thank our thesis supervisor Professor Dr. Shamsuddin Ahmed, who provided us with ample of literature for the study with his invaluable guidance and help without which this work might not be possible.

DECLARATION

This is to declare that the project "DETERMINING FACTORS HAMPERING THE IMPLEMENTATION OF TECHNIQUES FOR THE REDUCTION OF PROMINENT WASTES IN EXPORT-ORIENTED GARMENTS FACTORIES: 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).

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1.1. IMPORTANCE OF THE STUDY

Apparel is the main export industry of Bangladesh. This industry started its course in the late 1970s under the umbrella of the Multi-fiber Arrangement (MFA) import quotas. Relatively less restrictive import quotas for Bangladesh compared to large apparel exporters like China and India, induced the growth of the apparel industry in Bangladesh. Trade liberalization since the early 1990s, and financial sector liberalization since the mid-1980s, which eased the restrictions on foreign direct investment, combined with substantial depreciation of the currency, stimulated rapid expansion of the labor intensive apparel industry in Bangladesh (Islam, 2001).

In RMG sector of Bangladesh, there are more than 5000 garment factories (private statistics) at the current time, employing more than 12 lack labors, where 85% of the labor force is women. But, according to BGMEA the number of garment factories in Bangladesh around 4000. Now, RMG industry is the country's largest export earner with the value of over $24.49bn of exports in the last financial year. It's a great news for us that, Bangladesh is clearly ahead from other South Asian suppliers in terms of capacity of the readymade garments industry.

Though, there are various types of garments are manufactured in Bangladesh, but all the readymade garments are classified into two broad categories, where one is woven products and another one is knitted products. Woven products includes Shirts, Pants and Trousers. On the other hand, knitted product includes T-Shirts, Polo Shirts, Undergarments, Socks, Stockings and Sweaters. Woven garments still dominates the export earnings of the country. From BGMEA

website it has been seen that day by day knitted items production is increasing in considerable rate and now about 40% export earnings has achieved from knitted products (Merchandiser, 2015). Key Rating areas of today's garments are Cost Effective Strategy, New Product Development strategy, Product Diversification Strategy and Market Diversification Strategy (Merchandiser, 2015).

The garment industry of Bangladesh has been the key export division and a main source of foreign exchange for the last 25 years. National labor laws do not apply in the EPZs, leaving BEPZA in full control over work conditions, wages and benefits. Garment factories in Bangladesh provide employment to 40 percent of industrial workers. But without the proper laws the worker are demanding their various wants and as a result conflict is began with the industry.

1.2. PROBLEM STATEMENT

Reduction of waste in production may be the only way to reduce the production cost in the garments industry and effort of reducing waste are hindered to some factors which demands clear addressing. Furthermore, prominent types of wastes that are seen in the export-oriented garments factories requires extensive study in proper context for properly determining initial measures towards a sustainable waste reduction system. None of these mentioned works have been done to the necessary extent.

1.3. OBJECTIVE

- To identify key factors that hampers the reduction of waste in and export-oriented garments factory.

- To identify different categories of waste prevalent in the garments factories.
- To develop and propose suitable measures for paving the way towards implementing modern production systems for reducing waste.

1.4. SCOPE AND LIMITATION

- This work will focuses on a single export-oriented garments company. Hence the findings may not provide generalized conclusions.
- The definition and categorization of waste is based on Lean Manufacturing concept. Other perception of waste was not addressed.
- The recommendation provides a few tools for paving way to a total waste reduction system. Though they are necessary for implementing a modern production system, they cover only a partial aspect of the modern system.
- A comparative study with a modern production environment would yield greater clarity of the finding.

1.5. METHODOLOGY

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

1. Literature review on the published work such as journals, books and articles.
2. An export-oriented garments factory is selected to conduct a case study.
3. Data collection in qualitative and quantitative form by observation, interview and document collection from managers and employees.

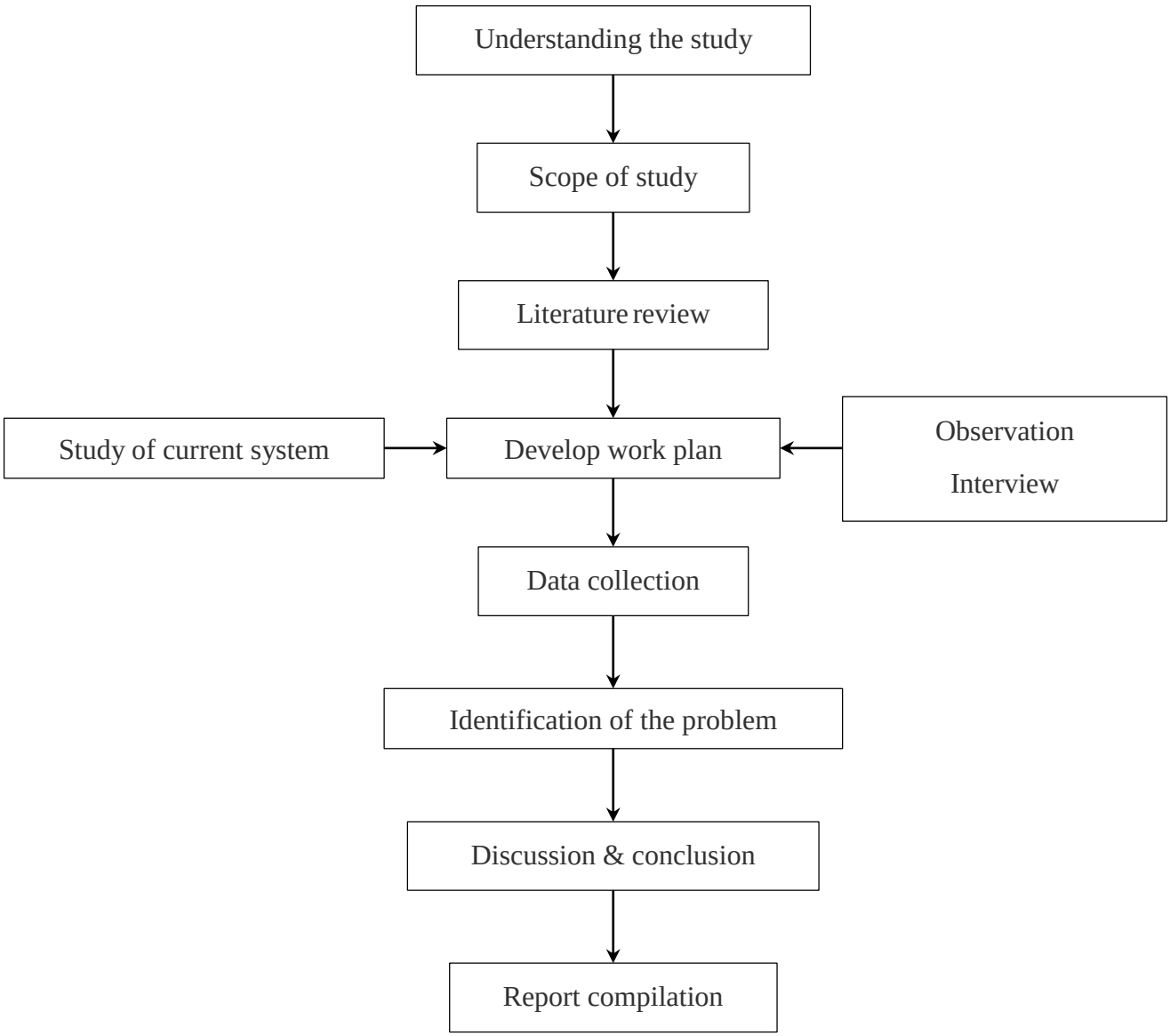


Figure 1.1 : Work Schedule Flowchart

1.6. CONTRIBUTION OF THE STUDY

This study will help in identifying the factors that are hampering in implementing modern production systems which are designed to reduce waste in an organization. Furthermore, this study

will also help to address some of the prevalent waste that are seen in garments factories in Bangladesh.

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 the scope of the study. Chapter two discusses literature review of the thesis. Chapter three covers the details on research design. Chapter four deals with the data collected and analysis of the data. Chapter five provides discussions on the findings of chapter four and draws conclusion.

CHAPTER 2 : LITERATURE REVIEW

2.1. INTRODUCTION

Due to customer demands and international competition, industry owners are searching for innovative production systems. Terms like lean manufacturing, world-class manufacturing, agile manufacturing and many others have emerged in pursuit of delivering products to the customer faster than the competitor and meeting or exceeding the "best-in-class" quality requirements. There has been a shift in the study of improvement opportunities from the past approach of focusing on the manufacturing processes or the value added process steps (Conner, 2001) to reduction of cost and waste (Strategic Direction, 2004) in recent time owing to the struggle of manufacturers with low-cost countries in global markets and teetering economic conditions.

In an internal manufacturing context, operations can be categorized into three types: non-value adding (NVA); necessary but non value adding (NNVA) and value adding (VA). The first of these is pure waste and involves unnecessary actions that should be eliminated (Hines, 1997). If attention is mostly given to value adding activities only without proper consideration of non-value adding activities like storage and transportation, minimum effect is realized in overall lead time, quality improvement and cost reduction. Conner (2001) reported that in examining lead time, the two percentages of value-added activities and non-value-added activities are found to be 5 and 95 percent respectively. When the only focus is on improving value added component of the lead-time, improvement in lead-time would be only 2.5 percent.

Hence new systems are developed aiming at increase in production efficiency and maintaining high level quality, cost and on-time delivery. Among these systems, Just-in-time (JIT)

in particular, has attracted much attention during the past decade having a well-documented success story (Daugherty, 1994) which has been shown to yield increased efficiencies and performance excellence throughout an organization. It is considered to be a combination of techniques that serve to improve product quality and reduce cost by elimination of all waste in the production system (Miltenburg, 2001). In this philosophy, the principal focal point is the elimination of all waste within a system (Daugherty, 1994).

Hence, a successful implementation of such approach or increment of the revenue in a manufacturing company in general requires an elaborate study of operations, processes and other aspects in order to identify and eliminate the waste elements. This research aims towards such a study of waste by systematic categorization and establishing means of elimination.

2.2. DEFINITION OF WASTE

Waste can be defined as anything other than the minimum amount of equipment, materials, parts, space and workers' time, which are absolutely essential to add value to the product or service. In terms of cost, waste refers to any incurred costs such as inventory, set-up, scrap and rework that do not add to the value of the product (Svensson, 2001). Flinchbaugh (2004) argued that any goal beyond delivering the right product to the right customer at the right time at the right place is waste. From an end user perspective, waste is internal and external resources that are consumed without adding value to the customers (Emiliani, 2001).

2.3. CATEGORIES OF WASTE

From a practical perspective waste can be categorized into seven categories: waste from overproducing; extra processing; inventory; transporting; producing defects; time waiting and motion waste (Shingo, 1992; Emiliani, 2001; Flinchbaugh, 2004).

4. Overproducing – An excess of products being made too early owing to continuing operations after they should have ceased.
5. Extra processing – Extra operations that are done such as rework, reprocessing, handling or storing.
6. Inventory – Comprises all inventory which are not directly required for fulfilling current customer orders. It includes raw materials, work-in-progress and finished goods.
7. Transporting – Unnecessary movement or motion of materials from one operation to other.
8. Producing defects – Finished products that do not meet customer's expectation.
9. Time waiting – Queuing of processes causing inactivity in downstream processes due to incompletion of upstream activities.
10. Motion waste – Non Value Adding steps taken by the employees or equipment to compensate for any of the previously mentioned wastes.

Womack and Jones (1996) argued of an eighth category referring to the underutilization of employees, especially ideas or creative inputs for the improvement of process and practices.

2.4. SCENERIO OF WASTE IN BANGLADESH

As most of the industries of Bangladesh haven't yet adopted modern manufacturing techniques like agile manufacturing, lean manufacturing, JIT etc., several problems still exist in the system related to:

1. **Raw materials:** Bangladesh imports raw materials for garments like cotton, thread color etc. This dependence on raw materials hampers the development of garments industry. Moreover, foreign suppliers often supply low quality materials, which result in low quality products.
2. **Unskilled workers:** Most of the illiterate women workers employed in garments are unskilled and so their products often become lower in quality.
3. **Improper working environment:** Taking the advantages of workers' poverty and ignorance the owners forced them to work in unsafe and unhealthy work place overcrowded with workers beyond capacity of the factory floor and improper ventilation.
4. **Lack of managerial knowledge:** There are some other problems which are associated with this sector. Those are- lack of marketing tactics, absence of easily on-hand middle management, a small number of manufacturing methods, lack of training organizations for industrial workers, supervisors and managers, autocratic approach of nearly all the investors, fewer process units for textiles and garments, sluggish backward or forward blending procedure, incompetent ports, entry/exit complicated and loading/unloading takes much time, time-consuming custom clearance etc.
5. **Gendered division of labor:** In the garment industry in Bangladesh, tasks are allocated largely on the basis of gender. This determines many of the working conditions of women workers. All the workers in the sewing section are women, while almost all those in the

cutting, ironing and finishing sections are men. Women workers are absorbed in a variety of occupations from cutting, sewing, inserting buttons, making button holes, checking, cleaning the threads, ironing, folding, packing and training to supervising.

6. **Safety Problems:** Because of the carelessness of the factory management and for their arrogance factory doors used to be kept locked for security reason defying act.
7. **Lead Time:** World Standard is 30-40 days in the current decade. However, in this regard the Bangladesh RMG industry has improved little; for example, the average lead time is 90-120 days for woven garment firms and 60-80 days for knit garment firms. In China, the average lead time is 40-60 days and 50-60 days for woven and knit products respectively; in India, it is 50-70 days and 60-70 days for the same products respectively.

2.5. WASTE IN RMG SECTOR

Typical wastes that still exist in garments can be classified as follows:

1. **Waste in Operations:** Walking, searching, standby, rework, change overs.
2. **Waste in Layout:** Distances traveled, backtracking, crowded conditions, redundant handling.
3. **Waste in Flow of Goods:** Overproduction, W.I.P., failure to meet standard output/ hour/ person
4. **Waste in Equipment:** Line stops, broken down / antiquated, poor production yields.
5. **Other Waste:** Poor housekeeping practices, damaged materials, improper tools, not having the right information.

2.6. PROSPECTIVE MEASURES

It is acknowledged that the implementation of JIT is one of the major factors contributing to the success achieved in the international competitiveness of Japanese manufacturing firms in the last two decades (Wu, 2003). In this case, JIT manufacturing systems consisting of systematic allocation and reduction of wasteful practices helps to reduce waste at all levels of any organization. Waste allocation and elimination have recently become an important subject of research. Numerous contemporary definitions focus on JIT as an approach to minimize waste in manufacturing and research has identified that the JIT manufacturing philosophy is dependent upon organizations continually seeking to improve their products and processes by eliminating waste (Monden, 1983).

A systematic and continuous identification and reduction of waste can lead to increased efficiency of a manufacturing system, resulting improved productivity for higher competitiveness. Generally, companies that work towards the elimination of waste in their manufacturing processes realize the following benefits: lower raw material stock and associated holding cost, reduced work-in-process, and lower finished goods inventories; higher levels of product quality; increased flexibility and ability to meet customer demands; lower overall manufacturing costs; and increased employees' involvement (Chase, 1995) (Canel, 2000). Emiliani (2001) reported that, fundamentally, poor competitiveness is caused by the existence of large amounts of waste. Reduction of these non-productive activities (waste) eventually saves time and allows more resources to be allocated to improving throughput and profitability. The principle of continuous improvement by waste elimination has been applied as an approach to improving the performance of a case production system (Ramaswamy, 2002).

Another powerful tool for diminishing waste is 5'S, which came out from TPM & TPS. 5S relates to workplace organization and forms a solid foundation upon which many organizations base their drive for continuous improvement. It is equally applicable & successful in all sectors helping to achieve high impact results. It is a systematic and methodical approach allowing teams to organize their workplace in the safest and most efficient manner.

1. Seiri, or sort is the first step in 5S, it refers to the sorting of the clutter from the other items within the work area that are actually needed. This stage requires the team to remove all items that clearly do not belong in the working area and only leave those that are required for the processes in question.
2. Seiton or Straighten is the process of taking the required items that are remaining after the removal of clutter and arranging them in an efficient manner through the use of ergonomic principles and ensuring that every item "has a place and that everything is in its place."
3. Seiso or Sweep is the thorough cleaning of the area, tools, machines and other equipment to ensure that everything is returned to a "nearly new" status. This will ensure that any non-conformity stands out; such as an oil leak from a machine onto a bright, newly painted clean floor.
4. Seiketsu or standardize is the process of ensuring that what we have done within the first three stages of 5S become standardized; that is we ensure that we have common standards and ways of working. Standard work is one of the most important principles of Lean manufacturing.
5. Shitsuke or sustain, ensuring that the company continue to continually improve using the previous stages of 5S, maintain housekeeping, and conduct audits and so forth. 5S should

become part of the culture of the business and the responsibility of everyone in the organization.

2.7. WRAPPING UP

The process of working on waste activities, however, is not an easy to achieve. The large number of variables and overlap between all the processes may cause waste activities to be concealed between other activities. The mere consideration of waste reduction brings about an important focus on the subject. Moreover, the importance of the problem is usually underestimated, and the starting point of where and how to search for waste is unclear. An additional issue is, when there are interventions to eliminate one type of waste, this may result in other waste-types being negatively affected. Such factors make it difficult to consider removing what may be considered as waste activities (Rawabdeh, 2001).

CHAPTER 3 : RESEARCH DESIGN

3.1. INTRODUCTION

This study is concerned with developing means for the identification, categorization and elimination of waste in a garments factory. This involves properly addressing practical issues that relates to waste defined in terms of lean manufacturing and relating them to relevant theories. Therefore the design of the research is important in order to achieve the objectives of this research. A case study was conducted in order to provide a real life experience and experimentation for this study.

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.

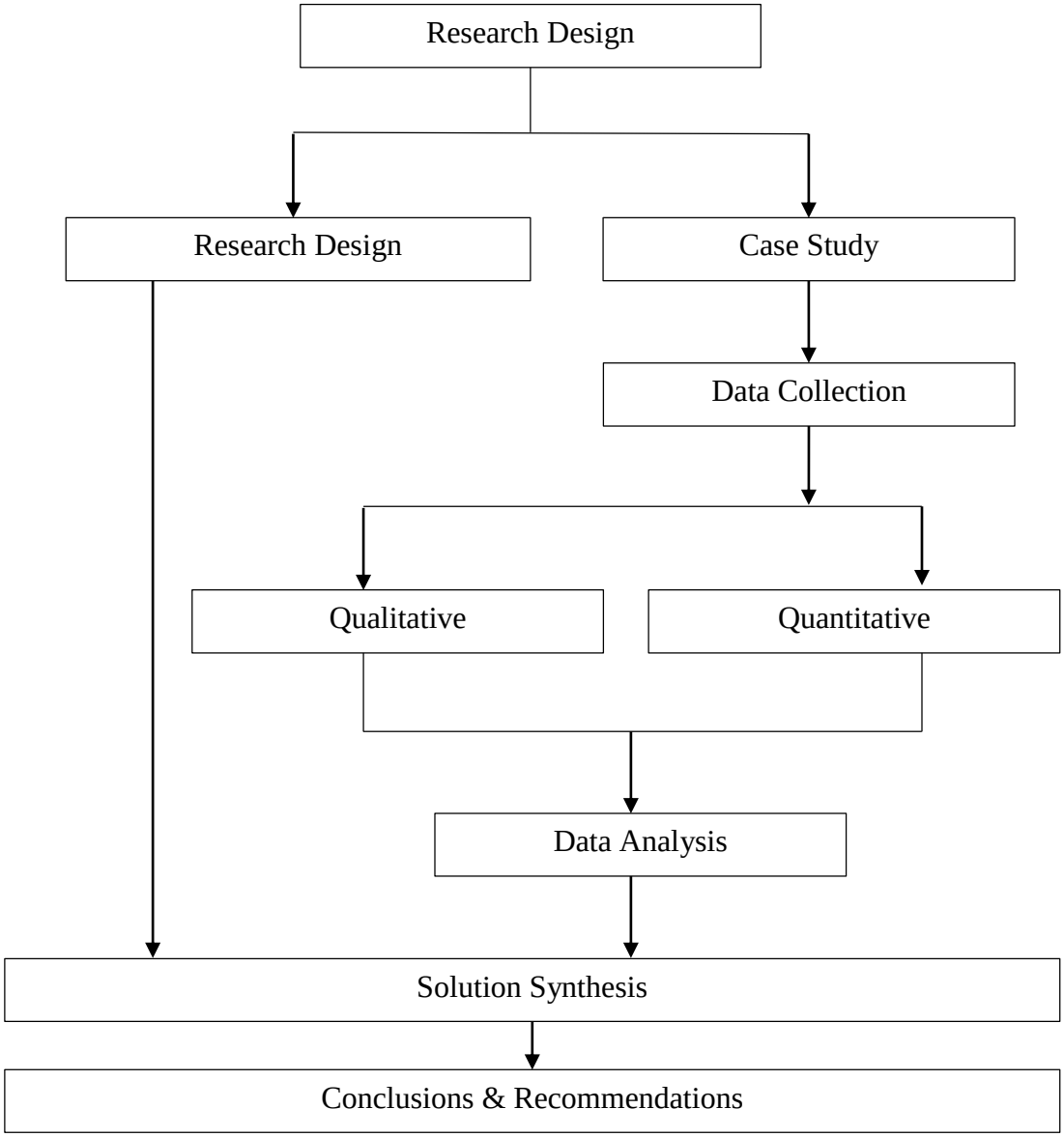


Figure 3.1 : Research Methodology Flow Chart

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 waste. Following this, different categories of wastes are studied in details. Then, literature review was done for realizing the scenario of waste 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 (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.

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 production system for waste reduction and hence justify 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 production process. The production 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. Subsequently, the identified waste and their categorization is provided.

4.2. PROFILE OF THE GARMENTS FACTORY

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 : Front Entrance of the Factory

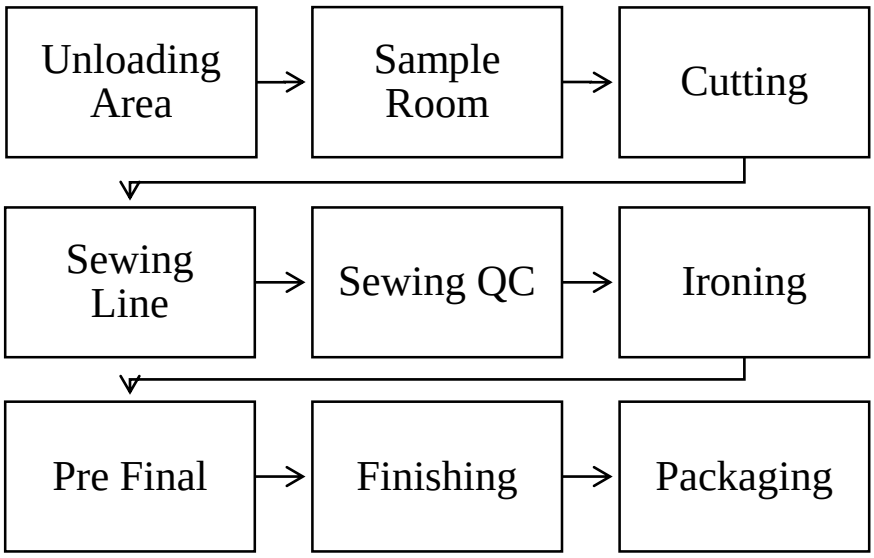
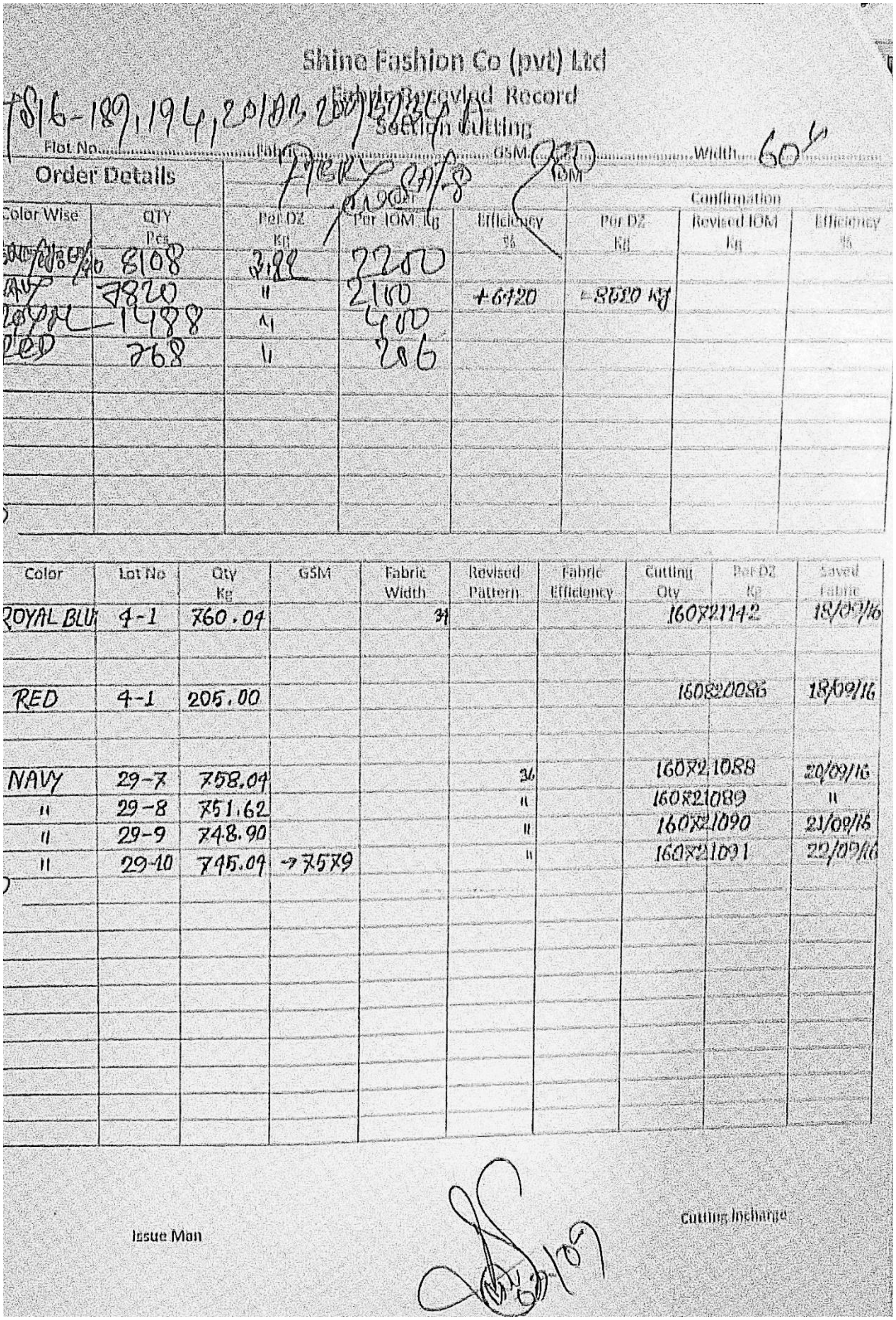


Figure 4.2 : Process Flow Diagram



Shine Fashion Co (pvt) Ltd

Fabric Received Record

Section Cutting

Plot No. Fabric GSM Width 60"

Order Details

Color Wise	QTY Pcs	Per DZ Kg	Per IOM Kg	Efficiency %	Per DZ Kg	Confirmation Revised IOM Kg	Efficiency %
	8108	3.82	2200				
	7820	"	2100	+6420	=8620 Kg		
	1488	"	400				
	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		34			160821142		18/09/16
RED	4-1	205.00					160820086		18/09/16
NAVY	29-7	758.04			36		160821088		20/09/16
"	29-8	751.62			"		160821089		"
"	29-9	748.90			"		160821090		21/09/16
"	29-10	745.04 →7579			"		160821091		22/09/16

Issue Man

Cutting Incharge

Figure 4.3 : Fabric Received Record Sample

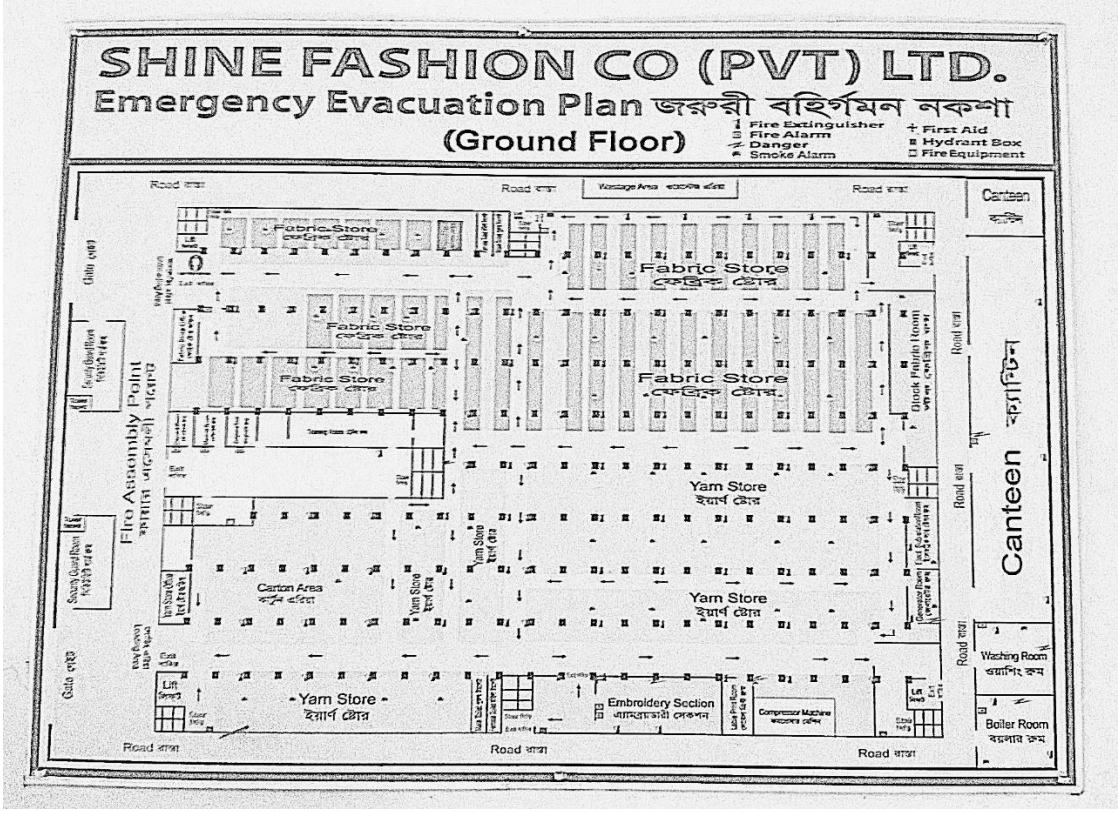


Figure 4.4 : Emergency Evacuation Plan for the Ground Floor

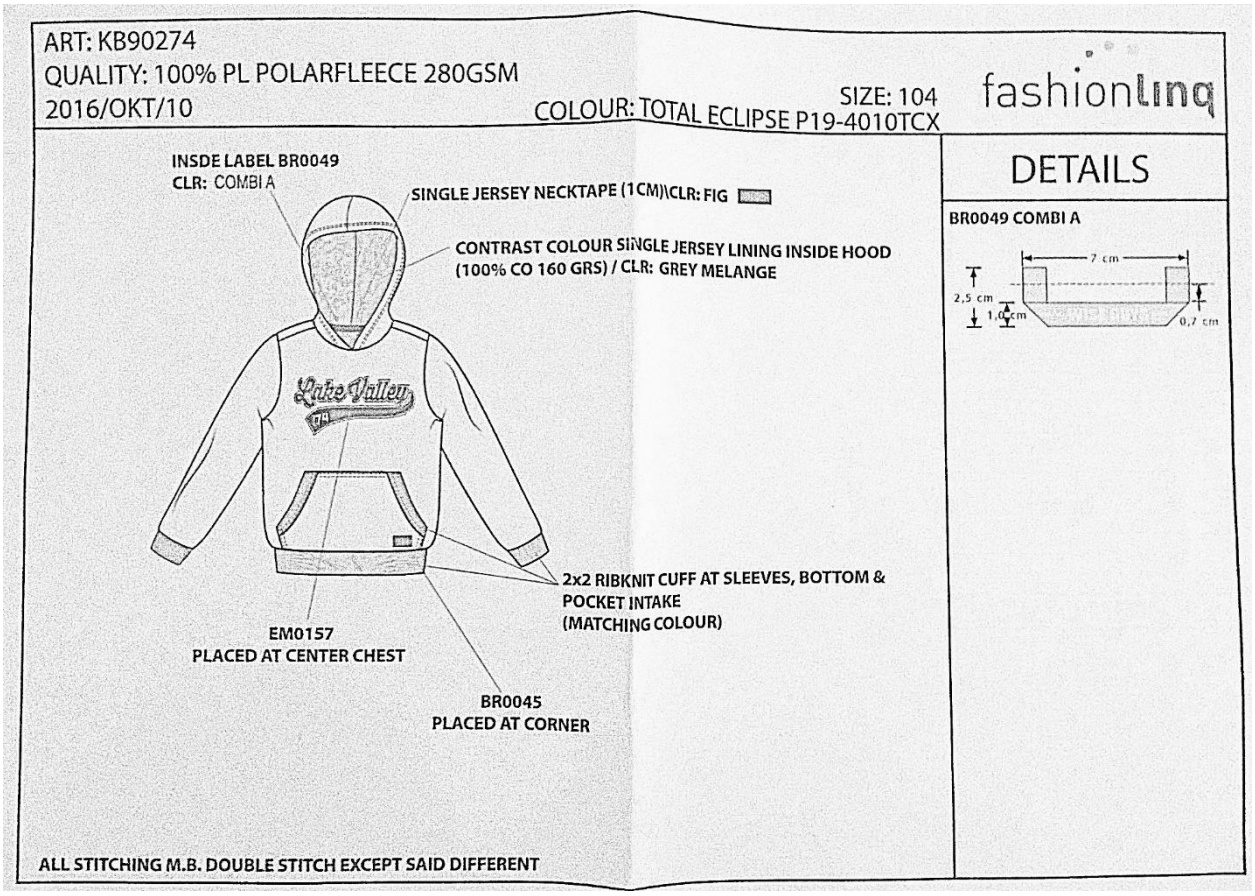


Figure 4.5 : Design Sheet Sample

HOLLAND HOUSE	GRADING :SWEATERS	DA1	13-10-2016 revised
Based on	Sion		
Article nr	25969		
Clients articlenumber	030 101034		
Season	S17		
Style	Jac	Client	Z2

Basic		S	M	L	XL	
A	1/2 chest	45	48	51	54	revised 13-10
B	waist position from neckpoint	39.5	40	40.5	41	
B1	1/2 waist	44	47	50	53	revised 13-10
C	1/2 bottom	47	50	53	56	revised 13-10
F1	outside neck width trimming	19.5	20	20.5	21	
G1	back neckdrop	2.5	2.5	2.5	2.5	
H1	front neckdrop	8.7	9	9.3	9.6	
	shoulder to shoulder	39.5	41	42.5	44	
	1/2 armhole straight	21	22	23	24	
I	1/2 upperarm width	18.5	19.5	20.5	21.5	
J	1/2 sleeve opening long sleeve	9	9.5	10	10.5	
	sleeve length from HSP	60	61	61	62	revised 13-10
L	length from neckpoint	65	66	67.5	69	
	collar height	8.5	8.5	8.5	8.5	
	bottom hem height	2	2	2	2	

ONLY FOR HOW TO MEASURE, NOT FOR STYLE

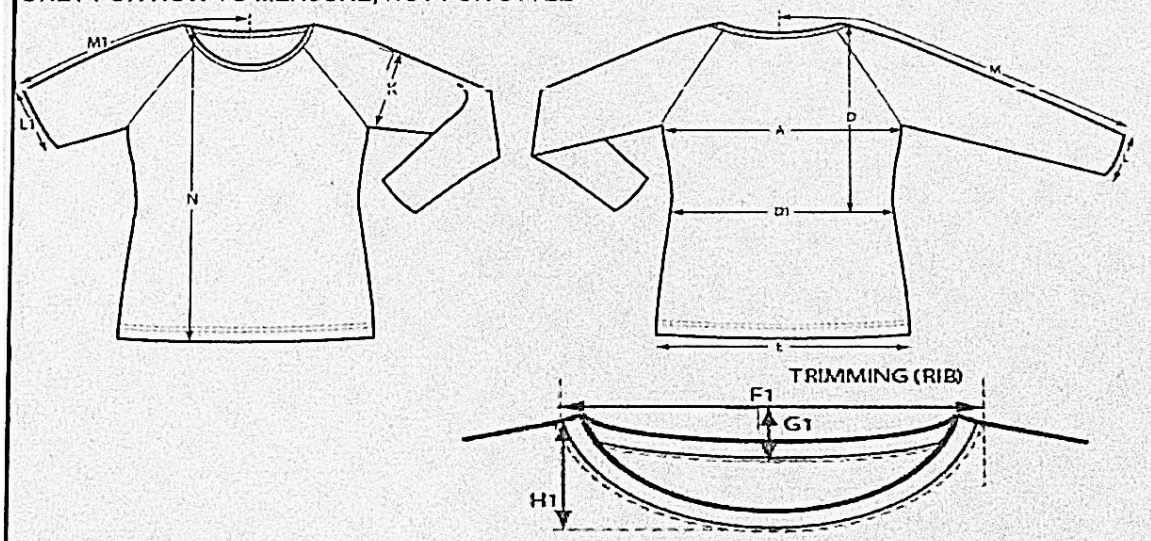
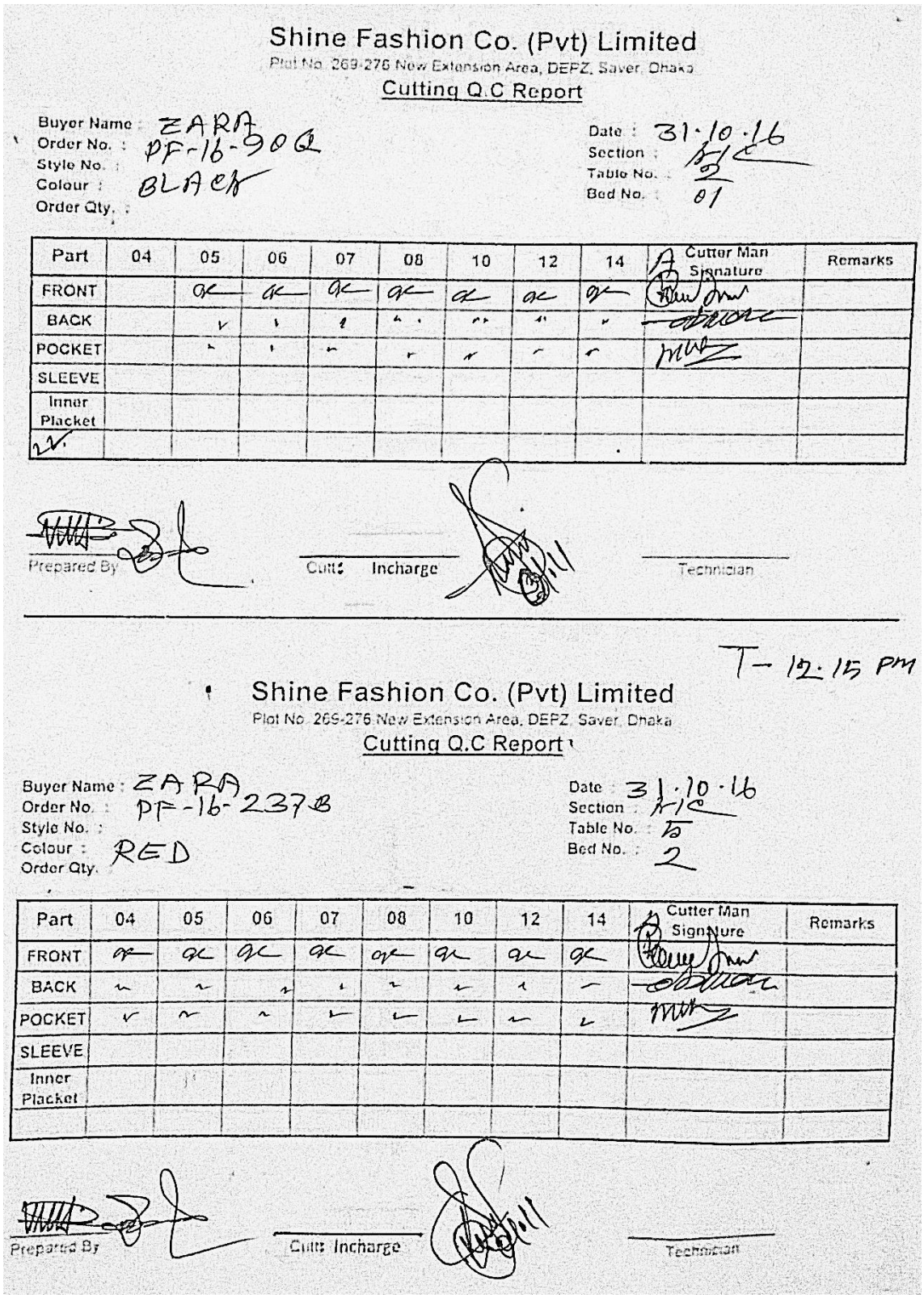


Figure 4.6 : Measurement Sheet Sample



Shine Fashion Co. (Pvt) Limited

Plot No. 269-276 New Extension Area, DEPZ, Saver, Dhaka

Cutting Q.C Report

Buyer Name : ZARA
Order No. : PF-16-90Q
Style No. :
Colour : BLACK
Order Qty. :

Date : 31.10.16
Section : A/C
Table No. : 2
Bed No. : 01

Part	04	05	06	07	08	10	12	14	Cutter Man Signature	Remarks
FRONT		ok	ok	ok	ok	ok	ok	ok		
BACK										
POCKET										
SLEEVE										
Inner Placket										

Prepared By | Cutt: Incharge | Technician

T- 12:15 PM

Shine Fashion Co. (Pvt) Limited

Plot No. 269-276 New Extension Area, DEPZ, Saver, Dhaka

Cutting Q.C Report

Buyer Name : ZARA
Order No. : PF-16-2378
Style No. :
Colour : RED
Order Qty.

Date : 31.10.16
Section : A/C
Table No. : 15
Bed No. : 2

Part	04	05	06	07	08	10	12	14	Cutter Man Signature	Remarks
FRONT	ok	ok	ok	ok	ok	ok	ok	ok		
BACK										
POCKET										
SLEEVE										
Inner Placket										

Prepared By | Cutt: Incharge | Technician

Figure 4.7 : Cutting Q.C. Report for Two Different Products

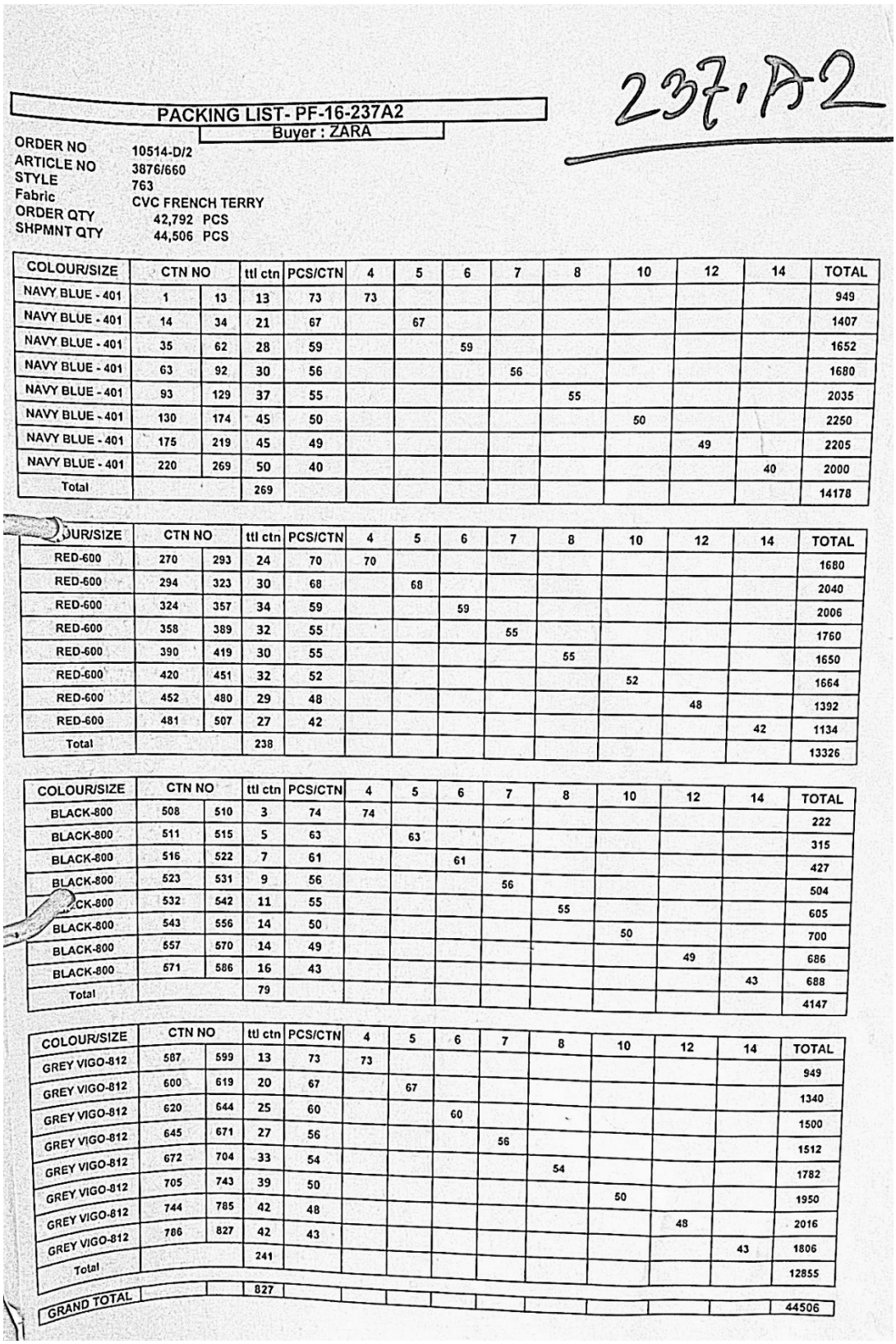
Acceptable quality limits (AQL s) have been set as follows.

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 4.8 : AQL Sheet for Q.C.



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

COLOUR/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
BLACK-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 4.9 : Packing List Sample

4.3. SUMMARY OF QUALITATIVE DATA

As mentioned before, the absence of an Industrial Engineering department and proper performance data collection techniques, much emphasis had to be given on the qualitative data that was collected mainly through interviews and observations from the employees, section in-charge's and the assistant human resource and admin manager. The essence of those data are provided below.

Absence of an IE Department

During the initial meeting with the assistant HR and admin manager, he informed that the factory did not have an Industrial Engineering department. He also acknowledged us that due to that worker performance data were scarce and the traditional planning leads introduces waste during production

Absence of Workplace Cleaning and Organizing Policy

While observing different sections of the factory, we observed that the workplace was dusty and not very organized. After asking our visit guide, he informed us that no workplace and cleaning policy existed in the factory.

Variability in Worker Performance

Most of the defects in the finished products are caused by either worker or machine error. High variability exists among the worker and variability implies uncertainty in performance level.

Traditional Worker Training and Managing Policy

Throughout the organization, traditional rule of thumbs are used for training workers and for managing them.

CHAPTER 5 : SUGESTIONS & CONCLUSION

5.1. INTRODUCTION

In the previous chapter, we have gathered & analyzed a set of qualitative data that immediately calls for measures that should to taken to improve the current scenario. This chapter deals with the discussion of these issues elaborately along with providing recommendations for resolving particular problems that are necessary for introducing modern production systems that targets waste reduction.

5.2. IDENTIFIED PROBLEMS

From the data analysis of previous chapter, we have identified some key problems which are mentioned below.

- Absence of Industrial Engineering Department
- No specific cleaning and organizing system
- Scarcity of worker performance measurement data
- Variability in worker performance
- Traditional training through experience

5.3. SOLUTIONS SUGGESTED

After analyzing the data & the discussion upon the results, we have come up with some suggestions to improve the present system or solve the problems. Firstly, by introducing an

industrial engineering department in the factory, all the problems can be overcome. With the rule of thumb that each and every one of the organization must have the commitment to it.

Establishing Industrial Engineering Department

Industrial engineering involves different functions, which support manufacturing and service operations in order to improve productivity, safety and workers welfare. These functions, as in the past, are otherwise neglected by many entrepreneurs who are only motivated by profit. Developed countries have long ago realized the physiological needs of their citizens as their life style has improved with the abundance of material resources. Further, with an increase in educated workers, the demand for improved working conditions and better treatment from the owners of enterprises increased. The owners adopted many of the industrial engineering functions to satisfy the employees demand while still maintaining profitability.

Introducing TPM Throughout the Organization

TPM can come into action to stand against this crisis. Basically, 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.

The working environment can be improved by applying a good housekeeping, 5S in the factory. '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.

5.4. CONCLUSION

This paper presented the definition of waste under lean manufacturing, as well as properties of waste and how they affect production. 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. A lot of waste is produced.
5. Perfect field for employing 5'S.
6. Options of improving the overall system are available.

The developed model is dependent on categorizing waste into the well-known seven categories, but for better understanding & findings, other categorization systems are also shown. Interrelationship between different types of waste has not been considered here, but the assessment & methodology was done on the level where the resulting effect of these phenomenon is negligible enough. The model is anticipated to play a significant role in identifying waste as a first step to elimination, and in helping solve problems related to the operational environment of a Garment.

Objective of this study is the same as the name, deriving methods of identification of waste. Here, the basic of lean manufacturing is used. For this purpose, at least one factory was needed to be visited.

Another objective is was to reduce waste as much as possible to improve quality of the product, as well as lowering production cost. 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. Data related to production & quality control, as well as IE was taken from the main information center of the company. A walk through the whole production area was also done, for finding fields of applying 5'S.

On the basis of the information gathered from the field survey, problems/causes behind waste production were detected. Solutions were also provided accordingly. Expected results of the solution was then compared with export quality garments, and came out satisfactory.

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, it is also possible that this approach could be applied to the service sector, taking into consideration that the definitions of each type of waste may change due to specific requirements of the service sector.

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