Economic Analysis of Lean Wastes: Case Studies of Textile and Garment Industries in Ethiopia

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Abstract
In today's competitive world, customers are demanding better quality products with fast and reliable deliveries. To meet this demand, new manufacturing technologies are developing rapidly, resulting in new products and improvements in manufacturing processes. As part of this effort, lean production principles have been established and are in use in developed countries to minimize and/or remove wastes.

The purpose of this study is to identify and analyse lean wastes surfacing in production lines of four textile and garment industries. The information will make it possible for them to minimize or eliminate lean wastes using recommended tools and techniques. As a result, a smooth working environment will be created which will improve the plants' ability to produce exactly the right quantity with the right quality and at exactly the right time, with a minimum of interruption. This study has followed qualitative and quantitative research approaches for collecting and analysing the data of the four cases chosen. The main methods used for data collection are questionnaires, shop floor visits, and check sheets. The empirical findings are analysed using appropriate tools of investigation and by theoretical concepts of lean production and economic cost analysis.

The aggregate data collected over time show that there is substantial waste in the production process from the start of producing products to the day of delivery, using all available resources. Furthermore, the result of the analysis mainly demonstrates that there is an inconsistent production rate per shift, and noticeable employee turnover.

KEY WORDS: Waste, Lean, Economic Analysis

1) Introduction

The success of textile and garment companies in their competition for the global market rests in large part on their focus on more effective and efficient manufacturing processes. The necessity to reduce the cost of production has also caused manufacturers to focus on waste minimization.

Textile and garment industries are among the most labor intensive industries known, and in developed countries labor has become expensive. Because of this, these industries are expanding in Africa as a way to involve its idle man power and to give Africa a chance to participate in the global market. Many are now beginning to increase in Ethiopia, producing products for local and foreign customers. However, these industries are not as profitable as they were expected to be and their customers are becoming dissatisfied. This can be avoided if different tools and techniques are used and waste management is controlled.

To eliminate waste in any business environment, it is important to understand exactly what waste is and where, how and why it exists. Waste is an uneconomical use of resources. This waste includes materials, machines, labour, time, and revenue, resulting in a supply of products in an unwanted quantity (over and above, less and below). For any waste, there is a strategy to reduce or eliminate its effect on a company, and improve overall performance and quality of the product or service delivered by the factory.

The theme of this study is identification of wastes in textile and garment factories which then forwards their economic cost-benefit analyses intuitively. At the Hawassa Textile Factory, Almeda Textile and Garment Factory, Bahir Dar Textile, the study investigates the following departments of the industrial process: Human Resources, Marketing, Production, and Utility. There are many tools and techniques which can be applied to these areas of production in order to tackle any one of the forms of waste mentioned above. After identifying problems observed via appropriate tools of investigation, the study was obliged to classify according to seven wastes nomenclature. Even though some data are missing from the respective factories, a smaller sample size did not affect the robustness of the result as the analysis is taken out in absolute terms. The next part concerns the wastes of recognized departments of the case factories and their economic costs analysis. The research question of the study is**:** How can textile and garment industries improve their production flow by identifying and classifying lean wastes and assessing their economic effects using a cost-benefit analysis?

2) Literature review

After World War I, Henry Ford and General Motors' Alfred Sloan moved world manufacturing from centuries of craft production to the age of mass production and dominated the global economy (James P. et al, 1990). In craft production, the producer uses highly skilled workers with simple but flexible tools to make exactly what the consumer wants. The problem with this model is that goods produced by this method cost too much for most of people to afford. Thus, mass production was developed as an alternative which uses narrowly skilled professionals to design products made by unskilled or semi-skilled workers tending expensive, single-purpose machines. After World War II, Japanese manufacturers were faced with the dilemma of vast shortages of materials and human resources. As a result, in order to make a move toward improvement, an early Japanese leader, Shigeo Shingo, devised a new, disciplined, process-oriented business model, which is the "Toyota Production System" and its use is still growing all over the world (Fawaz, 2003)

Lean production

Lean is Elimination of waste -Toyota Production System; Philosophy - produce only what is needed, when it is needed, with no waste; Methodology -determination of value added in the process; and tool -like takt time (William, 2001). Lean production is a Japanese manufacturing philosophy that focuses on abolishing or reducing wastes and on maximizing or fully utilizing activities that add value from the customer's perspective (Peter and David, 2000). It combines the advantages of craft and mass production, while avoiding the high costs of the former and the rigidity of the latter. This business model distils the essence by using a lean approach with five key principles showing how the concepts can be extended beyond automotive production to any company or organization, in any sector (William, 2001).

- **Specify** what does and does not create **value** from the customer's perspective
- **Identify** all the steps necessary to design, order and produce the product across the **whole value stream** to highlight non-value adding waste
- Take those actions that create value **flow** without interruption, backflows, delays, or scrap
- Only make what is **pulled** by the customer
- Strive for **perfection** by continually removing successive layers of waste as they are uncovered

These principles are fundamental to the elimination of waste. To improve a company's ability to focus on customers' needs, it must define the value streams inside the company (all the activities which are needed to provide a particular product or service) and later, to focus on the value streams in their wider supply chain as well. To satisfy customers, industries will need to eliminate or at least reduce wasteful activities in their value streams that customers would not wish to pay for. Next, the company must find a way to set direction by fixing targets and seeing whether or not change is actually occurring. There needs to be an internal (and later external) framework to deliver **value** for their customers when making a change.

The first stage in lean production is understanding the wastes in an organization. Waste in economics refers to the overall poor performance of a plant from different perspectives such as underutilization of resources, improper assignment of resource to the **wrong** position, process inefficiency, and ineffectiveness of transforming the right input to the right output. A systematic attack on waste is also a systematic attack on the factors underlying poor quality and probably fundamental management problems. In the Toyota Production System, seven types of wastes were identified by Shigeo Shingo; Table 1 below (Fawaz, 2003).

Table 1: Type and description of wastes

S/N	Waste	Description
1	Overproduction	Producing too much or too soon, resulting from poor flow of information
2	Defects	Frequent errors, product quality problems, or poor delivery performance
3	Unnecessary inventory	Excessive storage and delay of information or products, resulting in excess inventory
4	Inappropriate processing	Going about the work process using the wrong set of tools, procedures or systems, often when a simpler approach may be more effective
5	Excessive motion	Excessive movement of people, information or goods, resulting in wasted time, effort and cost
6	Waiting	Long periods of inactivity for people, information or goods
7	Unnecessary motion	Poor workplace organization, resulting in poor ergonomics, for example excessive bending or stretching and frequently lost items

Additionally, while thinking about wastes, there are three types of activities that should be defined within organizations (Ana R., 2008):

1. Value adding activity: those activities that, in the eyes of the final customer, make a product or service more valuable. A value adding activity is simple to define; industries can ask themselves if they as a customer would be happy to pay for it.
2. Necessary non-value adding activity: those activities that, in the eyes of the final customer, do not make a product or service more valuable but are necessary, in the event the existing supply process is radically changed. Such waste is more difficult to remove in the short term and should be a target for longer term or radical change.
3. Non-value adding activity: those activities which, in the eyes of the final customer, do not make a product or service more valuable and are not necessary even under present circumstances. These activities are clearly 'wastes' and should therefore be the target of immediate or, at least, short term removal.

Lean production elements

Lean production is a holistic view; it emphasizes the interconnectivity and dependence among a set of five key/primary elements. These five primary elements are: Manufacturing Flow, Organization, Process Control, Metrics, and Logistics (William, 2001).

1. Manufacturing Flow: The aspect that addresses physical changes and design standards that are deployed as part of the cell.
2. Organization: The aspect focusing on identification of people's roles/functions, training in new ways of working, and communication.
3. Process Control: The aspect directed at monitoring, controlling, stabilizing, and pursuing ways to improve the process.
4. Metrics: The aspect addressing visible, result-based performance measures; targeted improvement; and team rewards/recognition.

5. Logistics: The aspect that provides definition for operating rules and mechanisms for planning and controlling the flow of material.

2.1: Conceptual framework

This study was designed to play a role in identifying and classifying lean wastes, and to analyze their economic cost in the chosen textile and garment factories so as to increase their productivity and competitiveness. This goal will be achieved by pacing the actual production lead time to task, by eliminating/minimizing the chance of rework and reject, and by increasing the trustworthiness of delivering ordered and defect-free products to the intended customer.

3) Research Methodology

The methodology used in this study is descriptive, acquiring input from all sources like facilities, equipment, and personnel to achieve the objectives defined. A qualitative approach is also used. Its main emphasis is to gain insight into wastes existing in the production process by using check sheets, questionnaires, shop floor visits, and informal interviews.

Data collection

Two types of data were used to conduct the research: primary and secondary data. Primary data was collected physically from the production plant. And the secondary data were collected based on data from other sources.

A) Primary data collecting methods:

- Shop floor visits and intensive physical observations
- Questionnaires and check sheets for professionals to identify the wastes in the cases chosen
- Informal interviews with concerned bodies (top level management)

B) Secondary data collecting methods:

- Review of relevant literatures, concerned with the seven types of wastes,
- Manuals, historical documents, and other necessary sources from case companies
- Economic cost analysis relating to the objectives defined to minimize and eliminate the problems identified

4) Result and Discussion

Based on the theoretical concepts of lean production, appropriate tools of investigation (such as tables, graphs, charts etc.) were used to analyse the collected data.

4.1: Waste of Resources

Resource waste is one common type of waste prevalent in manufacturing. Usually resource/utility wastes are derived from personnel’s negligence and lack of attention during on-off work. Other types of wastes are uneconomical utilization of water, power, electronic equipment, machine time, and any inefficiencies of the work area. Unwise utilization of these resources causes a significant financial loss since such costs are overhead and not able to be retrieved. Most of the time factories are unable to assess their effect upon the company's profitability. Table 2 below depicts the perception of the production departments of each factory on the utilization status of the above resources/utilities and their corresponding economic effects.

Table 2: Factory response on Resource/Utility waste trend (Source: Survey data, 2012)

Waste type	Factory name		
	Bahirdar textile	**Hawassa textile**	**Augusta garment**
Light-on left room	St. Disagree	Disagree	St. Disagree
Light-on at daytime	St. Disagree	Neutral	St. Disagree
PC-24 hours on	St. Disagree	Disagree	St. Disagree
Machine run-off job	St. Disagree	St. Disagree	St. Disagree
Ventilated room left	St. Disagree	Disagree	Agree
Water tape left running	St. Disagree	Disagree	St. Disagree
Doors open-left	Disagree	Disagree	St. Disagree
Things done-wouldn't do at home	Neutral	St. Disagree	Neutral

Bahir Dar and Augusta factories have good practices to minimize utility wastes so far. Both are concerned with proper utilization of the power source. However, Hawassa textile factory responds neutrally to the daytime light-on at the factory while giving no importance to any type of factory process. The occurrence of this waste is not certain in Hawassa since the responsible body to take care day time lighting is not well defined and management of such non-value adding activities might not consider it a vital component of the low competitiveness of the organization.

4.2: Waste of overproduction

Overproduction inhibits the smooth flow of materials and actually degrades quality and productivity. Often production supervisors assume that a factory's waste is caused by intermittent quality problems and that producing extra units will make sure the customer order is satisfied. However, the outcome becomes unpredictable and over time wasteful overproduction can become the norm of a factory. Production systems should be "Just in Time" with every item made as it is needed. Otherwise a "Just in Case" scenario will have a high opportunity cost. The economic cost of overproduction is multidimensional i.e., it creates excessive lead times, high warehouse costs, and possible deterioration of product if shelf time is long. Bahir Dar textile factory provided full data concerning the supply of a particular textile product, including the actual demand-in-time series base. The analysis illustrated this specific factory's assessment of waste from overproduction. Data were taken for two consecutive years (2010/11-2011/12), for two types of products and they are discussed below.

A. Fabric

The product was produced consistently for twelve months a year and there was demand at the market price. Table 3 shows the production capacity of Bahir Dar Textile Factory and the quantity demanded in the years 2010/11-2011/12 for fabric. The two market forces, supply and demand, show inconsistencies. On average, supply exceeds demand, though during some months of the year a shortage of product is observed. This empirical evidence justifies the conclusion that overproduction occurs for this particular type of product. Conversely, the incapacity of the factory to satisfy the market demand when needed is another waste which means that it misses out on huge market potential. That the factory fails to harmonize market demand with production is exhibited in the analysis of two years of data.

To check whether there is over production or not, it becomes profoundly important to determine the equilibrium quantity and equilibrium price of the product which is illustrated in figure 1.

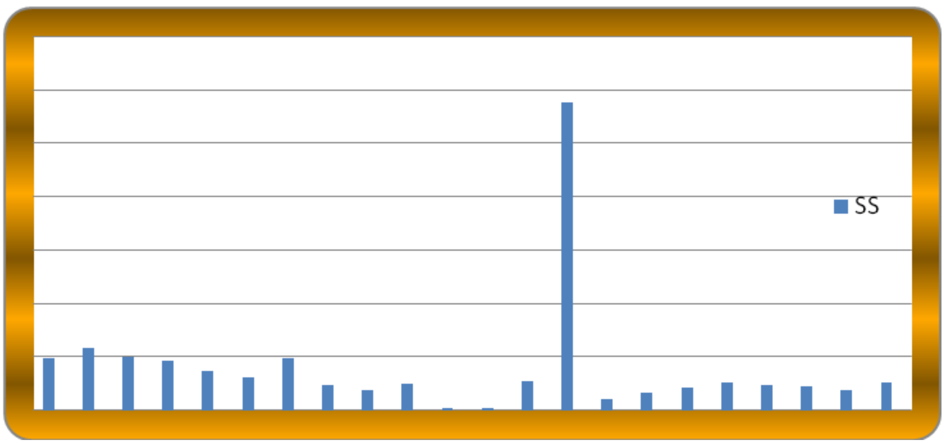


Fig 1: Comparison of Demand and Supply of Fabric product (Source: Survey data, 2012)

Figure 1 above shows that, October 2011 was the highest of all months in production volume. The microeconomic analysis of this product can be further investigated through market price determination of the product and which market force outshines to set out the price.

Table 3: Examining over production of fabric product (Survey data, 2012)

Year	Production (SS)	Demand (DD)	Difference (SS-DD)	Description
Sep-2010	486368	648371	-162003	Shortage
Oct-2010	588202	261727	326475	Over production
Nov-2010	506152	664402	-158250	Shortage
Dec-2010	473379	565576	-92197	Shortage
Jan-2011	376092	242484	133608	Over production
Feb-2011	307313	175039	132274	Over production
Mar-2011	490599	316520	174079	Over production
Apr-2011	235028	653664	-418636	Shortage
May-11	190817	262863	-72046	Shortage
Jun-2011	252258	375152	-122894	Shortage
July-2011	23541	NA	23541	Over production
Aug-2011	24526	NA	24526	Over production
Sep-2011	276557	345262	-68705	Shortage
Oct-2011	2888552	301597	2586955	Over production
Nov-2011	102433	193575	-91142	Shortage
Dec-2011	171556	125249	46307	Over P.
Jan-2012	221032	205633	15399	Over production
Feb-2012	269635	122749	146886	Over production
Mar-2012	240788	534905	-294117	Shortage
Apr-2012	231783	304739	-72956	Shortage
May-2012	186023	62232	123791	Over production
Jun-2012	267355	583408	-316053	Shortage
Average	**400454**	**315688.5**	**84765.55**	**Over P.**

SS = supply, DD = demand, and NA = data not available

From the law of demand, one can observe an inverse relationship between quantity demanded for fabric and the corresponding price, while in a linear relationship there is a positive relationship between the supply of fabric and market price. Once, the above two hypothesis are certain, the next step becomes the equilibrium analysis of the market forces to identify the gap. For that matter, the supply equation of the Fabric product appears to be:

$$Q_{ss} = 429.4 + 0.993P_f \text{ ……………….. (1)}$$

Where Qss = quantity of fabric produced in each month in units
P_f = market price of fabric in the respective month in Birr

Similarly, the demand equation for the product is also determined in such a way that there is an expectation of a negative relationship between the quantity demanded and price of the product:

Q_{dd} = 296.8+ 5.50P_f ……………… (2)

Where Q_{dd} = quantity of fabric sold out in units
P_f = selling price of the Fabric in Birr

However, the analysis failed to assure that the law of demand and the marketing system of this particular product at the factory level were not governed by market principle. Furthermore, the next figure shows the relationship between the quantity demanded and the market price of the fabric in Bahir Dar Textile. It reveals that there is no consistency confirming the law of demand. This kind of poor business outcome can be resolved by continuously monitoring and evaluating the capacity of the factory in order to fill the demand gap and increase its competitiveness.

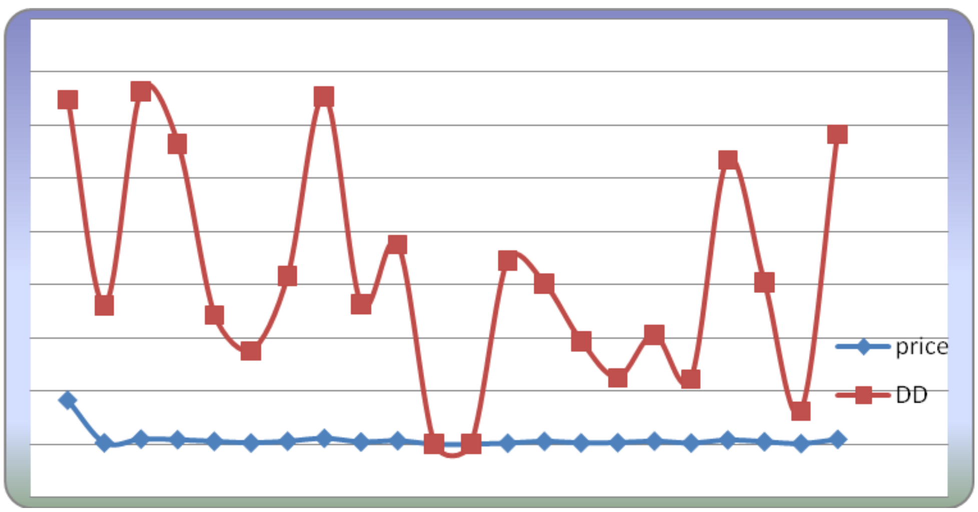


Fig 2: Test for law of demand for fabric product (Source: Survey data, 2012)

B. Yarn

This product exhibits similar features of the Fabric product, where overproduction is the factory's unsolved problem. This study took 22 months production data from the production department and shows there are months when there is no production of this product. This production downtime is an atypical form of waste. In table 4, except for the months of February (2011) and October (2011) which show shortages of Yarn products, the performance of the remaining twenty months confirms overproduction. More importantly, November, 2011 to January, 2012 output is over supplied and demand is marginal to nil. This indicates that the product is produced without plan or is inferior and rejected by customers. For that matter, on average 38,145 units of Yarn product is in excess of demand. Its overall business implication is that it is extremely expensive when all resources engaged in producing of Yarn are being used at high opportunity cost.

Table 4: Examining Overproduction status of Yarn product (Survey data, 2012)

Year	Production (SS)	Demand (DD)	Difference (SS-DD)	Description
Sep-2010	110237	43480	66757	Overproduction
Oct-2010	110269	70944	39325	Overproduction
Nov-2010	104398	51926	52472	Overproduction
Dec-2010	123191	75568	47623	Overproduction
Jan-2011	50050	32292	17758	Overproduction
Feb-2011	99606	105538	-5932	Overproduction
Mar-2011	101114	67142	33972	Overproduction
Apr-2011	86466	19035	67431	Overproduction
May-2011	74000	54129	19871	Overproduction
Jun-2011	83486	27945	55541	Overproduction
July-2011	0	0	0	-
Aug-2011	0	0	0	-
Sep-2011	76758	10858	65900	Overproduction
Oct-2011	20872	39447	-18575	Under
Nov-2011	65559	0	65559	Overproduction
Dec-2011	72882	0	72882	Overproduction
Jan-2012	65430	0	65430	Overproduction
Feb-2012	61887	17181	44706	Overproduction
Mar-2012	73770	1700	72070	Overproduction
Apr-2012	67653	20736	46917	Overproduction
May-2012	44593	30749	13844	Overproduction
Jun-2012	67017	51359	15658	Overproduction
Average	**70874.45**	**32728.59**	**38145.86**	**Over production**

SS = Supply, DD = Demand

Given twenty- two months of production data, figure 3 depicts that supply outshines demand on average by 25%, and one quarter of product is not in demand at all resulting in excessive inventory, higher capital requirements, and subject to obsolescence. In conclusion, the plant is challenged by poor performance and creates a negative effect on the factory’s competitiveness and survival.

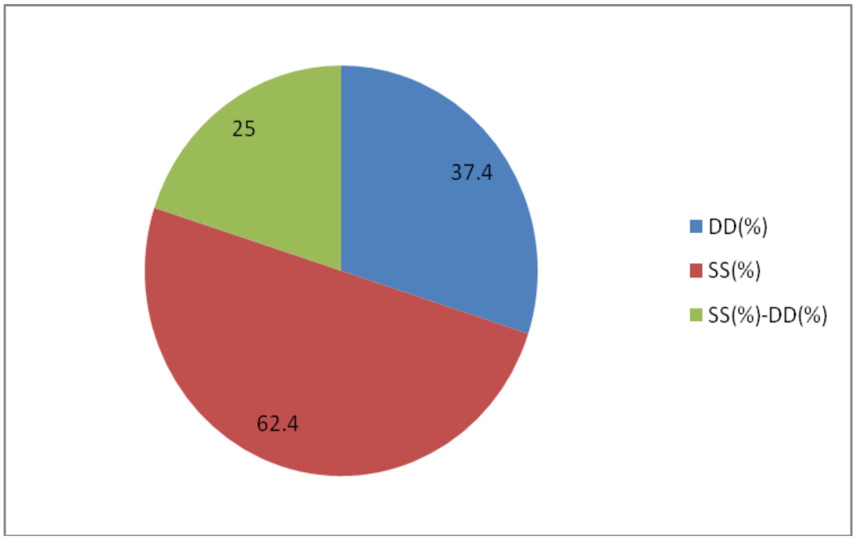


Figure 3: Over production of Yarn product (Source: Survey data, 2012)

In Almeda Textile and Garment, the study tries to detect the overproduction of different products using same approach as above. Products incorporated in this survey are Trouser, Cap, and Shirt for the production times of 19 months, 18 months and 20 months respectively. Prices of the particular products for 20 or 19 months are consistent and the supply curve becomes a straight line when the factory makes a binding contract agreement with a customer for a fixed-price, or when a perfectly competitive market prevails.

4.2.1) Economic costs of overproduction

- Capital is tied up in stock, raw materials, work-in-progress (WIP) and finished goods. Factory cash is what it relies on to operate, so the factory either finds itself producing short or it ends up paying charges to the bank
- Costs are associated with storage and movement of the inventory, requiring warehouse space, labor, and equipment, all of which are costly for the firm

4.3: Waste of people (Talent or Creativity)

The waste of creativity is one of the seven Muda of lean manufacturing. It is a failure to make good use of firm's manpower. Employees are the most valuable assets when it comes to ensuring that organizations succeed. It is necessary to make large investments in employees with training, developing, and maintaining them, including the efforts to retain them. However, employee turnover is one of the most serious issues for the factories under investigation. This problem is more relevant when business processes are less dependent on machinery and heavily reliant on human relationships. The textile and garment factory is one such example. This study examines the extent and trend of employee turnover on three textile factories of Ethiopia (Bahir Dar Textile, Almeda Textile and Garment, and Augusta Garment) with respect to the labour force requirement and the losses faced. The following table typifies the yearly occurrence of loss in creativity from labour turnover at each factory. **Note**: NA = data not available

Table 5: Examining Labour force statistics (Structure Vs Actual) (Survey data, 2012)

Year	Factory names						
	Hawassa textiles		Augusta garment		Almeda textiles		
	Structure	Actual	Structure	Actual	structure	Actual	
2003	1039	949	378	352	NA	NA	
2004	1045	933	378	344	NA	NA	
2005	1045	964	378	339	NA	2331	
2006	1045	946	378	268	NA	2928	
2007	1045	958	271	235	NA	2827	
2008	1045	1065	217	208	NA	2657	
2009	1045	1009	217	171	NA	3140	
2010	1045	955	217	146	NA	3193	
2011	1045	960	217	132	NA	5699	
2012	1045	830	217	108	NA	5143	

Almeda Textile and Garment has no labour force requirement in its organization, rather recruiting without any human resource planning because of poor expertise in the management of the factory. There are no old records or documentation regarding the company's human resources. Factories with no current or future labour force planning will fail to see a way to meet their competition. Hawassa Textile and Augusta Garment exhibited human resource planning in their organizational structure and recruit appropriately, although their existing labour force is smaller than that required. Time serious data of the two factories indicate that the gap between the structure and actual labour force requirement is inconsistent because the magnitude of labour turnover aggravates the gap.

Hawassa Textile has a robust human force structure, since right after 2004 the required labour force was fixed at 1045. However, except in the years 2004, 2006, 2007 and 2010, the factory took in a smaller labour force than that required and this vacancy had strong negative implications on the overall business environment of the factory. The gap (the required labour less actual labour force) becomes severe in year 2012 when there are 215 fewer workers to fulfil production needs. This failure brings greater losses to the factory's profitability. On the fourth column of Table 6, a positive number reveals the factory employed an additional 20 workers beyond its requirement which is unnecessary and creates additional wage payment for those with no value added to the factory. On the other hand, positive numbers may indicate that the factory needs an additional labour force for different disciplines. Similarly, in the fifth column, a negative number refers to the recruiting of additional labour while a positive number indicates labour resigned from the factory.

Table 6: Labour force gap and Turnover of Hawassa textile (n= 10) (Survey data, 2012)

Year	Structure	Actual	Gap	Turn over
2003	1039	949	90	0
2004	1045	933	112	16
2005	1045	964	81	-31
2006	1045	946	99	18
2007	1045	958	87	-12
2008	1045	1065	-20	-107
2009	1045	1009	36	56
2010	1045	955	90	54
2011	1045	960	85	-5
2012	1045	830	215	130
Average	**1044**	**957**	**88**	**13**

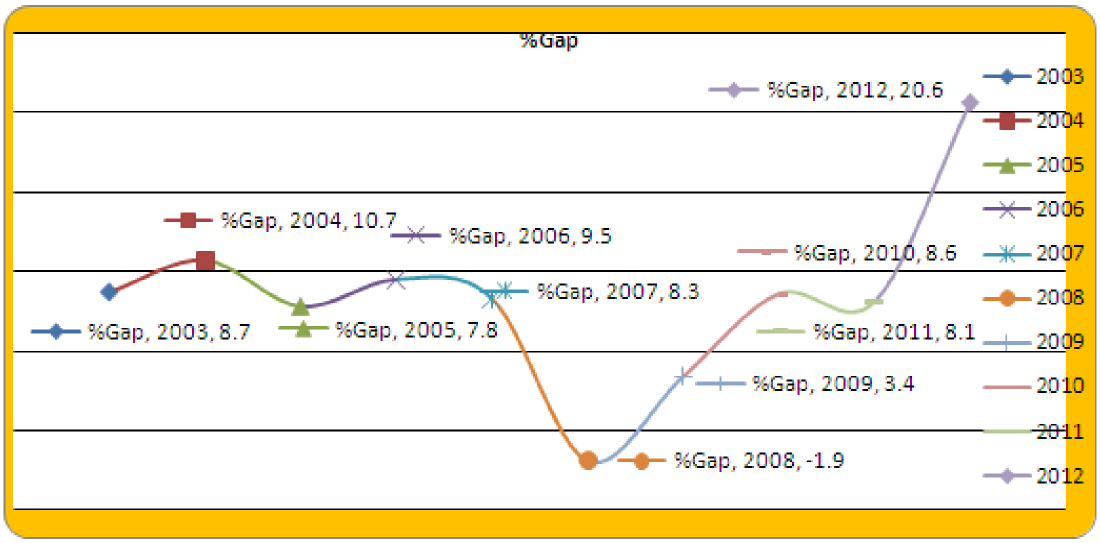


Fig 4: Labour force vacant position of Hawassa textile (Source: Survey data, 2012)

Figure 4 above indicates that there is a mismatch between the actual labour force and the organizational requirement except in year 2008 when 1.9% more than required are employed for no economic reason. The highest labour force gap is recorded as 20.6% in year 2012. This is due to high employee turnover during this year. Examining the percentage of employee turnover from the existing labour force data will give insight to decision makers when they address the seriousness of this problem to emphasize better resource utilization. Figure 5 shows a greater percentage of labour turnover,14%, is observed in year 2011-12 and a lower percentage in years 2006 and 2010 which account for 1% each year, while in 2007, 11% of the required labour is employed and bringing another year of overstaffing.

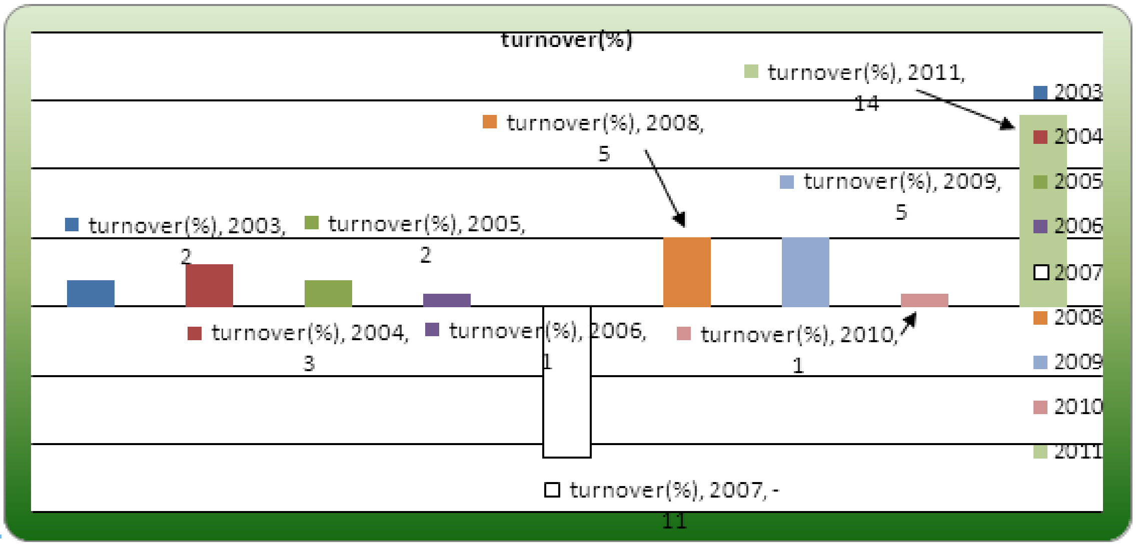


Fig 5: Percentage of labour turn-over of Hawassa textile (Source: Survey data, 2012)

Likewise, Augusta Garment factory shares similar characteristics to Hawassa Textile in gap and turnover, but the structural requirement for labour is revised downward three times within ten years. The decreasing demand for labour resulted from privatization of the factory in 2007. The factory has had no experience in the production of textile products, rather it engages in finishing activities, mostly ordered by customers. Except in the year 2008 when the marginal gap was 4%, the rest of the time, the gap was significant especially in 2012 (100 %). On average 21% of labour force gap is observed in the factory revealing a serious shortage of the required labour force. In addition to scarcity of labour, employee turnover aggravates the problem of talent loss.

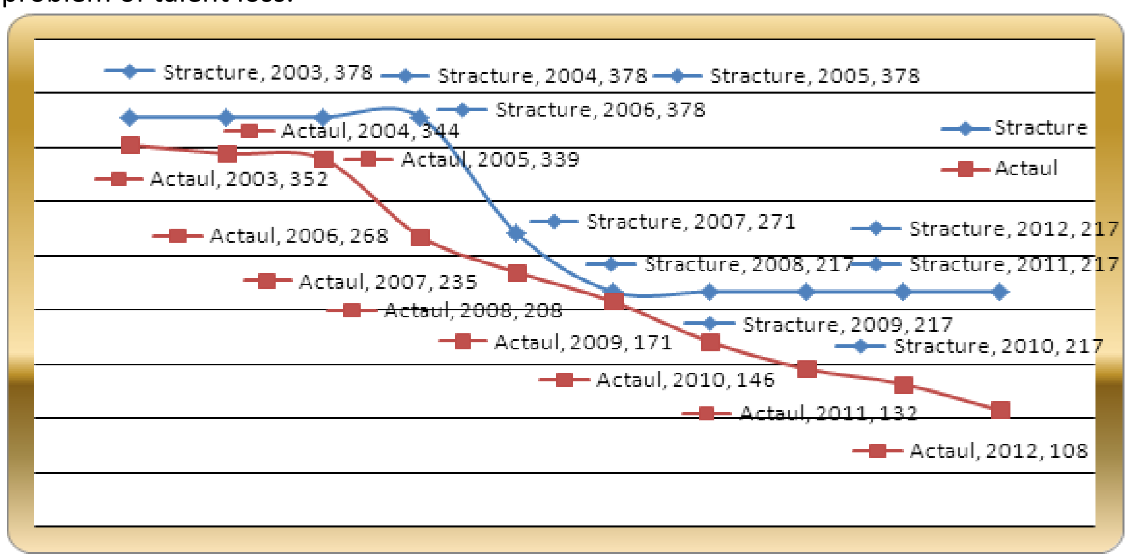


Fig 6: Labour force gap of (structure-actual) Augusta Garment factory (Survey data, 2012)

Regarding labour turnover, as shown in figure 7 below, the highest turnover of factory employees is registered in 2005 (21%) and the lowest in 2004 (1%). Compared with Hawassa Textile, Augusta Garment suffers much greater employee turnover and its effect on the factory's overall performance is sobering. In Almeda Textile and Garment, where there is no established labour force at the factory level, its poor structural organization exposes the factory to arbitrary and unmanageable labour recruiting practices that incur huge expenses.

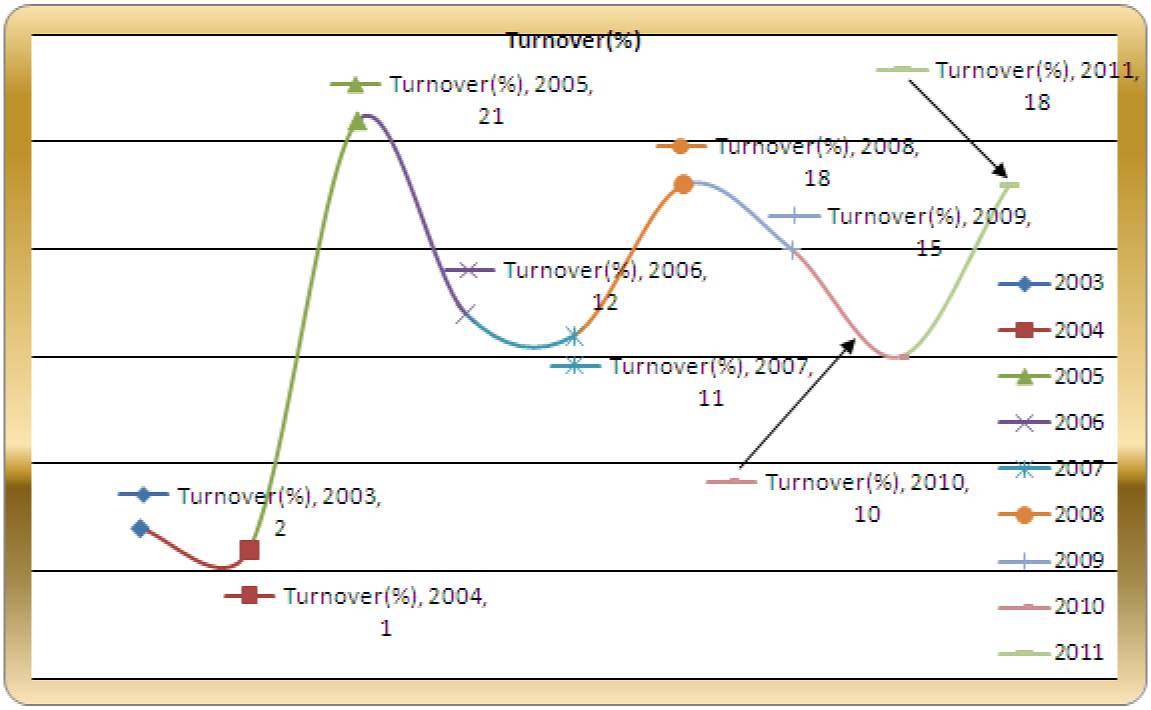


Fig 7: Labour turnover of Augusta garment (Source: survey data, 2012)

More than any of the factories investigated in this study, Almeda Textile and Garment factory suffers significantly in the loss of talented resources; table 7 below.

Table 7: Talent loss of Almeda textile and garment (Source: Survey data, 2012)

Year	Structure	Actual	Gap	Turnover	% turnover from actual
2005	NA	2331	-	198	8.5
2006	NA	2928	-	171	9
2007	NA	2827	-	238	8
2008	NA	2657	-	316	12
2009	NA	3140	-	174	6
2010	NA	3193	-	452	14.2
2011	NA	5699	-	437	8
2012	NA	5143	-	722	14

NA = Data not Available

The effect of losing creativity is more significant than any of the other wastes in a business since losing accumulated knowledge is greater than losing physical resources. Almeda creates a huge labour market for the economy, yet every year it loses a minimum of 6% of existing talented resources. When comparing the rate of recruitment with the rate of creativity waste, the data show the loss rate is greater than the recruiting rate, figure 8 below. During periods of economic decline when the demand for labour is decreasing, turnover is not considered a serious problem.

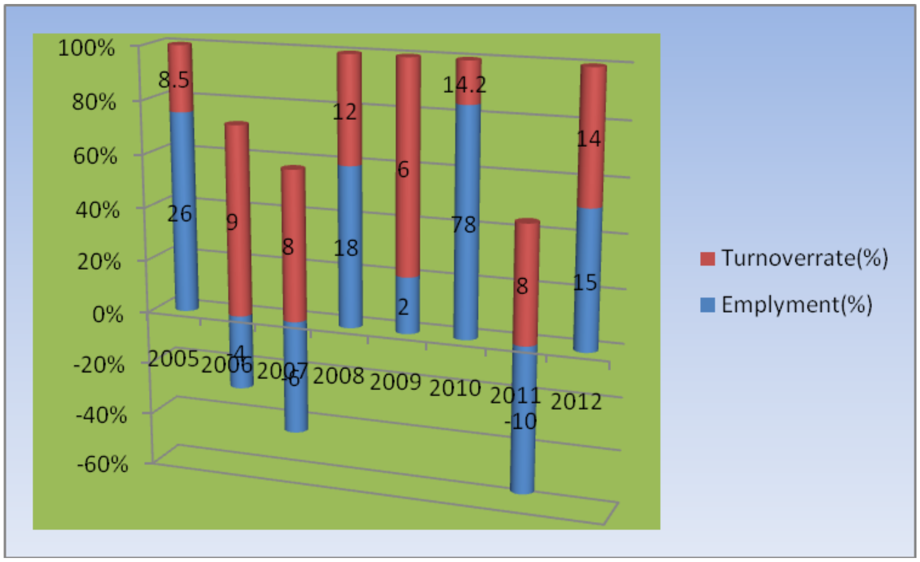


Fig 8: Comparison of creativity loss and creativity gain rate in Alemeda Textile and Garment

Factories are not totally to blame for the waste of creativity; it may also be associated with the nature and degree of economic activity at the respective factory or with the regional labour market. For that reason, Augusta Garment entertains greater percentage of creativity loss (12%) during eight years of data.

Table 8: Regional difference in Creativity loss and net result (2005-2012)

Factory Name	Average Creativity loss (%)
Alemeda textile and garment	9.96
Augusta garment	12
Hawassa textile	9.5

In the factory, the waste of talent not only results from the turnover of skilled and competent employees, but also from ignorance about the importance of involving the existing workforce in the overall activities of the factory. Since employees are the most valuable resources when it comes to ensuring that the business runs smoothly and continuously, without their involvement and loyalty the company will fail to compete with optimum effectiveness. According to the information collected from the human resources departments of the respective factories, they have **heterogeneous** practices to consider their employees' efforts in any activity.

Table 9: Cross tabulation of factories vs. talent resources underutilized (Survey data, 2012)

		Responses				
Perspective of talent resources underutilized	**Factory Name**	**Str. Disagree**	**Disagree**	**Neutral**	**Agree**	**St. Agree**
Having a culture that fails to recognize the strengths and contributions of firm's employees	Almeda	+				
	Bahir Dar			+		
	Augusta				+	
	Hawassa					+
Mangers that manage and employees that follow	Almeda					+
	Bahir Dar					+

instructions	Augusta	+				
	Hawassa				+	
Problem-solving conducted only by experts, ignoring input from other employees	Almeda	+				
	Bahir Dar				+	
	Augusta				+	
	Hawassa					+
Ideas for improvement that are forced upon different sections of the company rather than created within them	Almeda	+				
	Bahir Dar				+	
	Augusta					+
	Hawassa					+

Table 9 above depicts the different perceptions factories have towards talent utilization revealing their inconsistency in understanding their employees' contributions for enhanced performance of the company. These are the most important factors for a developing country's industries. They can undermine the talent of employees but by correcting them they have the potential for enhancing the competitiveness of the firm. For example, recognizing the employees' talents in solving a company's problems was a point of discussion during the survey time. Except for Almeda Textile and Garment, the remaining factories agree that company's problems can't be solved solely by the top experts; to a certain extent, the employees should be actively involved. They believe that the fate of the company lies on the shoulders of all employees including top management. Augusta Garment, Bahir Dar and Hawassa textile factories promote innovation and ideas for improvement from their employees and uphold the company policy promoting involvement in and loyalty to the firm.

4.4: Economic cost of creativity waste

Nowadays employee turnover is one of several factors that affect the productivity of an organization. The impact of employee turnover has received considerable attention of senior management, human resources professionals, and industrial psychologists. It has proven to be one of the most costly and seemingly intractable human resource challenges antagonising global organizations. Intuitively, the cost of creativity loss is divided into primary, secondary and tertiary effects, as shown in table 10 below. The main cost is time spent to make improvements to meet changing customer demands. Thus, failure to make improvements at a good pace eventually means that the factory's competitors will move ahead to lead the way within the industry leaving others far behind. Generally, there is curvilinear relationship between loss of creativity and factory performance.

Table 10: Costs of creativity waste (loss)

Effect	**Dimension of the effect**	**Cost implication**
Primary	Recruitment and selection costs, Registration and documentation costs, Integration costs, and Separation costs	Explicitly
Secondary	Production effects, Staff attitude effects, Extra labour cost, and Extra operating cost	Explicitly
Tertiary	Extra investment costs and Losses in business	Implicitly

4.5: Waste of defects

Defects occur when industrial products deviate from what the customer requires. They are common in manufacturing sectors and most often actual output (supply) is less than that required (demand). Company data were collected from three factories (Almeda Textile and Garment, Augusta Garment, and Hawass Textile) through scheduled interviews with production supervisors about their practice of defect detection in the production system. The results are summarized as shown in table 11.

Table 11: Summary of defects in three textile and garment factories (Survey data, 2012)

Defect type and its causes	Factory name		
	Almeda textiles and G.	**Augusta Garment**	**Hawassa Textile**
Input defect	Yes	Yes	Yes
Output defect	Yes	Yes	Yes
Cause of input defect	Technical (loading - unloading)	Lack skilled labor	Spare parts
Cause of output defect	Incapable process	Incapable supplier	Operator error + excessive stock
Defects prevalence	Scrap produced + lack of control + parts damage	Incorrect orientation + incapable process + incapable supplier	Data not available

The above table shows the prevalence of defects in input utilization and output production in three factories. For example, Almeda and Augusta experience input and output defects, but from different causes. Input defects are derived from technical problems during loading and unloading at Almeda, and from lack of skilled labor to properly utilize the inputs at Augusta. Moreover, the survey tries to address the dominant cause of input and output defects commonly occurring in the factories. The findings revealed that scrap produced and machine parts damaged due to excessive handling only affected Almeda Textile and Garment. Augusta Garment suffered from input and output defects caused by incorrect orientation in the assembling of machine parts resulting in malfunctions during the production process. Defect identification gives a sound signal to what extent input and output defects affect the productivity and the performance of a manufacturing plant. For that matter, this report incorporates only the data of two products of Almeda Textile and Garment.

A. Basic T-shirt style M-10, GSM=180

Input and output data are taken from twelve months of 2011/12 for two products of the garment section, with their respective defects and their extent examined accordingly. As a result, the quantity of the input passed for finishing (sewing) is less than what was received (see column three of table 12 next). Likewise, there is a significant gap between the expected and actual output produced for this particular product.

Table 12: Defect identification of Basic T-shirt style M-10, GSM = 180 (Survey data, 2012)

Year	Requested quantity/month	Passed for process (sewing)	Expected output/month	Actual output/month	Efficiency
Sep-2011	354800	236685	354800	225444	0.64
Oct-2011	420788	368935	420788	348052	0.83
Nov-2011	415966	320494	415966	299527	0.72

Dec-2011	160200	83744	160200	82102	0.51
Jan-2012	1000	321	1000	292	0.29
Feb-2012	31500	43448	31500	34398	1.09
Mar-2012	80626	41852	80626	49492	0.61
Apr-2012	1000	116	1000	107	0.11
May-2012	271441	235224	271441	190974	0.70
Jun-2012	290000	344218	290000	286848	0.99
July-2012	272441	23785	271441	190974	0.70
Aug-2012	150000	143445	150000	133404	0.89
Average	**204146.8**	**153522.3**	**204063.5**	**153467.8**	**0.67**

Efficiency = actual output divided by expected out put

Column six of table 12 shows the production efficiency of this product, an average 67% of the goal, although input was delivered to produce exactly what was planned (100%). Accordingly, input defect is illustrated in the following figure:

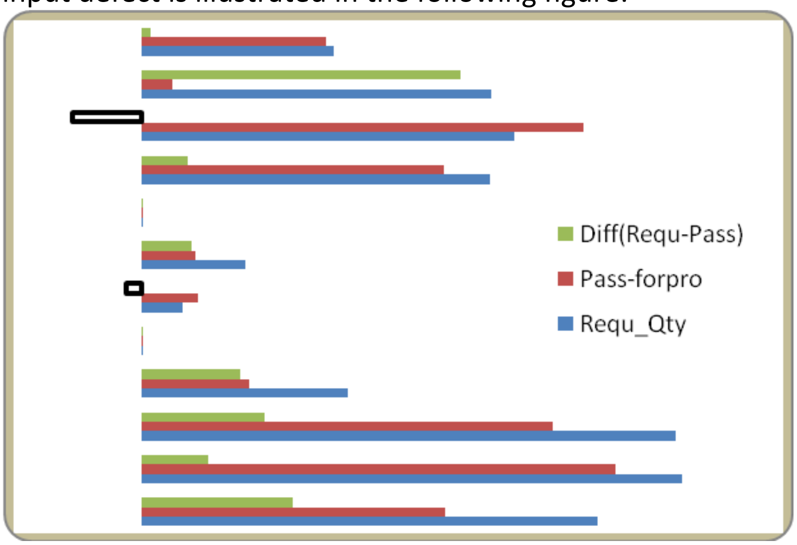


Fig 9: Input defect of Basic T-shirt style M-10, GSM=180 (Survey data, 2012)

From the previous figure, it can be deduced that input defect waste is a serious problem at Almeda and its implication for the overall performance of the organization is extremely high. Also, the problem is found in the output waste resulting from defects during the finishing stage. This massive defect creates high opportunity cost to the firm. The conclusion then is that 67% of the expected output is produced in the given year and 33% of the output is observed as defect and rejected by the customers.

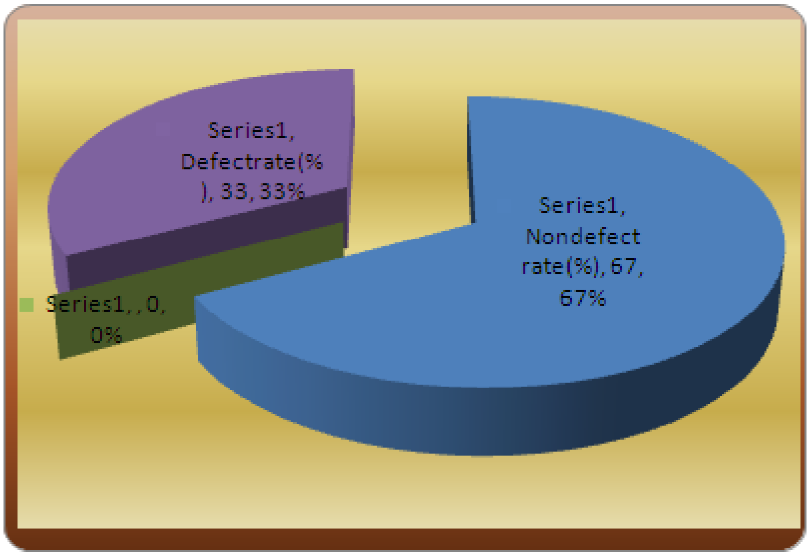


Fig 10: Waste of Output defect for Basic T-shirt style M-10, GSM=180 (Survey data, 2012)

B. Basic T-shirt Style M-01, GSM=120

Input and output defects are also common for this product as well. Table 13 shows that, in November 2011, April and May of 2012 there is no production of this type of product, so this accelerates the underperformance of the company. According to this table, the output defect rate exceeds the input defect rate except for the month of February 2012 where the input defect rate is higher than the output defect rate. Intuitively, a higher output defect rate brings higher monetary and opportunity costs upon the firm than the input defect rate. In other words, at the output level, once all resources are engaged in production with no value added and yet with enormous expenses, it strongly affects the survival of the firm. As a result, Almeda Textile and Garment factory exhibits this business environment. The difference between the output-input defect rates should signal the need to take appropriate action. The larger the gap between the output-input defect rates, the more difficult it becomes to react to the problem (this is shown in figure 11).

Table 13: Input and output defect rate for Basic T-shirt, GSM=120 (Survey data, 2012)

Year	Input defect (%)	Output defect (%)	Difference (Out-In) defect (%)
Sep-2011	24	27	3
Oct-2011	35	40	5
Nov-2011	Data not available	Data not available	Data not available
Dec-2011	-3	4	7
Jan-2012	1	14	13
Feb-2012	48	45	-3
Mar-2012	48	48	Data not available
Apr-2012	Data not available	Data not available	Data not available
May-2012	Data not available	Data not available	Data not available
Jun-2012	20	26	6
July-2012	9	15	6

Aug-2012	15	21	6
Average	**22**	**27**	**5**

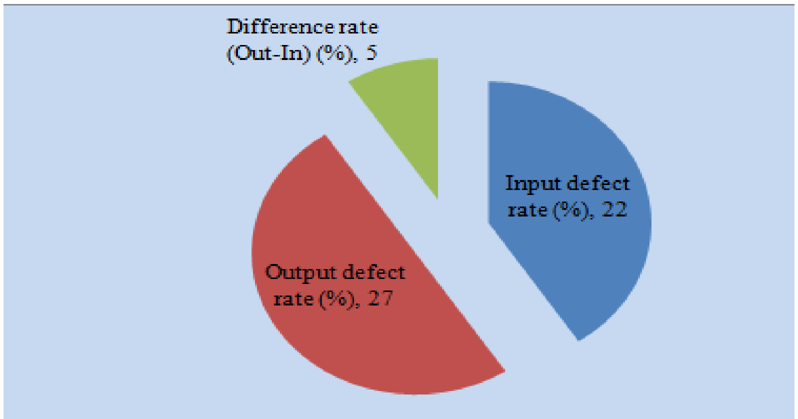


Fig 11: Input/output defect rate difference (Survey data, 2012)

The above figure is derived from table 13 based on the average values of input defect rate and output defect rate to depict the gap between them

4.6: Waste of Motion

Waste of motion in the production process gives rise to a number of problems which are either immediate or hidden beneath the surface waiting to rise up and bite the company in the future. The most obvious adverse effect in textile and garment industries is the lowering of work efficiency because of lost time in lifting, moving from place to place, retrieving, and searching. Data were collected from the production departments of Augusta and Almeda. Waste of motion resulted from machines traveling excessive distances from the entry point to the beginning of work which was chronically associated with Almeda and poorly coordinated with Augusta. The outcome differed significantly between the two factories. Augusta Garment deals only with finalizing readymade textile products for the finishing stage so neither there is no need for the mobility of machines nor for transporting items from place to place. However, in Almeda, the textile plant is far distant from the garment plant and much time is wasted transporting basics and other complementary inputs from one location to other.

Table 14: Identified waste of motion in Almeda and Augusta (Survey data, 2012)

Type of motion waste	Factory name	
	Almeda	**Augusta**
A machine that travels excessive distances	Str. Agree	Str. Disagree
Heavy objects placed on low or high shelves	Str. Agree	Str. Disagree
Searching for tools and equipments	Str. Disagree	Agree
Walking across work place to retrieve components or use machines	Str. Disagree	Neutral
Constantly turning and moving product during assembly	Agree	Agree
Having to orient components when taken from their locations	Neutral	Agree
Reaching excessive distances when taking components and tools	Neutral	Agree
Tools that are not organized	Str. Disagree	Str. agree
Lack of space and organization for component parts and so on	Agree	Agree

The study tries to detect waste of motion derived from heavy materials placed either at a low or high level on a sliding track. Almeda employees frequently suffer physically. Likewise, consistently turning and moving a product during assembly is another serious problem of the factory. Lacking an appropriate area for placement of component parts of textile inputs also leads to a waste of time, energy and labour force while searching and arranging.

4.7: Economic cost of motion waste

Economically, the waste of motion in any production process raises a number of short run and long run costs. As noted above, the first and most immediate cost of motion waste is lowering of a company's work efficiency, while workers are spending their times lifting, retrieving, and searching rather than actually assembling. Even a machine that has to move excessive distances within its cycle will be subjected to additional wear in bearings and joints leading to premature breakdowns.

5) Firm's Revenue

Profit maximization is the ultimate goal of any factory and the motivation for the operation of the business is finding ways to maximize that profit. Sales maximization for survival in a highly competitive environment results from the calculation of profit margin regardless of other non-monetary benefits. There are two ways to maximize profits:

- The first one is to increase the amount of production while maintaining the product price; which is the characteristic of a competitive market structure.
- The second one is to keep the product numbers low while increasing the product price; which is a characteristic of a highly monopolized market environment where every firm charges a price for its products according to the firm's motivation rather than taking into consideration the competition.

Looking at the two schemes, this study has tested the trend of one of the firms under consideration (Hawassa) for a sample of the firm's products. Normally, management is separated from ownership, and managers enjoy discretion to pursue goals other than profit maximization. Their discretionary power should eventually fall on sales maximization. In view of that, the study tries to prove the status of the factories with certain criteria: either their motive is sales maximization or profit maximization. In a modern business, there is a growing demand for sales maximization (Baume, 1967). A standard methodological argument for nullifying the status of a firm's revenue is by formulating statistical models of sales maximization, where the total revenue curve should exhibit a concave appearance that initially increases at an increasing rate with increasing sales, reaches a maximum and then begins to decrease. The following table and graphs refer to the sales amounts along with the total revenue generated for three of the factory's products (Sheet, Thread, and Uniform) during the production months of year 2010/11 and 2011/12.

Table 15: Sales and Total Revenue of Hawassa Textile factory (in ETB) (Survey data, 2012)

	Products					
	Sheet		**Thread**		**Uniform**	
Year	Sales (qty)	Total Revenue	Sales (qty)	Total revenue	Sales (qty)	Total revenue
2010/11-2011/12	30	834.78	2121	1609600	365	12264
	1588	36713.64	2596	239284	4594	182300
	2000	55652.2	4236	302069	8370	258790
	4000	111304.4	4575	326182	8732	341853
	5144.7	152128.78	7441	544904	13620	651631
	5501	56989.15	8000	502589	14436	730728
	20000	539200	8100	237765	16170	690686
	23715	556828.2	8499	876048	18291	464383
	31422	743498.68	10792	710013	23153	916652
	65898	922845	13676	1127272	26384	711555
	-	-	15774	1453953	26570	623499
	-	-	16525	949588	33893	1458621
	-	-	17731	96345	36152	1256753
	-	-	19941	1168004	40265	1359433
	-	-	23572	1544751	45771	1826940
	-	-	23685	1299204	48907	1568488
	-	-	24711	2235660	49152	2466177
	-	-	24781	2002483	56604	1674977
	-	-	28597	1716915	62717	1109977
	-	-	29508	1681671	70569	3204783
	-	-	29557	1753629	79360	1746368
	-	-	30348	2078789	106326	2075107

The Hawassa factory is not efficient enough in producing sheet products in the two production years, being limited to only ten months. Examining the reason why the factory exhibited underproduction is beyond the scope of the study. On relative terms, thread and fabric products are consistently produced throughout the 12 months of the year. To investigate the validity of the total revenue-sales volume relationship, it will be necessary to figure out the status of the factory when producing a particular product. Figure 12 shows the sales and total revenue of the Hawassa Textile Factory.

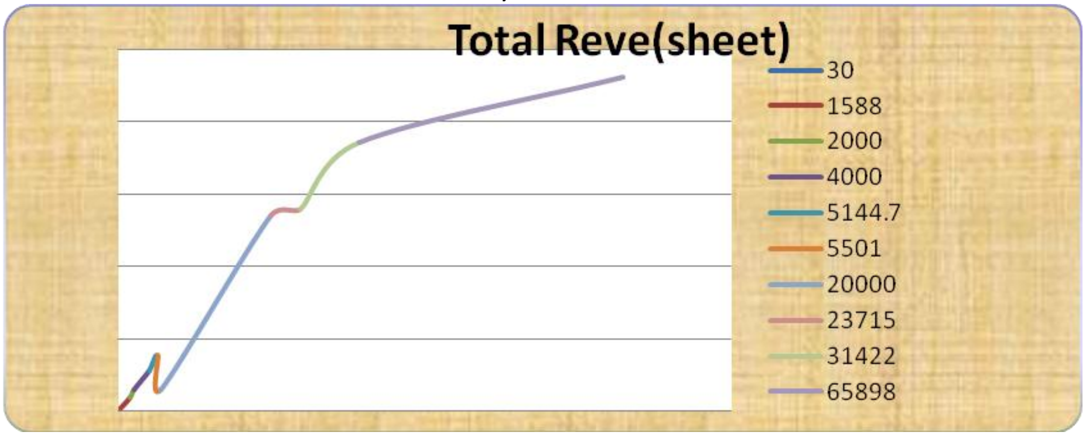
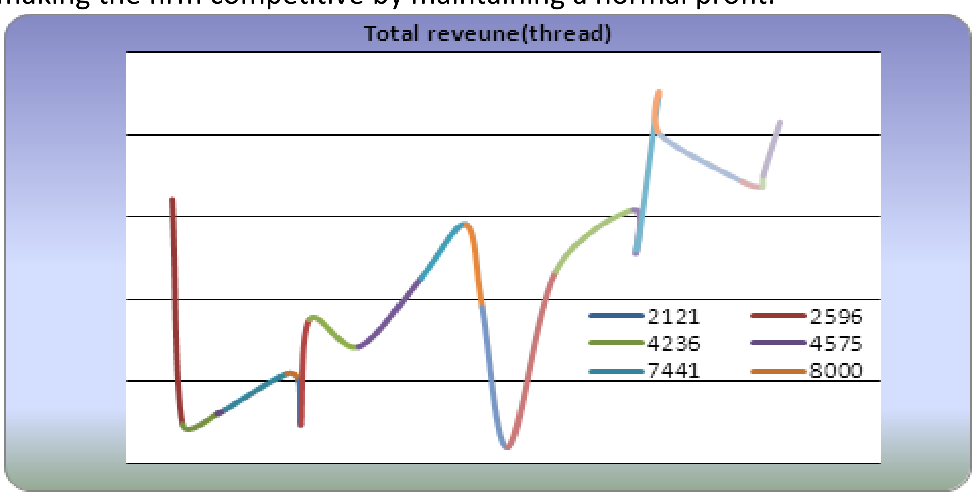
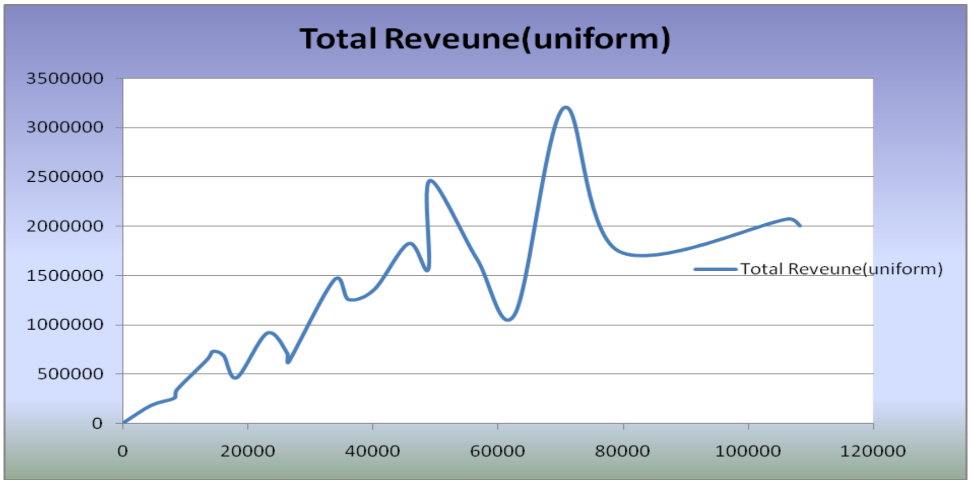


Fig 12: Sales-total revenue of factory's products, Sheet (Survey data, 2012)

Sheet products of the Hawassa textile factory run consistently with Boumal's (1967) model that refers to the sales maximization theory of a firm. Nonetheless the production process is half of the firm's potential. On the other hand, the thread and uniform products are produced neither to the sales maximization nor to the profit maximization so that the total revenue curve is neither concave (sales maximization) nor with a constant upward slope (profit maximization). Therefore, merely increasing production may not lead to sales maximization. Instead, the technical relationship between product size and market price becomes a sound reason for making the firm competitive by maintaining a normal profit.



(a)



(b)

Fig 13: Sales and total revenue of Thread and Uniform product (Survey data 2012)

Likewise, in another example, Bahir Dar textile factory's production scheme deviates from the standard production process by creating a conducive business environment for producing two types of products (Fabric and Yarn) with adequate supply and demand data.

I) Fabric

This product is produced during 22 months in the years 2010/11- 2011/12 and selling schemes take place without incurring warehouse and other overhead costs. Production, sales, and price data are available, and the firm's survival and profitability are examined using different approaches. The study scrutinizes the factory's status from the supply side and the demand side. In microeconomic analysis, firms are motivated to produce more output given that the supply should be responsive enough to the market price of the product, the so called price elasticity of supply (the ratio of percentage change of supply to the percentage change of product price), at a point in time citrus Paribas.

On average, when the price elasticity of fabric supply is less than 1 and the factory's output is not responsive to output price, that means that as the product price changes by 1%, the supply of a particular product is changed by less than 1% in the same direction citrus paribus. Furthermore, in short run production, the supply curve reflects the marginal cost to the firm and this curve crosses to the marginal revenue. At the point of intersection of the two curves (Marginal cost = Marginal revenue), the supply of the product is said to be optimal and generates a normal profit. Alternatively, when no point of intersection is observed, one can conclude that the fabric is produced without prior market analysis and the governing motive of the firm is not sales maximization.

II) Yarn

Market viability of Yarn product in the Bahir Dar textile factory was studied using the same approach as for the fabric products. Sadly, Yarn prices are extremely inelastic. On average they exhibit a negative relationship between supply and product price. To sum up, according to the business analysis of the Bahir Dar textile factory (Yarn production), there is no economic basis for producing the yarn using the principles of sales maximization. It is not unusual that the motive is profit maximization for supplying this particular product.

6) Elimination/reduction of wastes

Waste elimination doesn't mean zero waste. It means minimizing single coin expenditure to increase the profit margin of the firm. The more diligent the work to reduce the fundamental muda, muri and mura by applying the principles of lean manufacturing, the sooner the firm can realize the true benefits of the lean manufacturing principles of the organization. Accordingly, the study tries to outline how to overcome the common wastes so far discussed for the betterment of firm's survival and profitability.

6.1: Reducing waste of resource

Resource wastes usually occur because of ignorance and the carelessness of employees. Eliminating this waste from the work environment is the easiest and most cost effective.

- Post reminder notices such as, "Before you leave your work area, make sure that, power, light, water tap, and desktop computers are turned off and disconnected from any sockets''
- Monitor machine downtime when it is not in operation although the machine power is on
- Use safety equipment and apparatus optimally and appropriately

6.2: Reducing waste of defect

Waste of defect may derive from different causes and is associated with many problems. However, it can be minimized by applying the most appropriate input–output relationship of the production process such as:

- Adopt scientific designing of products, processes and equipment
- Use standard operational guidelines and manuals to coordinate shifts and jobs.
- Provide for timely service of machines and equipment which will contribute to a reduction of input and output defects
- Provide relevant on-the-job training for workers engaged in production and related processes
- Give greater emphasis to the quality than quantity of the product

6.3: Reduce the waste of talent:

Reducing the waste of talent gives credit to the labor force; motivating, appreciating teamwork, providing capacity building and clear leadership are required to retain employees and involve them in the company's obligation for continuous improvement. Hence, introduction of packages will reduce waste of talent such as:

- Provide guidelines and compensation packages reflecting the company's need for people to work together to improve the products
- Encourage people to take ownership of their areas, processes, and products to promote a sense of pride and involvement

- Workers are the most important asset, respect them, nurture them and involve them in the business by developing package rewards
- Create clear leadership to involve all of the firm's employees which will lead to a perfect work and competitive market environment

6.4: Reduce waste of motion

Waste of motion is a significant factor within the seven wastes identified, and every effort should be made to remove it from the production process. This will increase efficiencies while making work easier for all involved. Movement is not necessarily work, but it costs in time and money. Motion minimization reduces overburden (Muri) leading to benefits for employees and firms alike, especially when applying one of the following points:

- Develop standard operating procedures,
- Reduce the number of non-value adding steps, and
- Reduce movement of product from one location to another.

6.5: Reducing Overproduction waste

Overproduction occurs due to the mismatch of the two market forces (DD vs SS). The best way to reduce overproduction is to understand the heartbeat of the consumer constantly, and make demand assessments for a particular product, even if it is commercialized for longer period of time. Continuous communication with customers is one way of reducing overproduction since demand is dynamic and fine tuning the production scheme according to new information is necessary. Furthermore, quality improvement plays a great role in reducing overproduction.

7) Conclusion and suggestions for further research

The Augusta Garment (Addis Ababa), Hawassa Textile Factory (southern Ethiopia), Bahir Dar Textile (north western Ethiopia) and Almeda Textile and Garment Factory (Northern Ethiopia) were extensively studied to understand the impact of waste on their performance levels. Data were collected through primary and secondary sources. Production and marketing departments were exhaustively engaged. The Descriptive approach was used as an analytical tool, as well as waste detection parameters; defect, overproduction, motion, talent loss and the like were aggressively examined and factories were compared and contrasted accordingly.

Even though there is variation in the degree of waste allowed in the respective factories, holistic observations and data results reveal that all the industries studied exhibited serious problems with wastes. Overproduction prevailed in all factories. Giving credit to the labor force is an indicator of modern knowledgeable management in an industrialized economy. However, in the chosen case factories, this attention is not a priority. As addressed by the survey, the output defect rate is higher than input defect rate.

Finally, this survey discloses the inherent feature of factories in line with standard market principles and general truths of business. There is no promising trend and it is surprising how long the firms have survived without being governed by market doctrine and the inspiration of a global competitive environment. Based on the survey of the literature, it is important to note that further work needs to be conducted to devise and test lean tools, techniques, and methods in order to eliminate/reduce the persistent wastes identified in the cases chosen.

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