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Establishing a Rating Scale for Knitted Garment Industry Based on Man Machine Ratio for Ethiopia

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ABSTRACT

Garment industry has been an important industry with a promise for a further development for the countries in modernization and development. However, this industry is not without problem in terms of productivity. The purpose of this paper is to review the effectiveness in the use of machines and manpower in manufacturing of apparel products for ensuring high productivity investment from available resources in today's competitive business environment. The methodology to be adopted will analyze where the Ethiopian knitted garment industry stands in a rating scale created by using man-machine ratio. The findings of this paper are based on international suppliers of sewing machines and their methodology used and also by utilization of currently available resources. The researcher concludes that, although there are many ways of rating the standards for the garment industry based on many factors, the garment manufactures have put in place and know where they stand in the scale compared with the standard (international) manufactures and how it could be used as a benchmark in reducing the indirect cost.

Keywords: Ethiopian apparel manufacturing, garment industry, Man machine ratio, rating scale

1. INTRODUCTION

Ethiopia's textiles and clothing industry is undergoing a major development, aided by the presence of a cheap, skilled and highly motivated workforce. This surge has been helped by the country's impressive economic growth over the past years. Standard performance evaluation for garment are measured to assess where the factory currently stands and to find key focus areas where management needs to look into. Top 9 KPIs are: Factory efficiency %, MMR, Cut to ship ratio, Order to ship ratio, on time delivery, Average style changeover time, Right first time quality, Quality to production and Down time percentage.

1.1 Statement of Problem

Effective use of machines and headcounts is essential in manufacturing for high return of investment from expensive resources in today's competitive business environment. It is thus crucial to establish rating scale based on man-machine ratio to gain high resource utilization and output.

In Ethiopia, there is no any standard rating scale to measure where the garment industry stands. They use different man to machine ratios for the same product type because of a lack of standard reference for the man to machine ratio.

1.2 Objective of the Study

1.2.1 General Objectives

a) The Research is aimed at analyzing the man to machine ratio in Ethiopian garment industry.

b) This research will attempt to meet some of the Ethiopian garment industry leaders and benchmark the scale against that of the international competitors

1.2.2 Specific Objectives

1. Creation of Rating scale based on Man: Machine ratio
   a. Based on Product
   b. Based on Organization Structure
2. Grading the Ethiopian garment industry based on the Rating scale.

1.3 Scope of the Study

Ethiopia is one of the 37 sub-Saharan African countries with advantage with low labor costs and one among the emerging textile and garment industries in Africa.

For the reasons indicated in the limitation of the study section, the study will only concentrate firstly on knitted garment industries in Ethiopia; secondly it will be examine the man machine ratios that are product specific.

1.4 Methodology & Data Collection

The methodology to be adopted in this study is to make a detailed analysis on relevant knitting industries producing basic T-shirts using a man machine ratio concept.

The sample will be the representative of all Ethiopian garment industries and basic products. There are 18 recognized garment industries (TIDI). From those, only five have been analyzed. Reports and relevant documents were collected from available relevant offices from the industries.

1.5 Limitation of the Study

The results from this study may not be easily extended other products other than in the T-shirt or other garment industries. Another major constraint is the lack of maintenance of data and knowledge base for the ratios in Ethiopia. Furthermore, inquiry was made with the ETIDI to see if a research had been made on this topic. The reply was negative. No published reports were available either.

1.6 Definition of Basic Terms Used

Man Machine Ratio (MMR): Man to machine ratio is defined as total workforce in a factory to total number of operational sewing machines with respect to garment industry.

Rating Scale (RS): It is a classification or ranking of a person or system based on a comparative assessment their quality or quantity standards.

2. Review of Related Literature

2.1 Introduction

The manufacturing operations have increased its complexity due to constant changes required to cater to unpredictable customer demands. Siemieniuch and Sinclair [1] stated that manufacturing is considered complex if various resources that interact with each other resulted in an unpredictable organizational performance. Global competitions are also putting

pressures on the manufacturing companies to produce products cheaper and faster. Thus, manufacturing operations are urgently exploring methods to reduce the complexity and improve the efficiency in managing the resources.

Among the factor that is becoming critical in managing the complexity of manufacturing is the human resources. Human resources are required to fulfill orders such as in the areas of material processing, product assembly or component manufacturing [2].

Masood [3] explained that assembly line balancing is used to determine optimum allocation of operations at the workstations so as to minimize the cycle time of the line for a given number of workstations, or to minimize the number of workstations for a given cycle time, by equalizing the loads on the workstations.

Ethiopia's textiles and clothing industry is undergoing major development, aided by the presence of a cheap, skilled and highly-motivated workforce. This surge has been helped by the country's impressive economic growth over the past years.

Man to machine ratio is defined as the total available workforce in a factory/organization to the number of operational machines. Companies are following and setting benchmarks on MMR for their factories to optimize and hence further control the ever increasing cost of manufacturing.

$$MAN\ MACHINE\ RATIO = \frac{Total\ Available\ Workforce}{Operational\ Sewing\ Machine}$$

The benchmark value can vary greatly depending upon the production system, product and quality parameters and measurement system followed.

Many factories also consider a man-machine ratio comprising of total employees in the company. This provides a measure on the total investment that the company has made on people for the machines in the factory. Various other accounting measures can emerge from here.

Alok Apparels in India maintained their man-machine ratio well below 1.5:1 as stated on their website. Noble Garments of Bahrain have a man-machine ratio of 1.85:1[4].

In Sri Lanka, the total number of sewing machines installed is 230,976 (2001) and the man to machine ratio for the country is reported to be 1:1.7 [5].

Rating is a comparative evaluation measure, shedding light upon overall excellence of a company (firm) relative to its competitors.

Different teams and different organizations may use different ways of setting priorities that are critical as components that influence the rating scale. The rating shows where the company stands and the steps to be initiated towards achieving their goals in the competitive world.

Calculation of Man-to-Machine Ratio

As factories began using powered machinery early in the industrial revolution, it became possible for one worker to run more than one machine in some operations. For example, one worker was required to attend two or more looms in textile mills. The factory floor has changed enormously since then. One thing that has not changed is the need to calculate the right man-to-machine ratio. If a company has too few workers, machinery will sit idle due to lack of maintenance/attendance while too many workers create a waste and a loss of profit [6].

Resource utilization that ensures a balance among all workstations is essential for enhancing factory productivity. Another important factor that has to be considered is the MMR that provides an answer to how much manpower should be assigned to a machine [7].

Traditionally, the garment industries have faced problems that originate from the following: longer production lead time, high rework, poor line balancing, lack of standardized work process and lack of performance measurement system for the

employee, high work-in-process, low production capacity, high labor (operator) absenteeism, high rework, high fabric waste and poor resource utilization are among others in Ethiopian garment industries [8]

Mainly in garment manufacturing industries the performances are assessed by the management by measuring nine key performance indicators; factory efficiency percentage, man to machine ratio, cut to ship ratio, order to ship ratio, on time delivery, average style changeover time, right first time quality, quality to production and downtime percentage. According to online clothing study by Prasanta Sarkar, man machine ratio varies product to product and on organization structure so this research carried out to know at what scale the Ethiopian garment industries are performing with the competitors based on man machine ratio.

An enterprise can be defined as "Micro Enterprise" when the numbers of its employees (including the owner or family) are not greater than 5 and the total asset is ≤ 100,000 ETB for industrial sector and ≤ 50,000 ETB for service sector. In a similar manner, an enterprise with 6-30 employees and the total asset 100,001 - 1,500,000 ETB for industrial sector and 50, 0001 - 500,000 ETB for service sector is defined as "Small Enterprise" [8].

3. Study Analysis

3.1 Introduction

As noted previously, the garment industries are people oriented in that when the man ratios not achievable, then efforts are made to reduce the indirect cost in the manufacturing.

However, efforts are made to understand where they stand and how to achieve the scale of 1-5 and how to compete against the other competitors.

Table 1. Rating criteria based on Man Machine Ratio

RATING SCALE BASED ON MAN MACHINE RATIO					
RATING SCALE	**MICRO ENTERPRISES(<=5 EMPLOYEES &<=100000ETB ASSESTS)**	**SMALL ENTERPRISE(6 TO 30 EMPLOYEES & 100001 TO 1500000ETB ASSESTS)**	**LARGE ENTERPRISE (>31 EMPLOYEES & >1500001ETB ASSESTS)**	**BASED ON PRODUCT PER LINE**	**BASED ON ORGANIZATION STRUCTURE (INDIRECT %)**
5	_	_	3:1 to 3:5	2.3:1 to 2.6:1	>60%
4	_	_	2:5 to3:5	2.01:1 to2.3:1	50%-60%
3	_	_	2:1 to 2:5	1.6:1 to1.9:1	35%-50%
2	_	_	1:5 to 2:1	1.3:1 to 1.6:1	20%-35%
1	_	_	1:1 to 1:5	1.01:1 to 1.3:1	<20%
1=Excellent; 2= Very Good; 3=Good: 4= Satisfactory ; 5= Unsatisfactory					

*The researcher will analyze survey results and highlight specific solution for the specified product.

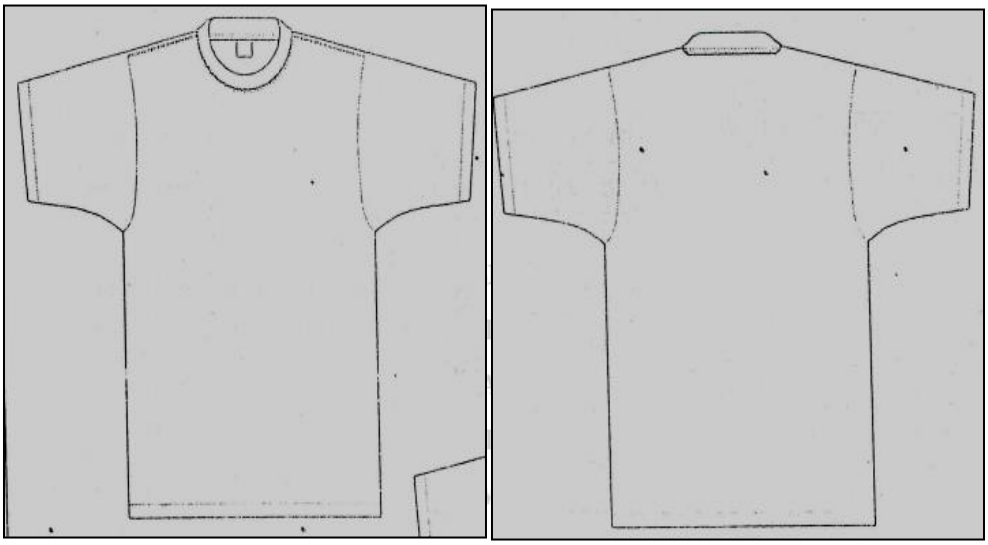
3.2 Calculating the MMR

3.2.1 Overall company MMR

Table 2. Overall Company MMR

Enterprise	Total Manpower	Total Sewing machine	MMR	Rating scale
Dest Garment PLC	558	205	2.72	4
Almeda	637	271	2.35	3
Maa Garment	979	602	1.63	2
Toto Garment Factory	166	101	1.64	2

3.2.2 Based On Product



Front View **Back View**

Figure 1.

OPE. NO.	DESCRIPTION OF OPERATION	OPE. TIME(Min)
SOP01	Sew shoulder	0.33
SOP02	Join neck rib & attach neck rib to body	0.5
SOP03	Covering neck seam	0.38
SOP04	Baste brand label to neck	0.13
SOP05	Attach tape to shoulder & neck line	0.42
SOP06	Hem sleeve mouth	0.42
SOP07	Attach sleeve	0.58
SOP08	Sew side & under sleeve	0.56
SOP09	Tack sleeve mouth	0.21
SOP10	Hem bottom	0.42
SOP11	Sew laundry label to bottom	0.13
SOP12	Turn body	0.17
	Total Sewing Operation Time	**4.25**

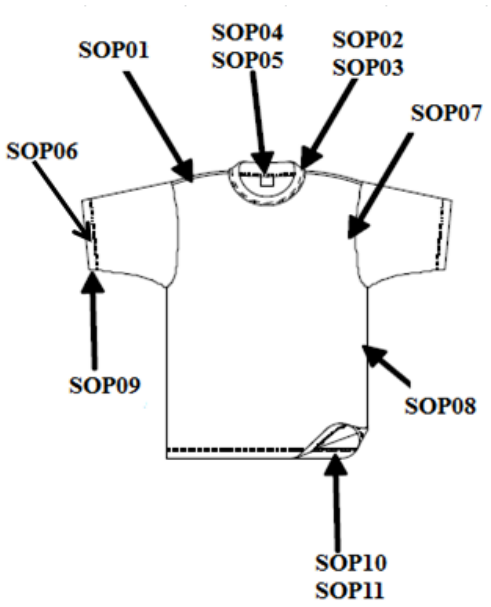


Figure 2. Standard Operation Time for a Basic T-Shirt

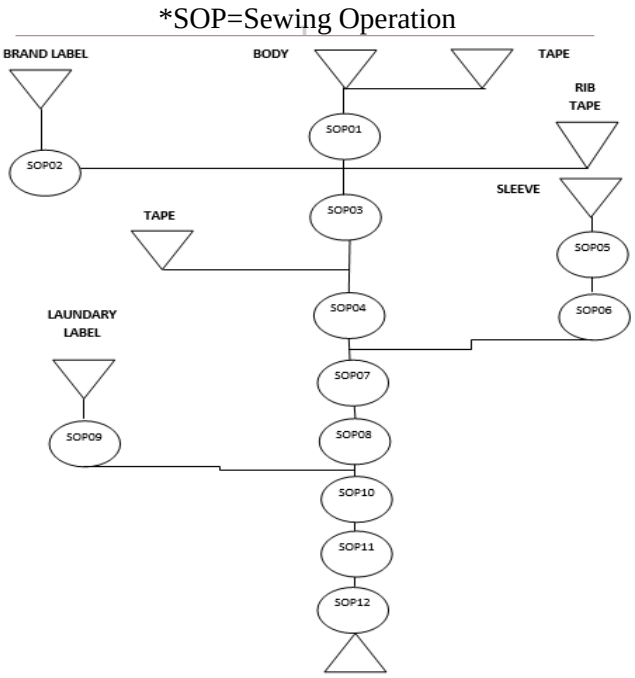


Figure 3. Flow Process Chart for the Standard Basic T-Shirt

Sample Factory 1:

OPE. NO.	DESCRIPTION OF OPERATION	OPE. TIME(Min)
ASOP01	Shoulder Attach & Close Neck Ripe	0.36
ASOP02	Attach Rip To Neck	0.8
ASOP03	Covering neck seam	0.44
ASOP04	Back Body Rib Marking	0.3
ASOP05	Piping From Sldr To Sldr + Label Attach	0.45
ASOP06	Sleeve Hem	0.37
ASOP07	Attach Sleeve	0.7
ASOP08	Sew Under Sleeve & Side Seam, Sew laundry label to bottom	1.05
ASOP09	Tack sleeve mouth	0.21
ASOP10	Bottom Hem	0.34
ASOP11	Turn body	0.17
Total Sewing Operation Time		**5.19**

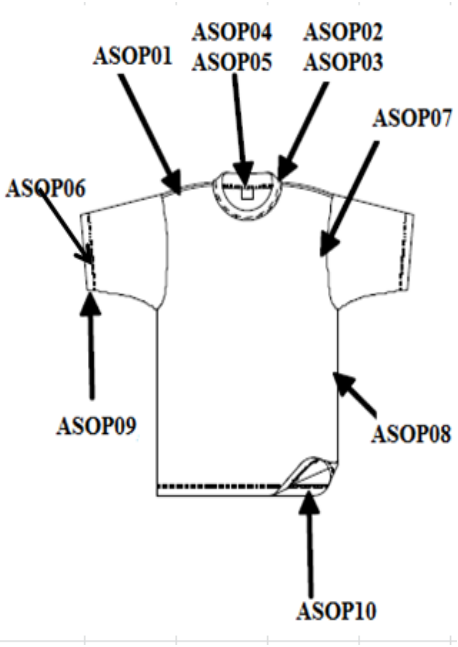


Figure 4. Sample Factory 1 Operation Time for a Basic T-Shirt

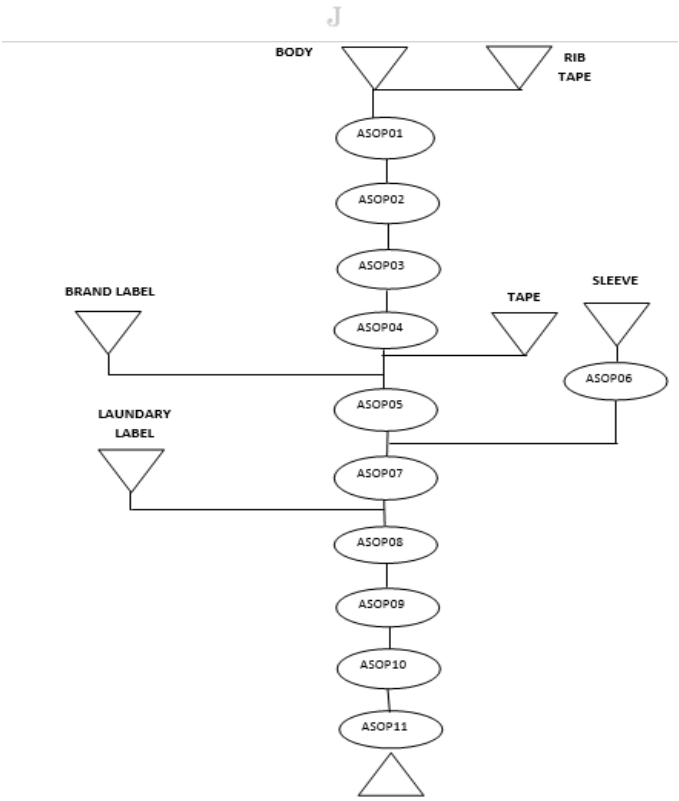


Figure 5. Flow Process Chart for the Basic T-Shirt from the Sample Factory 1

3.2.2.1 Comparison from the standard to the sample factory 1

OPE. NO.	DESCRIPTION OF OPERATION	OPE. TIME(Min)				OPE. TIME(Min)	DESCRIPTION OF OPERATION	OPE. NO.
SOP01	Sew shoulder	0.33	0.83	0.33	1.16	0.36	Shoulder Attach & Close Neck Ripe	ASOP01
SOP02	Join neck rib & attach neck rib to body	0.5				0.8	Attach Rip To Neck	ASOP02
SOP03	Covering neck seam	0.38		0.06		0.44	Covering neck seam	ASOP03
SOP04	Baste brand label to neck	0.13	0.55	0.2	0.75	0.3	Back Body Rib Marking	ASOP04
SOP05	Attach tape to shoulder & neck line	0.42				0.45	Piping From Sldr To Sldr + Label Attach	ASOP05
SOP06	Hem sleeve mouth	0.42	1.00	0.07	1.07	0.37	Sleeve Hem	ASOP06
SOP07	Attach sleeve	0.58				0.7	Attach Sleeve	ASOP07
SOP08	Sew side & under sleeve	0.56				1.05	Sew Under Sleeve & Side Seam, Sew laundry label to bottom	ASOP08
SOP09	Tack sleeve mouth	0.21						
SOP10	Hem bottom	0.42				0.21	Tack sleeve mouth	ASOP09
SOP11	Sew laundry label to bottom	0.13				0.34	Bottom Hem	ASOP10
SOP12	Turn body	0.17				0.17	Turn body	ASOP11
Total Sewing Operation Time		**4.25**		**0.94**		**5.19**	**Total Sewing Operation Time**	

Figure 6. Comparisons between the Standard Reference and Sample Factory 1 Based on Product

Table 3. Rating Based On Product

Enterprise	Manpower per line	No of sewing machine	MMR	Based on Product
Dest Garment PLC	34	27	1.259259	1
Almeda	16	13	1.230769	1
Maa Garment	24	20	1.2	1
Toto Garment Factory	20	14	1.428571	2

3.2.3 Based on Organization Structure

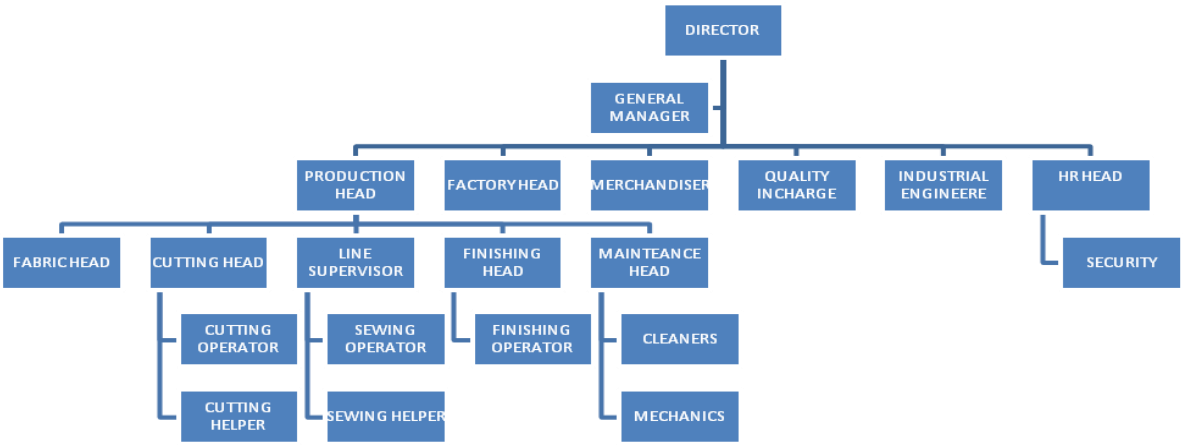


Figure 7. Standard Basic Organization Structure

Table 4. Rating Scale based on Organization Structure (Indirect Labor %)

Enterprise	Total Operator	Total indirect Labor	Indirect labor %	Based on Organization
Dest Garment PLC	205	353	55%	4
Almeda	271	366	57%	4
Maa Garment	602	377	59%	4
Toto Garment Factory	101	65	10%	1

4. Result and Discussion

Table 5. Comparison Chart of Samples based on different rating criteria

Rating Criteria	Dest Garment PLC	Almeda	Maa Garment	Toto Garment Factory
Overall	4	3	2	2
Based On Product	1	1	1	2
Based on Indirect labor	2	1	2	1

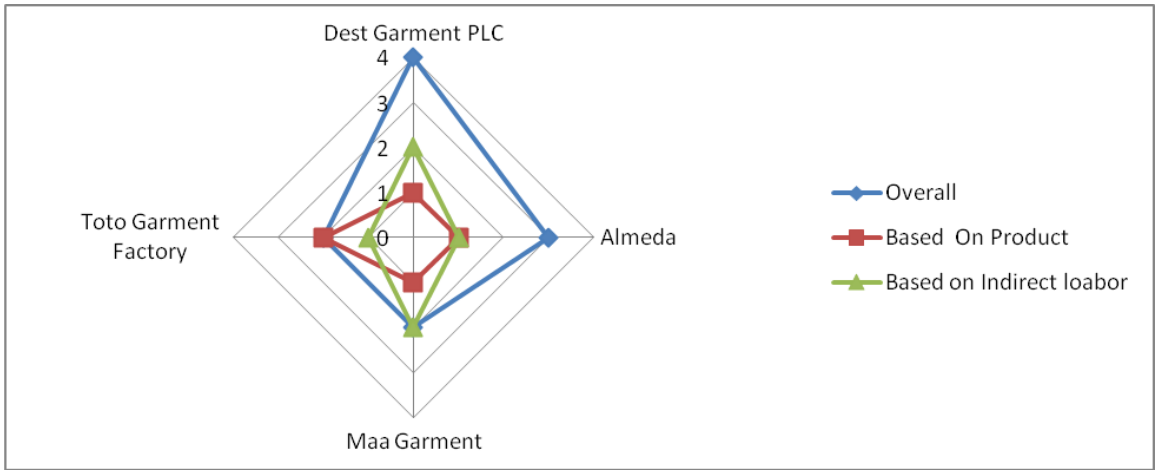


Figure 8. Comparisons Chart of Samples based on different rating criteria

The average MMR for the sample companies among Ethiopia which are large scale enterprise is around 2.09:1.and they fall under the scale of 2 which is VERY GOOD as per the Table 1 But the indirect labor percentage which are higher in MAA GARMENT and DESTA Garment on an average of 23.5% which means 76% of total manpower is direct where they fall under the scale of 2 which is VERY GOOD as per the TABLE 1 and when we see based on the operation breakdown of T-Shirt TOTO garment factory should follow the standards.

5. CONCLUSION

Ethiopia may have more potential than any other sub-Sahara African country when it comes to developing a competitive cotton, textile and garment chain, but it still has a rough road ahead. Indeed, Ethiopia's growth as a garment exporter will be slower and more difficult than the government and local textile organisations predict. Theoretically, all the necessary ingredients are available to transform Ethiopia into an internationally competitive business market.

From our results, we conclude that based on one parameter taken for analysis among the 9 KPI's, it is quite positive to warrant studies on the remaining 8 parameters to see their standings.

We feel all garment industries in Ethiopia should follow the same analysis on the 9 KPI parameters in order to see where Ethiopian garment industry stands in the competitive international markets in the world.

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